

PROPOSAL

NOT TO BE USED FOR BIDDING - FOR INFORMATIONAL PURPOSES ONLY

TO BE COMPLETED BY CONTRACTOR SUBMITTING
A BID ON GENERAL CONSTRUCTION
CONTRACT NO. S35109-01GR

ITEM NO.	APPROXIMATE QUANTITIES	ITEMS WITH UNIT PRICE WRITTEN IN WORDS				
1	Lump Sum	Base Bid for furnishing all Labor, Materials and Equipment required for all Construction work at Long Beach Water Pollution Control Plant Consolidation Pump Station Conversion as specified and shown on the Drawings complete and ready for operation. <hr/> DOLLARS CENTS	N/A	N/A		

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ITEM NO.	APPROXIMATE QUANTITIES	ITEMS WITH UNIT PRICE WRITTEN IN WORDS				
2	Allowance	For work due to Unforeseen Field Conditions <div> <div>Two Hundred Fifty Thousand</div> <div>No</div> <div>DOLLARS</div> <div>CENTS</div> </div>	N/A	N/A		00
3	Allowance	For work due to Unforeseen Hazardous Material <div> <div>Fifty Thousand</div> <div>No</div> <div>DOLLARS</div> <div>CENTS</div> </div>	N/A	N/A		00
4	Allowance	For costs to PSEG <div> <div>One Hundred Twenty Thousand</div> <div>No</div> <div>DOLLARS</div> <div>CENTS</div> </div>	N/A	N/A		00
5	Allowance	For Signage <div> <div>Two Thousand</div> <div>No</div> <div>DOLLARS</div> <div>CENTS</div> </div>	N/A	N/A		00

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ITEM NO.	APPROXIMATE QUANTITIES	ITEMS WITH UNIT PRICE WRITTEN IN WORDS				
6	Allowance	For costs to maintain the project schedule, delays due to conditions out of control of the Contractor <div style="display: flex; justify-content: space-between;"> One Million No </div> <hr/> DOLLARS CENTS	N/A	N/A		00

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ALLOWANCES: It is expressly understood and agreed that the total Bid presented in this Proposal is the basis for establishing the amount of the Bid Security and includes the following allowances:

1. Item No. 2: An allowance of two hundred fifty thousand dollars (\$250,000) for costs associated with work due to Unforeseen Field Conditions.
2. Item No. 3: An allowance of fifty thousand dollars (\$50,000) for costs associated with work due to Unforeseen Hazardous Material.
3. Item No. 4: An allowance of one hundred twenty thousand dollars (\$120,000) for upfront costs for PSEG to design and installation of Submersible Transformer and the relocation of utilities.
4. Item No. 5: An allowance of two thousand dollars (\$2,000) for signage, if required by FEMA and/or GOSR.
5. Item No. 6: An allowance of one million dollars (\$1,000,000) for costs incurred to maintain the project schedule which would otherwise be delayed due to conditions out of the control of the Contractor.

All in accordance with the requirements of Division 1, Special Conditions; Section 01010, Summary of Work; Section 01020, Allowances; and Section 01150, Measurement and Payment.

Final Contract Payment for allowance items shall be based upon actual payments, and not on the approximate amounts cited herein.

DETERMINATION OF LOW BID: Determination of low Bid will be made by comparing the total Bid which shall include the lump sum Base Bid price, unit price totals and allowances.

PROPOSAL

MAJOR EQUIPMENT ITEMS: The Bidder shall fill the name and address of the proposed system suppliers for the major equipment items tabulated hereinafter. It is expressly understood that the furnishing of this information will not relieve the Bidder of any requirements of the Contract Documents and failure to fill out properly is grounds for rejection.

<u>Specification Number</u>	<u>Description</u>	<u>Manufacturer and/or Supplier</u>
11000	Electric Motors	
11115	Submersible End Suction Pumps - Wet Pit	
11116	Submersible End Suction Pumps - Dry Pit	
11217	Mechanical Bar Rack	
11220	Open Channel Grinders	
11287	Stainless Steel Slide Gates	
13205	Fuel Storage Tank	
13440	Panel Mounted Instruments and Devices	
13420	Primary Sensors and Field Instruments	
13451	PLC Hardware and Software	
14603	Gantry Crane	
15451	Packaged Submersible Sewerage Sump Pump Units	
15738	Ductless Split-System Air-Conditioners	
15786	Packaged Outdoor Central-Station Air-Handling Units	
15836	Electric Unit Heaters	
15866	Non-Metallic HVAC Fans	
16231	Engine Generator	
16271	Dry Type Transformers	
16400	Switchboards	
16425	Variable Frequency Drives	
16441	Panelboards	
16720	Electrical Control Equipment Low Voltage AC Motors and Devices	

**LONG BEACH WPCP CONSOLIDATION
PUMP STATION CONVERSION**

TABLE OF CONTENTS

SPECIFICATIONS

DIVISION 1: GENERAL REQUIREMENTS

<u>Specification No.</u>	<u>Specification Title</u>
01010	Summary of Work
01020	Allowances
01031	Additions, Modifications and Alterations to Existing Buildings and Structures
01039	Demolition and Removal of Existing Structures and Equipment
01040	Regulatory Requirements
01045	Cutting and Patching
01050	Field Engineering
01072	Reference Standards
01150	Measurement and Payment
01300	Submittals
01311	Construction Scheduling
01313	Public Relations and Communication
01342	Samples
01355	Hazardous Materials Control
01356	Safe and Healthful Working Conditions
01370	Schedule of Values
01400	Protection of Utilities
01416	Code Required Special Inspections and Procedures
01495	Spill Prevention and Control
01500	Temporary Facilities and Controls
01516	Temporary Fire Protection
01560	Environmental Controls
01610	Transportation and Handling of Materials and Equipment
01650	Starting of Systems
01660	Quality Control
01700	Maintenance of Plant Operations
01710	Cleaning
01720	Project Record Documents
01730	Operation and Maintenance Data
01760	Project Closeout

DIVISION 2: SITE WORK

<u>Specification No.</u>	<u>Specification Title</u>
02050	Demolition, Removals, and Modifications
02100	Clearing, Grubbing and Site Preparation
02200	Earthwork
02228	Construction Noise and Vibration Control
02240	Dewatering
02276	Erosion and Sediment Control
02430	Manholes
02455	Micropiles
02485	Grassing and Plantings
02500	Surface Restoration
02529	Concrete Curbs, Gutters and Sidewalks
02576	Pavement

DIVISION 3: CONCRETE

<u>Specification No.</u>	<u>Specification Title</u>
03100	Concrete Forming
03200	Concrete Reinforcing
03251	Concrete Accessories
03300	Cast-In-Place Concrete
03420	Designed Precast Concrete Vaults
03600	Grouting
03930	Repair and Rehabilitation of Cast-in-Place Concrete

DIVISION 4: MASONRY

<u>Specification No.</u>	<u>Specification Title</u>
04060	Masonry Mortaring and Grouting
04090	Masonry Anchorage and Reinforcing
04201	Unit Masonry Construction
04220	Concrete Unit Masonry

DIVISION 5: METALS

<u>Specification No.</u>	<u>Specification Title</u>
05051	Anchor Systems
05120	Structural Steel Framing
05130	Structural Aluminum Framing
05501	Miscellaneous Metal Fabrications
05511	Pre-Engineered Aluminum Stairs
05522	Aluminum Handrails and Railings
05532	Aluminum Grating

05542	Floor Access Hatch Covers
05561	Metal Castings
05601	Aluminum Stop Logs

DIVISION 6: WOOD, PLASTICS, & COMPOSITES

Specification No. **Specification Title**

(Not Used)

DIVISION 7: THERMAL & MOISTURE PROTECTION

Specification No. **Specification Title**

07191	Silane Water Repellants
07421	Metal Wall Panels
07920	Joint Sealants

DIVISION 8: OPENINGS

Specification No. **Specification Title**

08120	Aluminum Doors and Frames
08710	Door Hardware

DIVISION 9: FINISHES

Specification No. **Specification Title**

09611	Concrete Hardener
09900	Painting

DIVISION 10: SPECIALTIES

Specification No. **Specification Title**

10400	Identification Devices
10522	Portable Fire Protection Equipment

DIVISION 11: EQUIPMENT

Specification No. **Specification Title**

11000	Electric Motors
11002	Equipment Identification Tag System
11115	Submersible End Suction Pumps – Wet Pit (Bypass)
11117	Submersible End Suction Pumps – Wet Pit (Permanent)

11150	Hydrodynamic Separator
11217	Mechanical Bar Screen
11220	Open Channel Grinders
11287	Stainless Steel Slide Gates

DIVISION 12: FURNISHINGS

Specification No. **Specification Title**

(Not Used)

DIVISION 13: SPECIAL CONSTRUCTION

Specification No. **Specification Title**

13122	Metal Building Systems
13123	Pre-Engineered Shelter
13401	Process Control System General Provisions
13402	Process Control System Factory Testing
13403	Process Control System Start-up and Field Testing
13404	Process Control System Training
13420	Primary Sensors and Field Instruments
13430	Process Control System Panels and Enclosures
13440	Panel Mounted Instruments and Devices
13451	Programmable Logic Controllers Hardware and Software
13480	Input Output Point List
13491	Process Control Descriptions

DIVISION 14: CONVEYING EQUIPMENT

Specification No. **Specification Title**

14604	Jib Cranes and Trolley Hoist
14630	Bridge Cranes

DIVISION 15: MECHANICAL

Specification No. **Specification Title**

15050	Vibration, Seismic, and Wind Controls
15051	Buried Piping Installation
15052	Exposed Piping Installation
15055	Pipe Hangers and Supports
15061	Ductile Iron Pipe
15065	Concrete Pipe
15066	Steel and Stainless-Steel Pipe
15067	Thermoplastic Pipe
15073	High Density Polyethylene Drainage Pipe
15100	Process and Civil Valves

15120	Couplings, Adapters, and Specials for Piping
15121	Wall Pipes, Floor Pipes, and Pipe Sleeves
15518	Hangers and Supports for HVAC Ductwork, Piping and Equipment
15592	Facility Fuel-Oil Piping
15738	Ductless Split-System Air-Conditioners
15990	Testing, Adjusting, and Balancing

DIVISION 16: ELECTRICAL

<u>Specification No.</u>	<u>Specification Title</u>
16010	General Electrical Requirements
16020	Temporary Electrical System
16035	Demolition Electrical
16036	Testing
16061	Grounding
16062	Lightning Protection System
16071	Supporting Devices
16076	Labeling and Identification
16121	Electric Wires and Cables
16131	Electric Conduit System
16133	Underground Ducts - Ducts in Concrete
16134	Electric Manholes
16231	Engine Generator
16271	Dry Type Transformers
16282	Surge Protective Devices
16292	Power Distribution System Coordination
16300	Utility Electrical Services
16400	Switchboards
16425	Variable Frequency Drives
16441	Panelboards
16442	Electric Control Equipment Low Voltage AC Motors and Devices
16511	Lighting Fixtures and Devices
16720	Fire Protection and Alarm

+ + END OF SECTION + +

NO TEXT ON THIS PAGE

SECTION 01010

SUMMARY OF WORK

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. The Work to be done under this Contract and in accordance with these Specifications consists of furnishing of equipment, superintendence, labor, skill, material and all other items necessary for retrofitting the existing City of Long Beach Water Pollution Control Plant (WPCP) into the Long Beach Pump Consolidation Station, located in 2 West Pine Street, Long Beach, NY 11561. The Contractor shall perform all Work required for The Long Beach Consolidation Pump Station Conversion in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.
- B. The principal features of the Work to be performed and equipment to be provided for this Project under this Contract includes:
1. All labor, equipment, fees, permits, and other related costs necessary to provide for the conversion of the existing City of Long Beach WPCP into the Long Beach Consolidation Pump Station, as shown on the Contract Drawings including but not limited to the following:
 - a. Construction of a Temporary Electrical Facility to provide electric power and controls to the portion of Long Beach WPCP currently tied to the Electrical Room of the Service Building. The Temporary Electrical Facility shall also provide power to the Temporary Bypass Pump Station, the temporary construction trailers, and the Long Beach WPCP personnel trailers.
 - b. Construction of a Temporary Bypass Pump Station.
 - c. Demolishing the Service Building's superstructure in its entirety (Administration Area, Mechanical Room).
 - d. Partially demolishing the Service Building's belowground superstructure.
 - i. Wet well and Screen room: to be demolished in its entirety.
 - ii. Dry pit: bottom section to be filled in with flowable concrete and upper section to be reutilized as the valve pit.
 - e. Construction of the grinder chambers, equalization tank, wet well, and conversion of the dry pit into the valve pit.
 - f. Providing new pumps, grinders, and piping.
 - g. Construction of the Electrical Building and Generator Building
 - h. Construction of the bridge crane as shown in the contract documents.
 - i. Structural and Architectural work including concrete, masonry, doors, hardware, painting, finishes, and other work
 - j. Electrical work, instrumentation and controls work, heating, ventilation and air conditioning work, and other work

- k. Site work including excavation and fill, foundations, restoration such as paving and landscaping, site utilities and other site work. Connect the Long Beach Consolidation Pump Station to the new force main,
 - l. Abandoning the electrical power supply and Temporary Electrical Facility.
 - m. Coordination with other contracts
 - n. All other work as set forth in the Contract Documents.
 - 2. The foregoing is a general description only and shall not be construed as a complete description of the Work to be performed for this Project.
 - 3. The Contractor shall provide parking for work force off site at the Contractor's expense. No on-site parking will be allowed. No staging of vehicles on-site will be allowed.
- C. Contracting Method
- 1. The Project will be implemented as a single prime construction Contract
- D. Delays due to lack of available labor, supervision, equipment, or other resources necessary for the work are not grounds for changes in the Contract Price or Contract times. Delays attributed to Contractor's action or inaction and to the action or inaction by Subcontractors and Suppliers are not grounds for a change in the contract times or contract price.
- E. The existing plant will be operated in continuously by the City of Long Beach during the entire construction period, including the Temporary Bypass Pump Station. However, repairs, maintenance required and/or emergency shall be the responsibility of the Contractor. Work under this Contract shall be so scheduled and conducted by the Contractor that such Work will not impede any treatment process, reduce the quality of the plant effluent or cause odor and other nuisance. In performing the Work shown and specified, the Contractor shall plan and schedule his Work to meet the plant and collection system operating requirements.
- F. The construction sequence, as described in Section 01700, Maintenance of Plant Operations, must be maintained.
- G. Additional details concerning storm water permit compliance and pollution prevention plans can be found in the Federal Regulations 40 CFR 122 & 123.
- H. Refer to Section 01700 for expected mechanical and electrical shutdown operations.

1.2 GENERAL

- A. The Instructions to Bidders, Agreement, General Conditions, and Division 1, General Requirements, specifications shall apply to all Work under the Contract for this Project.
- B. Where articles of the Instructions to Bidders, Agreement, and General Conditions are repeated in the Sections of Division 1, General Requirements, it is intended to elaborate or qualify such articles. It is not intended that other articles of the above documents shall be omitted or that additional requirements set forth in the above documents and noted herein shall be excluded from Contract requirements unless specifically noted as such hereinafter.
- C. Where the words "Contract" and "Contractor" are used in Sections of Division 1, General Requirements, they shall apply equally to all parties entering into agreements with the County to perform Work specified herein and to all Contracts derived from said agreements.

1.3 CONTRACT DOCUMENTS

- A. The Contract Documents consist of the Notice and Instructions to Bidders, Bid Bond, Proposal, Agreement, General Conditions, the Technical Specifications, and the Contract Drawings.

1.4 GENERAL ARRANGEMENT

- A. The Contract Drawings indicate the extent and general arrangement of the Work. The specific equipment proposed for use by the Contractor on the Project may require changes in the construction detailed on the Contract Drawings, and all such changes shall be performed in accordance with the requirements of the General Conditions, Article GC 17, "Materials and Equipment, Approvals, Substitutions and Deviations", and shall be made without additional cost to the County and shall include the increase in costs of the other Contracts.
- B. In the preparation of the revised plans, clearance, access, walkway widths, stairways, headroom and other building and equipment layout features shall be equal to those shown on the original Plans. All materials involved in the redesign shall conform to the applicable provisions of the Technical Specifications.

1.5 PIPING, CONDUIT AND DUCT LAYOUT

- A. In accordance with the requirements of the Agreement, Article XII, "Coordination of Work", and the General Conditions, Article GC 14, "Contractor Submissions", paragraphs D, E, J, and K, Layout and Installation Drawings, the Coordination Drawings, the piping, conduit, duct and support layout shall be coordinated by the Contractor.

- B. In setting hangers and supports, the Contractor shall line up the Work properly, and particular care shall be used to obtain the most orderly, systematic, and compact piping, conduit and duct layout possible. All piping, conduit and ducts shall not be hung or supported by existing pipe hangers unless otherwise noted.

1.6 TIME OF WORK

- A. Overtime work by the Contractor necessary to conform to the requirements of Division 1, General Requirements, Section 01700, Maintenance of Plant Operations, shall be considered as normal procedure under this Contract, and the Contractor shall make no claims for extra compensation as a result thereof. The Contractor shall be prepared to work around the clock and supply multiple work crews as necessary to complete the Work including testing and acceptance as specified, within the specified time frame and the time of completion set forth in the Contract Documents.
- B. The normal working hours for the project are between 7:00 AM and 3:30 PM Monday through Friday. When required to meet the Contract Completion dates, the Contractor is advised that they shall work scheduled overtime or second shifts as needed. The Contractors shall have sufficient construction materials, labor, equipment, tools and supervision to support scheduled overtime or second shifts when required.
- C. It is understood that the Contractor has reviewed the schedule and has included in their bid sufficient monies to meet the schedule and will make no claim for extra compensation because of additional costs to meet scheduled dates.
- D. The Contractor is advised that they will be directed to take remedial action as necessary to recover lost time on any critical items as determined from the Construction Schedule.
- E. If it shall become imperative to perform Work at night, the County and the City of Long Beach shall be informed at least 24 hours in advance of Work done during off hours. Temporary lighting and all other necessary facilities for performing and inspecting the Work shall be provided as required and as specified in Division 1, Section 01500, Temporary Facilities and Controls, or as directed by the Engineer.
- F. Unless otherwise specifically permitted, all Work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work that will not cause injury to workmanship or materials will be permitted. The Contractor shall carefully protect his Work against damage or injury from the weather, and when Work is permitted during freezing weather, he/she shall provide and maintain approved facilities for heating the materials and for protecting the finished Work.

G. The Contractor shall require permission, in writing, to perform contractual work outside the regular County working hours of 7:00 AM to 3:30 PM, Monday through Friday, or on official County holidays. This written request should be received by the County 24 hours in advance of beginning the work. The Contractor is responsible for coordination with the County Engineer and/or his duly authorized representative, prior to the start of the work to determine the dates of observance of the official County holidays that may occur during the course of the Contract. The official County holidays are:

- New Year's Day
- Martin Luther King, Jr. Day
- Lincoln's Birthday
- Washington's Birthday
- Memorial Day
- Independence Day
- Labor Day
- Columbus Day
- Election Day
- Veteran's Day
- Thanksgiving Day
- Friday after Thanksgiving Day
- Christmas Day

Failure of the Contractor to consider official County holidays during the preparation of their work plans and schedules shall not be cause for a delay claim against the County.

H. Contractor shall obtain permission from Owner, Owner's Representative and/or Plant management and staff prior to prosecuting any portion of the Work beyond the standard working days or hours. Should circumstances arise during the course of the Contract, where the Contractor works outside of the County's regular working hours (7:00 am to 3:30 pm, or as otherwise established for the project) or on weekends or official County holidays, regardless if this work is performed as a result of the Contractor's request or as required by the contract documents, or as required by the approved baseline schedule (resource loaded); the Contractor will reimburse the County for the cost of providing inspection and/or plant assistance, at the rate of \$175 per hour per staff member. The County, County's Representative and Plant management and staff will review the scope of the operations and determine on a case-by-case basis the extent of construction oversight that may be required. Furthermore, failure of the Contractor to have considered such contingency cost in his bid price shall not be cause for an additional cost claim to the County.

1.7 WORK BY OTHERS

- A. The City of Long Beach will perform the following work:
 - 1. Operate all potable, protected water, effluent water system and all other pertinent existing plant valves and plant functions.
- B. The following contracts will be ongoing in the vicinity of this contract:
 - 1. Contract S35109-01S Long Beach WPCP Consolidation – Force Main.

1.8 REGULATORY AGENCY ACCESS TO CONSTRUCTION SITE

- A. Whenever construction work is in progress or preparation, the Contractor shall permit access and inspection and shall provide proper and necessary facilities to the representatives of the County, Engineer and Regulatory Agencies including, but not limited to, the New York State Department of Environmental Conservation and the New York State Environmental Facilities Corporation.

1.9 SITE CHARACTERIZATION AND INFORMATION

- A. The Bay Park Sewage Treatment Plant (STP) has been renamed to South Shore Water Reclamation Facility (WRF). Any references to Bay Park STP in the specifications and drawings shall mean South Shore WRF.
- B. The following documents are distributed with the Contract Documents (unless noted otherwise) for the convenience of the Contractor for information only. These documents are:

Item No.	Agency/ Firm	Contract	Year	Title
1	Precision Environmental Inc.	S35109-01GR	2020	Hazardous Material Investigation
2	Tenen Environmental	S35109-01GR	2020	Phase II Environmental Site Investigation
3	Hazen and Sawyer/ Arcadis, PMJV	S35109-01GR	2020	Geotechnical Investigation
4	Hazen and Sawyer/ Arcadis, PMJV	S35109-01GR	2020	NYS Office of Parks, Recreation and Historic Preservation (NYSOPRHP) – Consultation and No Effects Letter
5	Hazen and Sawyer/ Arcadis, PMJV	S35109-01GR	2020	GOSR NEPA Finding of No Significant Impact/ SEQRA Type II Determination
6	Hazen and Sawyer/ Arcadis, PMJV	S35109-01GR	2021	New York State Dept. of State (NYSDOS) Coastal Consistency Concurrence
7	Hazen and Sawyer/ Arcadis, PMJV	S35109-01GR	2021	FEMA NEPA FONSI Funding Compliance
8	Distinct Engineering Solutions, Inc.	S35109-01GR	2021	Geotechnical Report
9	Hazen and Sawyer/ Arcadis, PMJV	S35109-01GR	2022	City of Long Beach – Stormwater Pollution Prevention Plan (SWPPP)

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++.

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SECTION 01020

ALLOWANCES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. General: The Allowance described below shall be included in the Contractor's total bid. Any amounts not expended prior to completion of the Project shall be deducted from the final payment made to the Contractor.

1.2 SCHEDULE OF ALLOWANCES

- A. General Construction Contract:
 - 1. Item No. 2: An allowance of two hundred fifty thousand dollars (\$250,000) for costs associated with work due to Unforeseen Field Conditions.
 - 2. Item No. 3: An allowance of fifty thousand dollars (\$50,000) for costs associated with work due to Unforeseen Hazardous Material.
 - 3. Item No. 4: An allowance of one hundred twenty thousand dollars (\$120,000) for upfront costs for PSEG to design and installation of Submersible Transformer and the relocation of utilities.
 - 4. Item No. 5: An allowance of two thousand dollars (\$2,000) for signage, if required by FEMA and/or GOSR.
 - 5. Item No. 6: An allowance of one million dollars (\$1,000,000) for costs incurred to maintain the project schedule which would otherwise be delayed due to conditions out of the control of the Contractor.

1.3 BASIS FOR PAYMENT

- A. General Construction Contract:
 - 1. Item No. 2: The amount of compensation to be paid to the contractor under the allowance for work due to Unforeseen Field Conditions, as directed or authorized by the County, shall be determined by the actual cost of labor, materials, equipment, and incidentals, plus overhead and profit, to be determined as the work progresses in the manner specified in Agreement Article XXII, ("Extra Work"), paragraph C. Any funds remaining at the end will be eliminated by a credit change order.
 - 2. Item No. 3: The amount of compensation to be paid to the contractor under the allowance for work due to Unforeseen Hazardous Conditions, as directed or authorized by the County, shall be determined by the actual cost of labor, materials, equipment, and incidentals, plus overhead and profit, to be determined as the work progresses in the manner specified in Agreement Article XXII, ("Extra Work"), paragraph C. Any funds remaining at the end will be eliminated by a credit change order.

3. Item No. 4: The amount of compensation to be paid to the contractor under the allowance for the design and installation of the submersible transformer, and the relocation of utilities shall be determined by the actual costs invoiced by PSE&G Long Island.
4. Item No. 5: The amount of compensation to be paid to the contractor under the allowance for providing signage, as directed or authorized by the County, FEMA, and/or GOSR, shall be determined by the actual cost of labor and materials, equipment, and incidentals, plus overhead and profit, to be determined as the work progresses in the manner specified in Agreement Article XXII, ("Extra Work"), paragraph C. Any funds remaining at the end will be eliminated by a credit change order.
5. Item No. 6: The allowance for costs incurred to maintain the project schedule which would otherwise be delayed due to conditions out of the control of the Contractor. Payment under this allowance shall be for the premium portion of overtime or extended shift premium time work, expediting costs for equipment or materials, additional crew costs, and/or other costs necessary to mitigate delays caused by parties other than the Contractor and/or, as directed by the Engineer. Payment under this allowance shall only be made upon written authorization of the Commissioner and shall be only for work activities that are on or near the project schedule critical path, as reported in the latest approved CPM Schedule, that would otherwise delay completion of the project. This allowance is also applicable to extended operation of the bypass pump station as a result of delays in the completion of the force main. The amount of compensation to be paid to the Contractor under the allowance for work incurred to maintain the project schedule, as directed, or authorized by the County, shall be determined by the actual cost of labor, materials, equipment, and incidentals, plus overhead and profit, to be determined as the work progresses in the manner specified in Agreement Article XXII, ("Extra Work"), paragraph C. Any funds remaining at the end will be eliminated by a credit change order.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01031

ADDITIONS, MODIFICATIONS AND ALTERATIONS TO EXISTING BUILDINGS AND STRUCTURES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Work includes all labor, materials, equipment and appurtenances required for the complete execution of additions, modifications and alterations to existing buildings and structures as shown on the Drawings and specified.
- B. The Contractor shall have examined all Work to be performed to the existing buildings and structures and familiarize himself with the nature and extent to which the existing buildings and structures will be damaged, items removed or re-arranged due to the Work under this Contract and that of other contracts.
 - 1. Cutting and patching shall conform to the requirements of the General Conditions, Article GC-29, "Cutting and Patching", and Section 01045, Cutting and Patching.
 - 2. Patching Work shall be performed with similar materials and in the same manner as adjoining Work. Joining between old and new Work shall be perfect and practically invisible. All due caution shall be taken to obtain a bond between old and new Work.
- C. Major portions of the Work are indicated on the Drawings for the Contract and the accompanying Specifications thereto. All Work must be complete in all respects and executed with high quality workmanship.
- D. Work to be performed due to damage caused by Contractor or his workers during demolition, removals, additions, modifications, and alterations that is not specifically indicated by details or general notes on the contract drawings may include the following:
 - 1. Removing loose rust, sealing or peeling paint from metal surfaces by scraping, sanding or wire brushing; priming and repainting metal surface (inside and outside) as specified under Section 09900, Painting.
 - 2. Cutting and modifying existing openings as necessary to receive new Work.
 - 3. Cleaning and repainting steel handrailing, brackets, sleeves, etc. Replacing existing railing with new aluminum railing, brackets, sleeves, etc.
- E. The Contractor shall submit detailed description of methods and equipment and sequence for additions, modifications and alterations for Engineer's review.

1.2 SITE AND BUILDINGS

- A. Prior to ordering any materials or doing any Work, the Contractor shall verify and be responsible for the correctness of all measurements, dimensions and other conditions of each building and structure scheduled for Work as necessary and required.

1.3 MATERIALS

- A. All materials to perform and complete the Work for Contract shall be new. Salvaged materials, such as brick, stone copings, and granite sills, may be used under certain conditions subject to the approval of Engineer.
- B. All salvaged materials shall be sound and undamaged. Materials to be re-used shall be stored and protected as directed by Engineer. Care shall be taken to prevent damage to materials or equipment to be re-used.

1.4 SHORING, UNDERPINNING AND BRACING

- A. When necessary and required, the Contractor shall provide underpinning and temporary shoring and bracings, all in accordance with code requirements, the Drawings, and as approved by Engineer.
- B. Shoring and bracing shall be of such form and so installed as to safely support the Work and interfere as little as possible with the progress of the Work. Suitable means shall be provided to adjust any settlement in the shoring supports. Temporary shoring shall consist of sound timbers or rolled shapes of required dimensions which shall be removed after necessity for same ceases to exist. All Work removed or damaged through installation of temporary shoring or through improper shoring shall be replaced or repaired after the shoring is removed, at no additional cost to the County.

1.5 WORK PREPARATION AND TEMPORARY ACCESS

- A. The Contractor, before commencing Work shall prepare a Progress Schedule in accordance with the requirements of Section 01300, Submittals and Section 01700, Maintenance of Plant Operations, in order to coordinate the Work of all trades and to insure completion on or before the completion date. The County and the Engineer reserve the right to revise or modify such schedules as required to expedite each phase of Work and to coordinate such Work with the partial use of the building for purposes as directed.
- B. No facility such as toilets, corridors, etc., shall be barricaded or access restricted without providing other temporary or interim means of access. It is further required that no Work specified hereinafter shall disturb or interfere with the operation of the existing mechanical installation until proposed new Work has been completed or satisfactorily installed. Exception may be made to this requirement only by written approval from County and Engineer.

- C. Detailed sequence of availability of areas within the present buildings where Work is to be performed under each Contract shall be in accordance with Section 01700, Maintenance of Plant Operations, but may be modified by the Contractor, upon authorization by the County and Engineer as the Work progresses.
- D. The Contractor shall furnish and install all temporary fire exits, fire extinguishers, hose and safety devices as may be required by authorities having jurisdiction.
- E. Work within the existing building, once started, shall be completed as quickly as practicable and each trade shall determine before Work is started that all required materials are at hand or readily obtainable to avoid delays.
- F. Shut-downs of existing services within existing buildings which may be occupied during construction will be permitted only upon approval by the County subject to at least sixty days' notice in writing to the County in each case. Shut-downs will be limited to times which will result in the least interference with normal operations.

1.6 CUTTING, PATCHING, REPAIRING AND REFINISHING

- A. The Contractor will be responsible for cutting all openings in walls, floors and ceilings (indicated to remain) to accommodate alteration Work under this Contract in accordance with the requirements of the General Conditions, Article GC-29, "Cutting and Patching" and Article GC-30, "Openings and Chases" and as hereinafter specified.
 - 1. Where new openings are to occur in existing exterior and interior concrete and masonry bearing walls and structural concrete floors, the Contractor will be required to notify the Engineer in writing and shall obtain approval prior to cutting operations. The Engineer will determine whether such openings affect the structural stability or load bearing capacities of the walls and the floors. Where embedded electrical conduits are known to exist, or where embedded conduits are found, the Contractor shall notify the County to determine if the conduit can be abandoned. If the conduit connects to equipment or lighting that must be maintained in service, the County will direct the Contractor to install temporary conduit and cable to maintain service until existing service is no longer required.
 - 2. Core drill for individual openings passing through existing concrete slabs. Obtain authorization from the County prior to core drilling. Prior to core drilling, the Contractor shall drill sufficient number of small exploratory holes to establish that the area to be core drilled is free of existing embedded conduits.
 - 3. All holes and openings to be cut in existing walls, floors and ceilings of any nature shall be geometrically correct and no larger than necessary to accommodate the new Work.
 - 4. No cutting of finished or structural Work may be done without the approval of the Engineer.

- B. The Contractor shall be responsible for all finish patching operations of holes and openings in existing floors, walls, ceilings and roofs to accommodate the alteration Work under the Contract.
- C. The Contractor and/or his Subcontractors shall provide and set in place all sleeves, forms and inserts required for their Work before new walls, partitions, floors and roofs are built. All cutting and patching of new walls, partitions floors and ceilings necessary for the reception of Work caused by failure to properly locate sleeves, forms and inserts or caused by incorrect location of Work shall be done at the expense of the Contractor involved, and shall require the approval of the Contractor whose Work is being cut, and the approval of the Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01039

DEMOLITION AND REMOVAL OF EXISTING STRUCTURES AND EQUIPMENT

PART 1 – GENERAL

1.1 GENERAL

A. Work Included:

1. This Section covers the demolition, removal, and disposal of existing structures and equipment as indicated on the Contract Drawings and as specified hereinafter. The Contractor shall furnish all labor, materials and equipment to demolish structures and equipment and to remove fixtures, anchors, supports, piping and accessories designated to be removed on the Contract Drawings.
2. The Contractor's attention is directed to the fact there may be hazardous materials present within existing structures, and equipment to be demolished, removed, and disposed that will require special handling and other safe guard measures in order to minimize chemical exposure hazards to site workers and to prevent environmental impacts to offsite areas.
3. The removal of all equipment and piping, and all materials from the demolition of structure shall, when released by the Engineer, be done by the Contractor and shall become the Contractor's property, unless otherwise noted, for disposition in any other manner not contrary to the Contract requirements and shall be removed from the Site to the Contractor's own place of disposal.

B. Scheduling:

1. Prior to commencement of work, the Contractor shall conduct a hazardous materials survey of all structures, and equipment to be demolished, removed and disposed, as shown on the Contract Drawings. The survey shall include the identification, quantification, sample collection, and laboratory analytical testing of the following types of hazardous materials:
 - a. Asbestos: An asbestos survey shall be performed by a New York State Department of Labor (NYSDOL)-certified Asbestos Inspector. The survey shall include suspect material sample collection and the subsequent laboratory analysis of these samples by a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratory. The asbestos survey will be performed in accordance with current federal and state asbestos regulations.
 - b. Paint: A paint survey shall be performed by an Environmental Protection Agency (EPA)-certified Lead Inspector. The survey shall include paint chip sample collection and/or the use of an X-Ray Fluorescence (XRF) analyzer to determine the presence of lead and

- polychlorinated biphenyls (PCBs) in paints. Paint chip sample analysis shall be performed by a NYSDOH ELAP-certified laboratory.
- c. PCB-containing building materials: A survey of potential PCB-containing building materials (e.g., caulking and bitumastic coatings) shall be conducted by the Contractor. The survey shall include suspect material sample collection and the subsequent laboratory analysis of these samples by a NYSDOH ELAP-certified laboratory.
 - d. Mercury/PCB-containing fixtures and equipment: An inventory of potential mercury and PCB-containing fixtures and equipment shall be performed by the Contractor.
 - e. Survey Report: At the completion of the hazardous materials survey, the Contractor shall develop a survey report and submit it to the Engineer for review and approval prior to the commencement of work. The survey report shall include sample collection protocols and descriptions and estimated quantities of all materials that were sampled. In addition, the survey report shall include sample location drawings and laboratory analytical results for all samples collected.
2. The Contractor shall submit detailed description of methods and equipment and sequence for demolition and removal for the Engineer's review.
 3. The Contractor shall proceed with the removal of the equipment, piping and appurtenances in a sequence designed to maintain the plant in continuous operation as described in Section 01700, Maintenance of Plant Operations, and shall proceed only after approval of the Engineer.
 4. Any equipment, piping and appurtenances removed without prior authorization, which are necessary for the operation of the existing plant or of the plant expansion, shall be replaced to the satisfaction of the Engineer at no cost to the County.

C. Related Sections:

1. Section 01355, Hazardous Materials Control.
2. Section 01700, Maintenance of Plant Operations.
3. Section 02050, Demolition, Removals and Modifications.

1.2 PROTECTION

A. General:

1. Demolition and removal Work shall be performed by competent workmen experienced in the various types of demolition and removal work required and shall be carried through to completion with due regard to the safety of County employees, workmen on the Site and the public. The Work shall be performed with as little nuisance as possible.
2. The Work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, all governing codes and as hereinafter specified.
3. The Contractor shall make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give

particular attention to shoring and bracing requirements so as to prevent any damage to new or existing construction.

B. Execution:

1. The Contractor shall provide, erect and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
2. The Contractor shall provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
3. The Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new Work is being done, connections made, materials handled or equipment moved.
4. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing structures affected by the operations under this Section shall be protected by dustproof partitions and other adequate means.
5. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.
6. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall conduct operations with minimum traffic interference.
7. The Contractor shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.

1.3 WORKMANSHIP

- A. The demolition and removal Work shall be performed as described in the Contract Documents. The Work required shall be done with care, and shall include all required shoring, bracing, etc. The Contractor shall be responsible for any damage which may be caused by demolition and removal Work to any part or parts of existing structures or items designated for reuse or to remain. The Contractor shall perform patching, restoration and new Work in accordance with applicable technical sections of the Specifications and in accordance with the details shown on the Contract Drawings. Prior to starting of the Work, the Contractor shall provide a detailed description of methods and equipment to be used for each operation and the sequence thereof for review by the Engineer. All cutting and patching shall be performed in accordance with the requirements of the General Conditions, Article GC-29, "Cutting and Patching".
- B. All supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts and other supports shall be removed to approximately one inch (1-in.) below the

- surrounding finished area and the recesses shall be patched to match the adjacent areas as shown. Wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified, as shown on the Contract Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate sections of the Specifications, as shown on the Contract Drawings and as directed and approved by the Engineer.
- C. Wherever piping is to be removed for disposition, the piping shall be drained by the Contractor and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.
 - D. Materials or items to be demolished and not designated in Section 02050, Demolitions, Removals and Modifications, to become the property of the County or to be reinstalled shall become the property of the Contractor and shall be removed from the property and legally disposed of.
 - E. The Contractor shall execute the Work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the structures.
 - F. Where alterations occur, or new and old Work join in, the Contractor shall cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, so as to leave the altered Work in as good a condition as existed prior to the start of the Work. The materials and workmanship employed in the alterations, unless otherwise shown on the Contract Drawing or specified, shall comply with that of the various respective trades which normally perform the particular items of work.
 - G. The Contractor shall finish adjacent existing surfaces of new Work to match the specified finish for new Work. The Contractor shall clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.
 - H. Where existing equipment are indicated to be reused, the Contractor shall repair and refinish such equipment to put them in perfect working order. Refinishing shall be as specified in Section 02050, Demolitions, Removals, and Modifications, or and directed by the Engineer.
 - I. The Contractor shall remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the Work.

1.4 CONDITION OF STRUCTURES AND EQUIPMENT

- A. The County does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.

- B. Conditions existing at the time of inspection for bidding purposes will be maintained by the County so far as practicable.
- C. The information regarding the existing structures and equipment shown on the Contract Drawings is based on visual inspection and a walk-through survey only. Neither the Engineer nor the County will be responsible for interpretations or conclusions drawn therefrom by the Contractor.

1.5 MAINTENANCE

- A. The Contractor shall maintain the structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.
- B. The Contractor shall provide on-site dump containers for collection of waste materials, debris and rubbish, and he shall wet down dry materials to lay down and prevent blowing dust.
- C. At least once a week during the progress of the demolition and removal Work or as directed by the Engineer, the Contractor shall clean the Site and properties (including sweeping roadways with mechanical street sweeper), and dispose of waste materials, debris and rubbish.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

++ NO TEXT ON THIS PAGE ++

SECTION 01040

REGULATORY REQUIREMENTS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The items listed in this Section are a summary of the regulatory requirements for the work in this contract including but not limited to relevant agencies, work permits, disposal requirements, and inspection requirements.
- B. In general, the Contractor shall keep themselves informed of all current local, state and federal laws, rules, regulations and ordinances. The work shall be performed by the Contractor, in all respects, in strict conformity with all such laws, rules, regulations, requirements and ordinances of the local, state, and federal governments and all departments and bureaus thereof.
- C. Permits and approvals listed in this Section are for reference. It is the responsibility of the Contractor to determine and obtain what permits they need for their work.

1.2 REGULATORY AGENCY ACCESS TO CONSTRUCTION SITE

- A. The Contractor shall during the course of the Work permit access and provide assistance to the Owner, their representatives, and any other entities as requested by the Owner onto the project site(s). Representatives of the Owner and agencies that may need access include, but are not limited to, the Hazen and Sawyer/Arcadis Joint Venture, City of Long Beach, New York State Department of Environmental Conservation, Federal Emergency Management Agency, New York State Environmental Facilities Corporation and Governor's Office of Storm Recovery.

1.3 WORK PERMITS AND APPROVALS

- A. The Contractor shall obtain, pay for and comply with the terms and conditions of all necessary permits, licenses, approvals, certificates of inspection, and controlled inspection reports, and shall give all notices and pay all legal fees in connection with the work of this Contract.
- B. All work performed under the Contract shall conform to the rules and regulations of the City of Long Beach and all other State and Federal Departments having jurisdiction.
- C. The Contractor is advised that dewatering activities on Long Island are under the jurisdiction of the New York State Department of Environmental Conservation, 47-40 21st Street, Long Island City, New York 11101, 2nd Floor, Environmental

Permit Section, 718-482-4997. The Contractor shall obtain all required licenses, file photostatic copies with the Engineer and comply in all respects with the requirements of the New York State Department of Environmental Conservation.

- D. The Contractor shall provide registration to the New York State Department of Environmental Conservation of the temporary generator to be supplied for the temporary pumping station and the permanent pump station.
- E. Upon completion of the various stages of construction, the Contractor shall schedule inspections and obtain certificates of approval and/or acceptance from the various agencies and Departments having jurisdiction and shall deliver these certificates to the Engineer.
- F. The Contractor shall also comply with the conditions and regulations of the permits that are obtained by the City, the County, or its Engineer. These permits include, but are not limited to, the following:
 - 1. Federal Emergency Management Agency (FEMA) - National Environmental Policy Act Finding of No Significant Impact (NEPA FONSI), Funding Compliance
 - 2. Governor's Office of Storm Recovery (GOSR) – Environmental Clearance Letter (October 19, 2020). The letter stipulates the following:
 - a. Conformance with NYS Department of Environmental Conservation State Pollution Discharge Elimination System General Permit for Stormwater Discharges from Construction – Activity GP-0-20-001
 - b. Construction noise mitigation measures will be implemented, including outfitting equipment with mufflers and complying with relevant (e.g., City of Long Beach) noise ordinances/ regulations (i.e., time-of-day work limitations)
 - c. To address the short-term traffic impacts to the Long Beach portions of the project area, a construction traffic management plan will be prepared in coordination with the City.
 - 3. New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP) – Consultation & No Effects Letter
 - 4. New York State Department of State (NYSDOS) – Coastal Consistency Concurrence
 - 5. New York State Department of Environmental Conservation (NYSDEC) – 401 Water Quality Certification
 - 6. New York State Department of Environmental Conservation (NYSDEC) – 401 Water Quality Certification
 - 7. City of Long Beach – Stormwater Pollution Prevention Plan (SWPPP) MS4 Acceptance
- G. The Contractor shall renew and maintain all permits for the life of the contract, as necessary.

1.4 EXISTING UTILITIES

- A. All utility and structure information shown on the Contract Drawings were obtained from various plans and maps and field investigations; however they are not guaranteed to be complete or accurate. It shall be the Contractor's responsibility to locate all such necessary utilities or structures by the digging of test pits prior to the start of construction.
- B. During the progress of the work, the Contractor shall protect from damage any existing utilities or services within the work areas until they have been re-routed, disconnected or capped off.

1.5 DISPOSALS

- A. Water from open cut and/or sheeted excavations, manholes, structures, trenches, or from whatever source, shall be disposed of strictly in accordance with methods approved by the Engineer.

1.6 CONFORMANCE TO INDUSTRIAL CODE

- A. The Contractor's attention is directed to requirements of the Industrial Code of the State of New York, Department of Labor, Board of Standard and Appeals, latest edition and amendments or supplements thereto. All mechanical equipment with respect to manufacture, fabrication, and safety devices for protection of personnel from electrical parts and mechanically moving parts such as belts, shafts, couplings, and other apparatus, appliances or equipment, all floors, stair surfaces, ladders, equipment, access stairs and platforms, all exit enclosures, vertical openings and stairs, shall comply with this code; and all provisions therein shall be deemed included in and required by these specifications and shall be detailed for approval and furnished without additional cost; the price thereof considered to be included in the applicable prices bid for the various Contract Items in the Contracts.

1.7 NON-COMPLIANCE

- A. All fees/penalties incurred by the Contractor, City, County, Engineer or other such entity, resulting from non-compliance by the Contractor with permits or approvals obtained by the Contractor, permits obtained by the City or Engineer, conformance to the Industrial Code or conformance to other codes or standards governing the performance of this Contract will be paid for by the Contractor or deducted from the final payment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01045

CUTTING AND PATCHING

PART 1 – GENERAL

1.1 GENERAL

- A. This Section is supplementary to the requirements of the General Conditions, Article GC-29, "Cutting and Patching" and includes all cutting and patching of all Work under construction, completed Work and facilities installed by others, in order to accommodate the coordination of Work, install other Work, uncover Work for access, inspection or testing, or similar purposes. Demolition, removals and modifications work" is specified in Section 01039, Demolition and Removal of Existing Structures and Equipment. Execute all cutting and patching, including excavation, backfill and fitting required to:
1. Remove and replace defective Work or Work not conforming to requirements of the Contract Documents.
 2. Remove samples of installed Work as required for testing.
 3. Remove all constructions required to provide for specified alteration or addition to Work by others.
 4. Uncover Work to provide for the Engineer's inspection of covered Work or inspection by regulatory agencies having jurisdiction.
 5. Connect to completed Work that was not accomplished in the proper sequence.
 6. Remove or relocate utilities and pipes installed by others which obstruct the Work to which connections must be made.
 7. Make connections or alterations to new facilities or facilities installed by others.
- B. Restore all Work by others to a state equal to that which it was in prior to cutting and restore new Work to the standards of these Specifications.
- C. Submittals:
1. Prior to cutting, which may affect the integrity and design function of the Project, County's operations, or Work of another Contractor, submit written notice to the Engineer, requesting consent to proceed with cutting, including:
 - a. Identification of the Project.
 - b. Description of affected Work of Contractor and Work of others.
 - c. Necessity for cutting.
 - d. Effect on other Work and on structural integrity of the Project.
 - e. Description of proposed Work. Designate:
 - 1) Scope of cutting and patching.
 - 2) Contractor, Subcontractor or trade to execute Work.
 - 3) Products proposed to be used.
 - 4) Extent of refinishing.

- 5) Schedule of operations.
 - f. Alternatives to cutting and patching, if any.
 - g. Designation of party responsible for cost of cutting and patching.
 - 2. Should conditions of Work, or schedule, indicate change of materials or methods, submit written recommendation to the Engineer, including:
 - a. Conditions indicating change.
 - b. Recommendations for alternative materials or methods.
 - c. Submittals as required for substitutions.
 - 3. Submit written notice to the Engineer, designating the time Work will be uncovered, to provide for observation. Do not begin cutting or patching operations until authorized by the Engineer.
- D. Provide shoring, bracing and support as required to maintain structural integrity of the Project and protect adjacent Work from damage during cutting and patching.
- E. Conform to all applicable Specifications for application and installation of materials used for patching.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01050

FIELD ENGINEERING

PART 1 – GENERAL

1.1 GENERAL

- A. The General Construction Contractor shall establish at least two bench marks for use by all Contractors, in accordance with the General Conditions, Article GC 28, "Layout and Levels" and the Agreement, Article XXIX, "Character and Competency" and Article XXX, "Superintendence". The Contractor shall comply with this article.
- B. Contractor shall:
 - 1. Provide civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.
 - 2. Develop and make all detail surveys and measurements needed for construction including slope stakes, batter boards, piling and pier layouts and all other working lines, elevations and cut sheets.
 - 3. Keep a transit and leveling instrument on the Site at all times and a skilled instrument man employed or obtained whenever necessary for layout of the Work.
 - 4. Provide all material required for benchmarks, control points, batter boards, grade stakes, and other items.
 - 5. Be solely responsible for all locations, dimensions and levels. No data other than written orders of the Engineer shall justify departure from the dimensions and levels required by the Drawings.
 - 6. When requested by Engineer, provide such facilities as may be necessary for the Engineer to check line and grade points placed by the Contractor. The Contractor shall do no excavation, backfill or embankment Work until all cross sectioning necessary for determining pay quantities has been completed and checked by the Engineer.

1.2 CONTRACTOR'S FIELD ENGINEER

- A. The Contractor shall employ and retain at the Site of the Work a field engineer capable of performing all engineering tasks required of the Contractor. Tasks included are:
 - 1. A projection of Work to be completed the following day must be submitted to the Engineer by 4:00 PM of the preceding workday. This projection must include:
 - a. Location of all areas in which construction will be done, including the Contractor and his Subcontractors.
 - b. Major construction equipment utilized.
 - c. Equipment and materials to be installed.
 - 2. Provide all surveying equipment required including transit, level, stakes and required surveying accessories.

3. Furnish all required lines and grades for construction of operations. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment.
4. Maintain field office files and drawings, Record Drawings, and coordinate engineering services with Subcontractors. Prepare Layout and Coordination Drawings for construction operations.
5. Check and coordinate Work for conflicts and interference and immediately advise the Engineer of all discrepancies noted.
6. Cooperate with the Engineer in field inspections, as required

1.3 QUALIFICATIONS OF SURVEYOR OR ENGINEER

- A. A qualified engineer or registered land surveyor, acceptable to the Engineer.

1.4 RECORDS

- A. Maintain a complete, accurate log of all control and survey Work as it progresses.
- B. On completion of foundation walls and major Site improvements, prepare a certified survey showing all dimensions, locations, angles and elevations of construction.

1.5 SUBMITTALS

- A. When requested by the Engineer, submit a certificate signed by a registered Engineer or surveyor certifying that elevations and locations of Work are in conformance with the Contract Documents. Explain all deviations.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01072

REFERENCE STANDARDS

1.1 GENERAL

- A. When a reference standard is specified, comply with the requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the Work, unless otherwise specified. Reference standards include, but are not necessarily limited to, the following:

AMCA - Air Moving and Conditioning Association, Inc.

AASHTO - American Association of State Highway and Transportation Officials.

ABMA - American Boiler Manufacturers' Association.

ACI - American Concrete Institute.

ACIFS - American Cast Iron Flange Standards.

AFBMA - Anti-Friction Bearing Manufacturers Association.

AGA - American Gas Association.

AGMA - American Gear Manufacturers Association.

AIA - American Institute of Architects.

AISC - American Institute of Steel Construction.

AISI - American Iron and Steel Institute.

ANSI - American National Standards Institute.

APA - American Plywood Association.

API - American Petroleum Institute.

ASCE - American Society of Civil Engineers.

ASME - American Society of Mechanical Engineers.

ASTM - American Society for Testing and Materials.

AWPA - American Wood Preservers Association.

AWS - American Welding Society.

AWWA - American Water Works Association.

CGA - Compressed Gas Association.

CRSI - Concrete Reinforcing Steel Institute.

CMAA - Crane Manufacturers' Association of America.

DIPRA - Ductile Iron Pipe Research Association.

EEI - Edison Electric Institute.

EJMA - Expansion Joint Manufacturers' Association.

Fed Spec - Federal Specifications.

FM - Factory Mutual.

HMI - Hoist Manufacturers' Institute.

IEEE - Institute of Electrical and Electronic Engineers.

IPCEA - Insulated Power Cable Engineers Association.

NACE - National Association of Corrosion Engineers.

NB - National Board of Boiler Pressure Vessels.

NBS - National Bureau of Standards.

NEC - National Electric Code.

NEMA - National Electrical Manufacturers Association.

NFPA - National Fire Protection Association.

NYSDOT - New York State Department of Transportation.

OSHA - Occupational Safety and Health Act.

PCA - Portland Cement Association.

PCI - Pre-stressed Concrete Institute.

RMA - Rubber Manufacturers' Association.

SMACCNA - Sheet Metal and Air Conditioning Contractors National Association.

SPI - Society of Plastics Industry.

SSPC - Steel Structures Painting Council.

STI - Steel Tank Institute.

UL - Underwriters' Laboratory.

- B. The Contractor shall, when required, furnish evidence satisfactory to the Engineer that materials and methods are in accordance with such standards where so specified.
- C. In the event any questions arise as to the application of these standards or codes, copies shall be supplied on Site by Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

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SECTION 01150

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The items listed below, beginning with Article 1.3, refer to and are the same pay items listed in the Bid Schedule. They constitute all of the pay items for the completion of the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant services, Contractor's or Engineer's field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, approval and Record Drawings, water supplies, power, maintaining traffic, removal of waste, watchmen, Bonds, insurance, and all other requirements of the Agreement, General Conditions and the Special Conditions. Compensation for all such services, items and materials shall be included in the prices stipulated for the lump sum and unit pay items listed herein. Unless otherwise specified, no separate payment will be made for stored equipment.

1.2 RELATED PROVISIONS SPECIFIED ELSEWHERE

- A. Payments to the Contractor: Refer to the Agreement and the General Conditions.

1.3 CONTRACT NO. S35109-01GR – GENERAL CONSTRUCTION

- A. Item 1 – General Construction Contract:
1. Payment for Item 1 will be the lump sum bid under this item and will be full compensation for completing the Work described in Section 01010, Summary of Work, as shown on the Contract Drawings, and as specified under Divisions 1 through 16.
- B. The Contractor shall include a hazardous materials survey of buildings, equipment, and structures to be demolished, removed and disposed, as shown on the Contract Drawings, in the lump sum bid for Item 1.
- D. Allowance Item 2, 3, 4, 5 and 6 inclusive are described in the Proposal Section and in Section 01020 Allowances. The total cost for these items shall be included in the total price.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

++ NO TEXT ON THIS PAGE ++

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

- A. This Section specifies the general methods and requirements of submissions applicable to Shop Drawings, Product Data, Samples, Mock Ups, Construction Photographs, Construction or Submittal Schedules. Detailed submittal requirements are specified in the technical Sections.
- B. All submittals shall be clearly identified by reference to Section Number, Paragraph, Drawing Number or Detail as applicable. Submittals shall be clear and legible and of sufficient size for presentation of data.

1.02 SHOP DRAWINGS, PRODUCT DATA, SAMPLES

- A. Shop Drawings
 - 1. Shop drawings as specified in individual Sections include, custom-prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the work.
 - 2. All shop drawings submitted by subcontractors shall be sent directly to the Contractor for checking. The Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.

3. Check all subcontractor's shop drawings regarding measurements, size of members, materials and details to make sure that they conform to the intent of the Drawings and related Sections. Return shop drawings found to be inaccurate or otherwise in error to the subcontractors for correction before submission thereof.
4. All details on shop drawings shall show clearly the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.
5. Submittals for equipment specified under Divisions 13 through 16 shall include a listing of all installations where identical or similar equipment has been installed and been in operation for a period of at least one year.

B. Product Data

1. Product data as specified in individual Sections include, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliances and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing and printed product warranties, as applicable to the work.

C. Samples

1. Samples specified in individual Sections include, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of work to be used by the Engineer or Owner for independent inspection and testing, as applicable to the work.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. Review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:
 1. Field measurements
 2. Field construction criteria
 3. Catalog numbers and similar data
 4. Conformance with related Sections
- B. Each shop drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor: "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I

have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the Resident Project Representative a copy of each transmittal sheet for shop drawings, product data and samples at the time of submittal to the Engineer.

- C. The Contractor shall utilize a 9 character submittal identification numbering system in the following manner:
1. The first five digits shall be the applicable Section Number.
 2. The next three digits shall be the numbers 001 to 999 to sequentially number each initial separate item or drawing submitted under each specific Section Number.
 3. The last character shall be a letter, A to Z, indicating the submission, or resubmission of the same Drawing, i.e., "A=1st submission, B=2nd submission, C=3rd submission, etc. A typical submittal number would be as follows:

03300-008-B

03300 = Section for Concrete

008 = The eighth initial submittal under this section

B = The second submission (first resubmission) of that particular shop drawing

- D. Notify the Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents. All cost associated with any deviations shall be borne by the Contractor.
- E. The review and approval of shop drawings, samples or product data by the Engineer shall not relieve the Contractor from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Engineer will have no responsibility therefor.
- F. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall not be permitted. The Owner will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- G. Project work, materials, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

1.04 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule and in such sequence as to cause no delay in the Work or in the work of any other contractor.

- B. Contractor shall reference the General Conditions for additional submission requirements.
- C. Number of submittals required:
 - 1. Shop Drawings: See Article 1.05 below.
 - 2. Product Data: See Article 1.05 below.
 - 3. Samples: Submit the number stated in the respective Sections.
- D. Submittals shall contain:
 - 1. The date of submission and the dates of any previous submissions.
 - 2. The Project title and number.
 - 3. Contractor identification.
 - 4. The names of:
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
 - 5. Identification of the product, with the section number, page and paragraph(s).
 - 6. Field dimensions, clearly identified as such.
 - 7. Relation to adjacent or critical features of the work or materials.
 - 8. Applicable standards, such as ASTM or Federal Standards numbers.
 - 9. Identification of deviations from Contract Documents.
 - 10. Identification of revisions on resubmittals.
 - 11. A blank space suitably sized for Contractor and Engineer stamps as defined in the General Conditions.
 - 12. Where calculations are required to be submitted by the Contractor, the calculations shall have been checked by a qualified individual other than the preparer. The submitted calculations shall clearly show the names of the preparer and of the checker.

1.05 ELECTRONIC DATA SUBMITTAL FORMAT

- A. Files shall be electronically searchable based on Owner and Engineer established standard file naming convention.
- B. Quality and Legibility: Electronic submittal files shall be made from the original and shall be clear and legible. Do not provide scans of faxed copies. Electronic file shall be made at the full size of the original paper documents. All pages shall be properly oriented for reading on a computer screen without rotating.
- C. Organization and Content:
 - 1. Each electronic submittal shall be one electronic file. Do not divide and submit individual submittals into multiple electronic files unless directed by Engineer.
 - 2. When submittal is large or contains multiple parts, provide PDF file with bookmark for each section of submittal.
 - 3. Submittal content shall include Contractor's letter of transmittal and Contractor's review and stamp.

D. Electronic file format:

PDF (Portable Document Format): .pdf, Adobe PDF documents; created through electronic conversion rather than optically scanned whenever possible.

1.06 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, WORKING DRAWINGS
AND SAMPLES

- A. The review of shop drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
 - 1. as permitting any departure from the Contract requirements;
 - 2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
 - 3. as approving departures from details furnished by the Engineer, except as otherwise provided herein.
- B. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
- C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or Contract Time, the Engineer may return the reviewed drawings without noting an exception.
- D. Submittals will be returned to the Contractor under one of the following codes.

Code 1 - "APPROVED" is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

Code 2 - "APPROVED AS NOTED". This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

Code 3 - "APPROVED AS NOTED/CONFIRM". This combination of codes is assigned when a confirmation of the notations and comments IS required by the Contractor. The Contractor may, at his own risk, release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 14 calendar days of the date of the Engineer's transmittal requiring the confirmation.

Code 4 - "APPROVED AS NOTED/RESUBMIT". This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Engineer within 14 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

Code 5 - "NOT APPROVED" is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 - "COMMENTS ATTACHED" is assigned where there are comments attached to the returned submittal which provide additional data to aid the Contractor.

Code 7 - "SUBMITTED FOR THE RECORD" is assigned when the contractor has submitted information for record purposes.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data.

- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall identify all revisions made to the submittals, either in writing on the letter of transmittal or on the shop drawings by use of revision triangles or other similar methods. The resubmittal shall clearly respond to each comment made by the Engineer on the previous submission. Additionally, the Contractor shall direct specific attention to any revisions made other than the corrections requested by the Engineer on previous submissions.
- F. Partial submittals may not be reviewed. The Engineer will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor and will be considered "Not Approved" until resubmitted. The Engineer may at his option provide a list or mark the submittal directing the Contractor to the areas that are incomplete.
- G. Repetitive Review
 - 1. Shop drawings and other submittals will be reviewed no more than three times at the Owner's and Engineer's expense. All subsequent reviews will be performed at times convenient to the Owner and Engineer and at the Contractor's expense, based on the Owner's and Engineer's then prevailing rates. The Contractor shall reimburse the Owner and Engineer for all such fees invoiced to the Owner by the Engineer as defined in Article GC-18 of the General Conditions. Submittals are required until approved.

2. Any need for more than one resubmission, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time.
- H. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the Engineer at least 7 working days prior to release for manufacture. If such notice is not received within 7 day the Contractor will not be eligible for a claim against the County for additional compensation.
- I. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

1.07 DISTRIBUTION

- A. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the Engineer. Number of copies shall be as directed by the Engineer but shall not exceed six.

1.08 MOCK UPS

- A. Mock Up units as specified in individual Sections, include but are not necessarily limited to, complete units of the standard of acceptance for that type of work to be used on the project. Remove at the completion of the work or when directed.

1.09 CONSTRUCTION PHOTOGRAPHS

- A. Requirements for job photographs are provided in Article GC-37 of the General Conditions.

1.10 PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

- A. If specifically required in other related Sections, submit a P.E. Certification for each item required, in the form attached to this Section, completely filled in and stamped.

1.11 ADDITIONAL SUBMITTAL REQUIREMENTS

- A. Additional Contractor submission requirements are included in Article GC-14 of the General Conditions.

1.12 GENERAL PROCEDURES FOR SUBMITTALS

- A. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the

Long Beach WPCP Consolidation
Pump Station Conversion

01300-7

time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the Work.

++ END OF SECTION ++

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State of New York and that he/she has been employed by

_____ to design
(Name of Contractor)

(Insert P.E. Responsibilities)

in accordance with Section _____ for the

(Name of Project)

The undersigned further certifies that he/she has performed the design of the _____,
(Name of Project)

that said design is in conformance with all applicable local, state and federal codes, rules, and regulations, and that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

Nassau County Department of Public Works
(Insert Name of Owner)

or Owner's representative within seven days following written request therefor by the Owner.

P.E. Name Contractor's Name

Signature Signature

Address Title

Address

Long Beach WPCP Consolidation
Pump Station Conversion

01300-9

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SECTION 01311

CONSTRUCTION SCHEDULING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The work shall consist of preparing, submitting, and maintaining a computerized CPM (Critical Path Method) progress schedule using Primavera P6 software.
- B. The purpose of the computerized CPM progress schedule is to ensure timely completion of the contract and to establish a standard methodology for time adjustment analysis based on the principles of the Critical Path Method of Scheduling.
- C. For this specification, 'Engineer' means County authorized Construction Manager.
- D. The Contractor shall ensure that any and all computer files submitted to the Engineer are in a format that can be imported directly using Primavera P6 software, version 16.2 or later.
- E. The Contractor shall retain a CPM Consultant, approved by the Engineer, to assist in the development and preparation of the CPM schedule, and in subsequent schedule updating. The CPM Consultant shall have acceptable certifications such as AACE's Planning & Scheduling Professional (PSP), Project Management Institute's PMI-SP, or approved equal. The CPM Consultant is required to attend the Monthly Schedule Update Meetings. The Contractor is deemed to have included in the Bid price sufficient monies to pay all expenses required to develop the CPM Schedule and to guarantee its successful operation, implementation and maintenance.

1.2 DETAILS

- A. PRE CONSTRUCTION SCHEDULE MEETING
 - 1. The Engineer will schedule and conduct a Pre-construction Scheduling Meeting with the Contractor within ten (10) working days after the contract has been awarded. The requirements of this specification will be reviewed at this meeting. Additionally, the following topics will be discussed:
 - a. Specifics of any contract Time-Related Clauses.
 - b. The representation in the schedule of the Time Related work.
 - c. The calendar, activity coding, and resource definition requirements unique to and consistent with the contract.

- d. The Contractor's schedule methodology employed, proposed work sequence and any proposed deviations of sequences from the contract plans.
 - e. The factors that the Contractor determines to control the completion of the project and any milestone completions contained therein.
 - f. Narrative content for Initial Baseline and Monthly Updates.
 - g. Schedule submission protocol for Initial Baseline and Monthly Updates.
2. The Contractor's attendance at the Pre-construction Scheduling Meeting is mandatory. No field work will be allowed, with the exception of set up of the field office, until this meeting is held.

B. INITIAL BASELINE CPM CONSTRUCTION SCHEDULE

1. Within sixty (60) work days following the Notice to Proceed, the Contractor shall prepare and submit to the Engineer the Initial Baseline CPM Construction Schedule for the entire project. This submission shall include the electronic Schedule file and paper reports as required and approved by the Engineer.
2. The Initial Baseline Schedule must be cost and resource loaded and shall represent the Contractor's plan to construct the project. This schedule shall include all work and activities necessary to complete the project including but not limited to activities for the preparation, submittal, review, approval, fabrication, and delivery of all procurement related items. The Initial Baseline CPM Construction Schedule must be set up to conform to the staging/phasing and other requirements defined in or required by the contract.
3. The Initial Baseline Schedule shall meet all interim milestone dates and shall not extend beyond the contract completion date.

C. SCHEDULE REQUIREMENTS

1. The Contractor's Initial Baseline CPM Construction Schedule shall meet the following requirements:
 - a. CPM ACTIVITY NETWORK FORMAT - The schedule network shall use the Precedence Diagramming Method.
 - b. PROJECT DEFINITIONS - The following project specific properties within the schedule shall be defined:
 - 1) CALENDAR - All calendars created shall encompass and account for the total duration of the contract time period. The standard calendar shall be 8-hour days, five days per week and shall account for holidays and non-working days as defined in the Contract Documents. Additional calendars shall be created and included as required for:
 - a. Work week (5 or 6 day). (When or if the Contractor elects to utilize a 6-day work week he shall be responsible for the County's overtime costs as applicable by the Contract requirements)
 - b. Seasonal restrictions (asphalt, landscape, etc.).
 - c. Concrete curing/calendar days.
 - d. Shop drawing review.

- e. Any project specifics as required by the Engineer.
 - f. Expected and contemplated weather conditions shall be accounted for in the schedule and described in the narrative.
2. **ACTIVITY CODE-** As a minimum following activity codes shall be established:
- a. **Responsibility** - The party responsible for each activity. Only one party can be responsible for an activity. Include Values for "Nassau County Department of Public Works (NC)", "Prime Contractor" and third parties to the Contract as appropriate (utilities, etc.).
 - b. **Phase-** Phasing consistent with Contract plans where each activity is performed; Include Values for "None", and "Project Wide".
 - c. **Location** - Location of activity work by Stationing; Include Value for "None", and "Project Wide".
 - d. **Type-** The type of work for each activity; Include a Value for Administrative"
 - e. **Added Work-** Work added to the Contract and incorporated into the schedule with the Engineers Approval.
 - f. **As Required by Project** - Any coding unique to or as required by the Engineer to facilitate the use and analysis of the Schedule. This coding shall be established in consultation with the Engineer at the Pre-construction Scheduling Meeting.
3. **RESOURCES** - The Resource Dictionary shall be established as required by the Engineer. The Resource Dictionary shall be limited to Labor and Equipment. Labor may be represented by work crews. The composition of each crew must be detailed and included as an appendix to the Narrative Report. Sub-Contractors shall be represented as a labor crew(s).
4. **COST LOADING** – Basis of cost loading will be the approved Schedule of Values.
5. **ACTIVITY DATA**
- a. **ACTIVITY IDENTIFICATION** - Each activity shall have a unique identifier. The identifier may be alpha-numeric, but at a minimum must be a unique number.
 - b. **ACTIVITY DESCRIPTION** - Each activity shall be unambiguously described. Descriptions such as "construct 30% of Y" are unacceptable. Activities shall be discrete to the extent necessary to accurately schedule the work.
 - c. **ACTIVITY DURATION** - Durations of individual work activities shall not exceed twenty (20) working days. The minimum activity duration increment is one full day. Durations of individual shop drawing review activities may exceed fifteen working days and shall be consistent with Contract Requirements. Exceptions to this will be reviewed by the Engineer on an activity-by-activity basis. If requested by the

Engineer, production rates or other supporting information shall be supplied justifying the reasonableness of any given activity time duration. A Method Statement including the labor, equipment, production rates and any additional information, required to achieve a given activity shall be supplied within 5 working days when requested by the Engineer.

- d. **ACTIVITY RELATIONSHIPS** – Activity relationships shall be finish-to-start with no lags unless directed otherwise by the Engineer. Contractor requests for exemptions will be made on a case by case basis. Each activity with the exception of the required “Project Notice To Proceed” and “Completion” activities shall have a predecessor and a successor activity relationship.
- e. **ACTIVITY START and FINISH DATES** - The earliest start date, earliest finish date, latest start date, and latest finish date shall be calculated for each activity.
- f. **ACTIVITY TOTAL FLOAT** - The total float shall be calculated for each activity. Total float is the full amount of time by which the start on an activity may be delayed without causing the project to last longer.
- g. **ACTIVITY CALENDARS** - The appropriate calendar assignment shall be made to each activity
- h. **ACTIVITY CODES** - Coding shall be assigned to each activity from the defined activity dictionary. Each code shall have a value assigned in a given activity.
- i. **ACTIVITY CONSTRAINTS** - The start or completion of any activity shall not be constrained. Exceptions to this must receive prior approval in writing by the Engineer. A “Must-Finish-By” Date for the overall project is a constraint and must be pre-approved by the Engineer.
- j. **ACTIVITY RESOURCES**- The schedule shall be “Resource” loaded as required by the Engineer. The resources required to accomplish each activity shall be assigned to that activity from the ‘Resource Dictionary”

- 6. **REQUIRED ACTIVITIES** - The following activities shall be incorporated into the Schedule:

<u>Activity ID</u>	<u>Activity Description</u>	<u>Activity Type</u>	<u>Logic Relationship</u>
000010	Contract “Notice to Proceed”	Start Milestone	No Predecessors to this First Schedule Activity
999999	Completion	Finish Milestone	No Successors to this Last Schedule Activity

- 7. **DATA DATE** - The Data Date and Project Start Date in the Initial Baseline Schedule shall be the NOTICE TO PROCEED DATE. The

Data Date for each Monthly Update shall be the first work day of the month.

D. REVIEW AND ACCEPTANCE OF THE INITIAL BASELINE CPM CONSTRUCTION SCHEDULE -

1. The Contractor shall submit to the Engineer the following items to facilitate review of the Initial Baseline CPM Construction Schedule:
 - a. Narrative- A statement explaining the general sequence of work in the Contractor's schedule, a detailed definition of the work on the Critical Path, a statement regarding the meeting of any Time Restrictive Clause dates, and the explanation of any other ambiguities in the schedule.
2. The following Activity Reports generated from the software shall be provided or as required and approved by the Engineer:
 - a. Critical Path Activity Sort - The activities that comprise the projects Critical Path. The list shall start with the first activity in the path and then ascend by Early Start date to the final activity in the path.
 - b. Time Related Activity Sort - For the activities necessary to complete the work within each specific Time Frame provision in the contract, shall be listed. The list shall start with the first milestone activity and then ascend by Early Start date to the final milestone activity in the network comprising each Time Frame period. Include a Critical Path activity sort for each specific Time Frame in the contract.
 - c. Constraint Activity Sort - Listing of Constrained Activities and type of constraint.
 - d. Listing of Calendars and Activity Coding incorporated in the Schedule
3. Electronic copies of the Initial CPM Construction Schedule shall be provided in format approved by the Engineer.
4. The Engineer will review the Initial Baseline CPM Construction Schedule and forward any comments, revisions, or requests to the Contractor. Within ten (10) work days of the Engineer's reply, the Contractor shall make adjustment to the Initial Baseline CPM Construction Schedule in accordance with the Engineer's comments and resubmit copies for review consistent with the above directives.
5. Upon final revisions, the Contractor shall submit electronic file copies of the Initial Baseline CPM Construction Schedule to the Engineer. A sort of activities scheduled to start (ES) & finish (EF) in the next update period shall be included. The Logic Diagram shall be submitted as directed by the Engineer. The final submission shall be submitted for approval within five (5) work days of the Contractor's receipt of the final comments by the Engineer.
6. Approval of the Initial Baseline CPM Construction Schedule by the Engineer shall not be construed to imply approval of any particular method or sequence of construction or to relieve the Contractor of providing sufficient materials, equipment, and labor to guarantee completion of the project in accordance with the Contract proposal, plans, and specifications. Approval shall not be construed to modify or amend the completion date. Completion dates can only be modified or amended by standard contractual means.

7. Failure to include in the Initial Baseline CPM Construction Schedule any element of work required for the performance of the Contract shall not excuse the Contractor from completing all work required within the completion date(s) specified in the contract.

E. SCHEDULE UPDATES

1. MONTHLY PROGRESS UPDATES

The Contractor shall update the schedule monthly. The schedule shall be updated to include all work and progress up to and including the last working day of the month. This will establish the "Data Date". The Monthly update shall detail progress based on actual dates of activities started and completed, the percent of work completed to date on each activity started but not yet completed and the status of procurement of critical materials. The updated schedule data shall be submitted in an electronic file format acceptable to the Engineer.

2. A Narrative Report is required for each update and shall provide the following information:

- a. Contractors transmittal letter to the Engineer stating the update period and schedule "Data Date".
- b. Work started, completed and ongoing during the update period by activity with "Actual Dates".
- c. Description of current Critical Path and any change from previous Critical Path.
- d. Any activities added or deleted and any proposed changes in Activity Logic (Engineer's approval in writing is required).
- e. Current Delays or Advancements
 - 1) Delayed or Advanced Activities.
 - 2) Proposed corrective action and schedule adjustments to address any Delays.
 - 3) Impact of Delays or Advancement on other activities (duration, ES, EF, LS, LF), milestone and completion dates.
 - 4) Impact of Delays or Advancement on the Critical Path.
- f. Outstanding Items that effect the schedule and status thereof (including but not limited to):
 - 1) Permits.
 - 2) Shop Drawings.
 - 3) Change Orders.
 - 4) Reviews of submittals.
 - 5) Approvals.
 - 6) Fabrication and Delivery.
- g. Scheduled Completion Date Status
 - 1) Contract Completion.
 - 2) Interim Milestones / Time Frame if any.

3. The following Activity Reports generated from the Software shall be provided:

- a. Current Critical Path Activity Sort
- b. Near Critical Activities Sort

- c. Report of Activities scheduled to start (ES) & finish (EF) in the next Monthly update period.
 - d. Any other "Report" as directed by the Engineer and/or as discussed in the pre-construction scheduling meeting.
4. The Monthly Progress Updates shall be submitted to the Engineer within five (5) work days of the "Data Date". The Engineer shall prepare a written response within five (5) work days of receipt of the Monthly Update approving, approving with comments, or returning for resubmission within five (5) work days.
 5. If the Contractor fails to comply with the Monthly Progress Update submission requirements the Commissioner reserves the right to withhold any or all Contract payments.
 6. Monthly Schedule Meetings and Reports
 - a. Monthly, on a date established by the Engineer prior to the Data Date, a CPM Progress Meeting will be held, at which time the schedule update will be reviewed. The meeting shall be attended by the Engineer and representative(s) of the Contractor including the scheduling consultant. The Contractor representative(s) at the meetings shall have the competence and authority to make any necessary decisions and their statement shall commit the Contractor to the agreed procedures, sequencing of Work, coordination and time schedules.
 - b. Prior to the meeting, the CPM scheduling consultant shall obtain, through any required means including Site meetings, the necessary information to update the CPM schedule to reflect progress to date and to update/revise the schedule for the balance of the Project. The updated schedule and draft narrative report shall be furnished to the Engineer at least 48 hours prior to the meeting and be distributed by the Contractor in hard copy at the meeting for review. To update the CPM schedule, the Contractor shall:
 1. Enter actual start and completion dates for those Activities started and/or completed during the previous reporting period
 2. For Activities in progress, indicate the Remaining Duration correlating to an accurate forecasted completion date and physical percentage complete to date (Percent Complete is to reflect the actual quantity of Work completed, and is separate from any actual or Remaining Duration calculation). Review, and revise as necessary, the network logic for the Remaining Duration of the Work from the update to the estimated completion date
 3. For Activities not yet started, review, and revise as required, the necessary Logic, the Durations of Work and the estimated start and completion dates
 4. Enter, for each applicable Activity, actual installed quantities information
 - c. The total Duration to be initially added to any schedule update reflecting the Change Order Activities from identification to the approval of any

specific change order shall be in approved by the Engineer and shall be incorporated into the monthly schedule update following the identification of the changed in Work. The forecasted construction Activities shall be logically tied to the appropriate predecessor and successor base Contract Activities and contain all of the required Logic, Duration, Coding and Resource/Cost Loading specified for the detailed CPM schedule activities.

- d. In the event the Contractor begins performance in the field of Extra Work during the update period, the monthly progress schedule update shall reflect the actual start date of the Work, and any predecessor Logic ties or restraints shall be broken in order to accurately forecast completion of the identified Extra Work Activity. This will allow for accurate forecasting of the successor Work Activities and completion Milestones.
- e. Default progress data provided from the scheduling system is not be allowed. Actual start and finish dates and Remaining Durations of Activities shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual start and finish dates on the CPM schedule shall match those dates provided from the Contractor's Daily Quality Control Reports. Failure of the Contractor to document the actual start and finish dates on the Contractor Daily Quality Control Report for every in-progress or completed Activity and ensure that the data contained on the Contractor Daily Quality Control Reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's submittal.
- f. Activities that have reported progress without predecessor Activities being completed (out-of-sequence progress) will not be allowed except on a case- by-case basis with the approval of the Engineer. A written explanation for each instance shall be included in the monthly submittal.
- g. The Contractor shall not constrain the schedule with artificial Logic ties and/or constraint dates and/or any other scheduling techniques that may distort the Activity Float and Total Float associated with the critical path Activities and the schedule in general.

F. TOTAL FLOAT OWNERSHIP

Total Float belongs to the Contract and shall not be considered as available for the exclusive use or benefit of either the County or the Contractor. Total Float is the number of days an activity may be delayed without extending the completion of either the project or an interim milestone. Float is available on a first-come, first-served basis to all identified "Responsible" parties in the schedule.

G. FLOAT MANIPULATION NOT PERMITTED

The Schedule shall not sequester float through such strategies as calendar manipulation, resource/labor manipulation or the extension of activity durations to fill up available float time. The Initial Baseline CPM Construction Schedule shall not attribute negative float to any activity.

H. CHANGES TO THE SCHEDULE

The Initial Baseline CPM Construction Schedule shall accurately reflect the manner in which the Contractor intends to proceed with the project. Changes to the schedule (the addition or deletion of activities, logic changes, and duration changes) shall be submitted in writing to the Engineer for approval and inclusion in the next Monthly Progress Update. The process of comparing the Schedule Update to Baseline shall be followed throughout the contract. Revision to any contract milestones, or contractually mandated schedule provisions will not be permitted without written authorization from the Engineer.

I. CRITICAL ACTIVITIES AND BASIS FOR TIME ADJUSTMENTS

The measure for Time Adjustments in the schedule shall be based on the criticality, and responsibility of the delay or advancement. Criticality is defined as the presence of the delayed or advanced activity on the projects Critical Path. The Critical Path is defined to be the longest continuous chain of activities through the schedule network that establishes the minimum overall duration in the absence of constraints in the program software. Time adjustment does not mean an extension of time for this Contract.

J. CHANGES TO THE CONTRACT

In the event a notice of a change to the Contract is received the Contractor shall notify the Engineer in writing within 10 (ten) calendar days of the effect of such change to the schedule. Change to the Contract includes, but is not limited to, extra work, change orders, work suspensions, changed condition, Value Engineering Change Proposal, etc. The effect of the change to the Contract on the projects Critical Path shall be stated. Any proposed revisions to the Schedule to incorporate the change to the Contract shall be stated. No changes shall be made to the Schedule without prior written approval of the Engineer. The approved changes shall be incorporated in the next Monthly Progress Update.

1.3 TIME IMPACT ANALYSIS

- A. This analysis will be performed by the Engineer (CM's scheduler) based on schedule updates as accepted in monthly schedule updates.
- B. Events, actions, and progress that cause delays or gains to the Project Schedule will be analyzed solely by the "Contemporaneous Period Analysis" method. The Contemporaneous Period Analysis evaluates delays or gains in the period in which it occurred. The analysis period for the purpose of this Specification shall be the period covered in each Monthly update to the schedule.
- C. Impact of delay will be evaluated at the completion of the project. However, an interim extension of time for payment purposes only may be granted by the Commissioner at his or her sole discretion at the end of contractual completion date.

1.4 RECOVERY SCHEDULES

A. General Provisions for Recovery Schedules:

1. When updated Progress Schedule indicates and the Engineer determines that the ability to comply with the Contract Times falls behind schedule due to delay attributed to the CONTRACTOR, the Contractor shall prepare and submit a Progress Schedule demonstrating responsible Contractor's plan to accelerate related work to achieve compliance with the Contract Times ("recovery schedule") for Engineer's acceptance.
- 2.
3. Submit recovery schedule within 10 work days after submittal of updated Progress Schedule where need for recovery schedule is indicated or include in next update as directed by the Engineer.

B. Implementation of Recovery Schedule:

1. At no additional cost to OWNER, do one or more of the following: furnish additional labor, provide additional construction equipment, provide suitable materials, employ additional work shifts, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract Times.
2. Item 1 above is also applicable when the Contractor is required to accelerate their Work to recover lost time
3. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action:

1. The Contractor's refusal, failure, or neglect to take appropriate recovery action, or the Contractor's refusal to submit a recovery schedule and take appropriate recovery action, shall constitute reasonable evidence that CONTRACTOR is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for OWNER to exercise remedies available to OWNER under the Contract Documents.

1.5 METHOD OF MEASUREMENT

The CPM (Critical Path Method) Progress Schedule will be measured for payment on a Lump Sum Basis.

1.6 BASIS OF PAYMENT

The lump sum price bid for the Critical Path Method Scheduling system shall include the cost of preparation and submission of the Initial Baseline Schedule and the preparation and submission of the monthly updates.

Payment will be made as follows:

- A. Upon submission of the Initial Baseline CPM Construction Schedule 20%
- B. Upon acceptance of the Baseline CPM Construction Schedule 20%
- C. The balance will be paid in equal monthly payments distributed over the Contract. These payments will be contingent on the submission of acceptable monthly updates. 60%
- D. No additional payment over and above the lump sum price bid will be made for addition or deletion of work, delays, or any other reason whatsoever.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

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SECTION 01313

PUBLIC RELATIONS AND COMMUNICATION

PART 1 GENERAL

1.1 SUMMARY:

- A. The Public Relations and Communications function is critical to the success of the Long Beach Water Pollution Control Plant Consolidation project. This function provides for a two-way dialogue between project leadership and project stakeholders including residents, commercial businesses, municipalities, and local elected officials. The Owner and Owner's Representative (Hazen-Arcadis PM-JV) will engage a Public Relations and Communications organization that will use multiple channels to educate and inform members of the public regarding project progress and activities that are anticipated to temporarily affect the local roadway network, public amenities, and neighborhood conditions while also informing project leadership about community concerns and suggestions for construction activities. The Contractor shall support the outreach function by providing daily or weekly progress updates, as needed, and notifying the Owner and its Representative of planned construction work in accordance with Section No. 01040 Regulatory Requirements and other applicable specifications; this schedule shall be disseminated by the Public Relations and Communications organization to the public through various outreach activities.

1.2 STANDARDS:

- A. The Contractor shall provide adequate notice of construction activities per Section No. 01040 Regulatory Requirements and as required by any permits obtained by the Contractor and communicate updates to the Owner and Owner's Representative in compliance with the guidelines specified herein so that the project team may perform the outreach activities.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 PUBLIC OUTREACH:

- A. The Contractor shall communicate and notify the Owner and its Representative of scheduled closures or limited access to roads, parks, and amenities and the anticipated duration of each, Project milestones, and Project construction-related activities that have the potential to affect the general public and/or residents in

proximity to the Project area. In addition, the Contractor shall work closely with the Owner, the Owner's Representative, and the Construction Manager to ensure that road closures are communicated to the Traffic Division of the City of Long Beach Police Department so that it may disseminate the information throughout the City. This Section applies to the following stages of the Project which include but are not limited: to the visible start of construction activities; traffic pattern changes; significant Project accomplishments, and construction completion.

- B. The Contractor shall be aware that outreach to the public is a critical component to the successful completion of the Project. In an effort to offset potential concerns with the Project, the Contractor is expected to provide daily or weekly construction progress updates, as needed, so that information can be shared with the public by the Public Relations and Communications organization contracted by the Owner's Representative.
- C. Initial Public Outreach: The Contractor shall be prepared to meet with Nassau County, appropriate Stakeholders, elected officials, and the general public within thirty (30) days following the issuance of the Notice to Proceed. The Contractor shall be prepared at the time of these meetings to discuss the construction means and methods, the detailed schedule of construction activities, the time periods of the day during which the work will occur, and how movement by motorists, and pedestrians will be accommodated. The Contractor must also relay to the project team any concerns expressed by the public so that informed decisions can be made regarding project execution and required communications on matters of concern to specific communities, businesses, or neighborhoods. This will all be coordinated with the Owner, the Owner's Representative, and the Construction Manager.

3.2 STAKEHOLDER COMMUNICATION:

- A. The Contractor shall assist with the public relations and communications effort by performing the following activities:
 - 1. Relay any complaints, concerns, and suggestions from the public that may arise during construction to the Owner and the Owner's Representative.
 - 2. Inform the Owner and the Owner's Representative of scheduled Construction Work that may impact the public, including but not limited to road and park closures.

For disruption to road access:

- a. At least two (2) weeks advance notification of any disruptive work or work-related closures so that the project team may relay the information to the affected emergency services providers, residents, businesses, and municipalities. As part of the notification, provide a

schedule indicating the duration of closure or detour to the Owner's Representative.

- b. Continue communication during the period of disruption with information on anticipated restoration to normal conditions.

3.3 MEDIA RELATIONS:

- A. All media inquiries, requests for interviews from local print or broadcast news media, trade magazines, or other media outlets must be referred to the Owner. The Owner will coordinate and respond to all media requests. The Contractor shall alert all project personnel about this policy and strictly adhere to it.

+ + END OF SECTION + +

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SECTION 01342

SAMPLES

PART 1 – GENERAL

1.1 GENERAL

- A. Submittal of Samples shall conform to the requirements of the General Conditions, Article GC 15, "Samples" and to procedures described in this Section.
- B. Samples and Shop Drawings which are related to the same unit of Work or Specification Section shall be submitted at the same time. If related, Shop Drawings and Samples are submitted at different times, they cannot be reviewed until both are furnished to the Engineer.

1.2 PROCEDURE

- A. Submission of Samples shall conform to all applicable provisions under Shop Drawing Submittal and Correspondence Procedure.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

++ NO TEXT ON THIS PAGE ++

SECTION 01355

HAZARDOUS MATERIALS CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

1. This section describes the minimum health, safety, and emergency response requirements for the activities at the site. Site activities may involve worker exposure to potentially hazardous materials.
2. Contractor shall implement health and safety criteria and practices sufficient to protect onsite personnel, the public, and the environment from physical and chemical hazards particular to each site.
3. The Contractor shall furnish all labor, materials, equipment, and incidentals to remediate any hazardous materials discovered during the performance of the work in this Contract.

B. References: Where conflicts arise between requirements of the regulatory requirements listed below, the most restrictive of the requirements shall be followed.

1. 29 CFR 1910 OSHA Standards; General Industry
2. 29 CFR 1910.120 OSHA Standards; Hazardous Waste Operations and Emergency Response
3. 29 CFR 1926 OSHA Standards; Construction Industry
6. 29 CFR 1919 OSHA Standards; Gear Certification
7. DOT Standards and Regulations 49 CFR 171 Hazardous Materials Regulations; General Information, Regulations, and Definitions
8. DOT Standards and Regulations 49 CFR 172 Hazardous Materials Tables and Military Standards
9. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, ACGIH
10. Guide to Occupational Exposure Values, ACGIH

C. Related Specifications

1. Section 01356, Safe and Healthful Working Conditions.

1.2 REMEDIAL ACTION FOR UNFORESEEN HAZARDOUS MATERIAL

- ###### A.
- When remedial action is necessary for unforeseen hazardous materials, the Engineer will submit the scope of work in writing to the Contractor. The Contractor shall then obtain proposals for the work, including prices, from three separate County approved certified hazardous material remediation specialists, and submit them in writing to the Engineer within ten (10) consecutive calendar days of receiving the scope of work. The Engineer may select one proposal and direct the Contractor to engage the selected remediation specialist as a Subcontractor.

Remediation work shall not commence until the Contractor receives written notice from the Engineer to proceed with the work. All remediation work shall be performed by the certified remediation specialist.

- B. Some of the remediation work may be critical to maintaining construction schedules. When this occurs, a time of completion shall be indicated in the scope of work submitted to the Contractor by the Engineer, and the work shall be subject to liquidated damages as set forth in the Agreement, Article XIV, "Liquidated Damages."
- C. Disposal of wastes generated by remediation work will be based on the results of the testing performed by the Contractor. Disposal of remediated hazardous material must be at a site approved by the County and applicable state agency to accept such waste. The Contractor shall notify the Engineer at least fourteen (14) days prior to removal of the containers of hazardous material to allow for inspection of the containers and the hazardous waste manifest.
- D. The Contractor shall submit written evidence that the receiving waste treatment, storage, or disposal facility to receive such waste is permitted by the EPA, DEC and State or local regulatory agencies. The Contractor shall coordinate with the PM/JV Site Safety Officer, who represents the County, and is authorized to sign hazardous waste manifests. The Contractor shall also submit copies of the complete manifest, signed by the PM/JV Site Safety Officer, and dated by the initial transporter, in accordance with Federal and State requirements. Completed and signed manifests from the treatment or disposal facility shall be provided to the PM/JV Site Safety Officer within seven (7) days of disposal.

PART 2 – PRODUCTS

2.1 HEALTH AND SAFETY PLAN

- A. The Contractor shall have a site-specific Health and Safety Plan (HASP) prepared, prior to the start of any construction. The HASP shall be available to workers on site and be submitted to the Engineer, PM/JV Site Safety Officer, and the County within 14 days following NTP. Copies of the plan shall be provided to the Contractor's insurers and their risk managers, if any, by the Contractor.
 - 1. The Contractor will abide by the work specific Health and Safety requirements as directed by the County.
 - 2. The provisions of the site HASP in no way relieves the Contractor of his primary obligation to provide for the safety of his employees and to ensure that all operations under this Contract are carried out to protect persons and property on the site and in the surrounding work area.
- B. These minimum health and safety requirements are based on the potential for physical, biological, and chemical hazards associated with work activities, including the potential exposure to hazardous materials that may be present. The

HASP shall be prepared by a Board of Safety Professionals Certified Safety Professional (CSP) who is qualified by training and experienced to perform this work. The CSP should be familiar with projects working on or over the water. The HASP shall be submitted to the Engineer, PM/JV Site Safety Officer, and the County for review. The purpose of the HASP is to establish site-specific health and safety requirements for protecting the health and safety of the Contractor and subcontractor personnel and visitors during all activities conducted on-site.

1. Construction activities which need to be addressed in the HASP include, but are not limited to:
 - a. Soil excavation and grading.
 - b. Demolition.
 - c. Paving
 - d. Installation of equipment
 2. The HASP shall include as a minimum the following items tabulated in Paragraph 2.1.E through Paragraph 2.1.S, below.
- C. The Contractor shall identify an individual who shall serve as the Site Safety Representative for this project. The individual shall:
1. Have a working knowledge of pertinent federal, state, and local health and safety regulations, program development and implementation, and air monitoring techniques.
 2. Be knowledgeable in tank cleaning procedures and protocols required by this project.
 3. Be certified as having completed training in first aid and CPR by a recognized, approved organization, such as the American Red Cross.
 4. Be continuously onsite during all operations covered by this Contract.
 5. Be familiar with the Site Health and Safety Plan and its requirements and be responsible for the Plan's implementation.
 6. The Site Safety Officer may designate an alternate to assist him/her, provided the alternate meets all of the above requirements. The Contractor shall submit the name, qualifications (education summary and documentation), and work experience of the Site Safety Officer, and any alternates to the Engineer and PM/JV Site Safety Officer prior to commencement of work at the site.
- D. Personnel Qualifications (CSP): The Contractor shall identify an individual who shall serve as the CSP for this project. This individual shall:
1. Have a minimum of three (3) years experience in the excavation, demolition, or hazardous waste field.
 2. Be familiar with all applicable OSHA, USEPA, and NYSDEC standards.
- E. Standards and Regulations: The HASP shall be developed in accordance with the Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926) and all pertinent laws, rules, and regulations existing at the time of the work, including, but not limited to:
1. Hazardous Waste Management System, Title 40 CFR 261-264.

2. OSHA Standards, Hazardous Waste Operations and Emergency Response, Title 29 CFR 1910.120(q).
 3. OSHA Standards, Asbestos Regulations, Title 29 1910.1001.
 4. OSHA Standards, Subpart Z, Toxic and Hazardous Substance, Title 29 CFR 1926.1100.
 5. OSHA Standards, Title X, Lead in Construction, 1926.62.
 6. EPA National Emission Standard for Hazardous Air Pollutants, National Emission Standard for Asbestos, Title 40 CFR, Part 51, Subpart M.
 7. OSHA Standards, Hazard Communication, Title 29 CFR 1926.59.
 8. OSHA Standards, Access to Employee Exposure and Medical Records, Title 29 CFR 1910.1020.
 9. OSHA Standards, Personal Protective Equipment, Title 29 CFR 1910.132.
 10. OSHA Standards, Record Keeping, Title 29 CFR 1904.
 11. OSHA Standards, Respiratory Protection, Title 29 CFR 1910.134.
 12. The American National Standard Institute (ANSI) Practices for Respiratory Protection, ANSI Z88.2.
 13. OSHA Standards, Ventilation, Title 29 CFR 1910.94.
 14. ANSI Fundamentals Governing the Design and Operation of Local Exhaust System, ANSI Z9 2.
 15. Hazardous Waste Management System, Title 6 NYCRR Parts 370-373.
 16. Asbestos Safety Program Requirements, NYCRR Chapter 11, Title 10, Part 73.
 17. Industrial Code Rule 56, NYCRR Title 12, Part 56.
 18. Transportation Act, Title 49 CFR Parts 106, 107, 171-179.
 19. New York State Solid Waste Hauling and Disposal Regulations, NYCRR Title 6, Parts 360 and 364.
 20. New York State Department of Labor Part 23 Protection in Construction, Demolition and Excavation Operations.
- F. Identification of Key Health and Safety Personnel and Alternates:
1. List key personnel and alternates for site health and safety on a project responsibility chart, which includes phone numbers.
 2. Identify roles and responsibilities of key personnel.
- G. Project Task/Operation Health and Safety Risk Analysis (Job Safety/Hazard Analysis, JHA)
1. Identify and describe the project tasks.
 2. Provide a hazard assessment of each project task, which shall include descriptions of potential chemical, biological, and physical hazards associated with the performance of the activity.
 3. Provide a description of health and safety mitigative actions for each project task which shall include, but not be limited to, first, administrative controls, second, engineering controls, third, safe work practice controls and Lastly, personal protective equipment.

H. Personnel Training Requirements:

1. Confirm that personnel are trained to conduct their job responsibilities and handle the specific hazardous situations they may encounter during the project.
 2. Provide, as required, certification of personnel training and First Aid/Cardio-Pulmonary Resuscitation (CPR).
 3. Establish procedures and training for Hazard Communication Program in accordance with 29 CFR 1910.1200.
 4. Provide information regarding training and experience of the person who will oversee excavation activities and be responsible as the project's OSHA defined Competent Persons(s).
 5. Provide copies of training cards demonstrating that employees have completed the OSHA 10 Hour Construction Safety Course.
- I. Personnel Protective Equipment (PPE) and PPE Reassessment Program:
1. Describe the protective clothing and equipment to be worn by personnel during task-specific operations of the project
 2. Describe the PPE reassessment program for the upgrading/downgrading of PPE levels associated with the task-specific operations of the project.
 3. Provide a written respiratory protection program and reassessment program, which shall be implemented during task-specific operations. The written program must include the procedure for proper selection and use of respirators, instructions on proper cleaning, storage, and inspection of respirators.
- J. Medical Surveillance:
1. Describe the program for medical monitoring for each task-specific activity.
 2. Confirm and provide documentation, as applicable, that all project personnel are currently under a medical surveillance program.
 3. Provide documentation, as applicable, that all project personnel have respiratory clearance.
- K. Site Control Measures:
1. Define site control methods, site communications, and include a site map delineating the control areas, if appropriate.
 2. Delineate the work area, including an exclusion zone (EZ), contamination reduction zone (CRZ) and the support zone, and describe the activities allowed in each zone.
- L. Engineering Control Measures:
1. Identify methods to control the generation of airborne particulates and volatile organic vapors during excavation of potentially contaminated soils.
 2. Identify engineering control of generation of lead-containing airborne particulates when impacting materials coated with lead paint.
 3. Identify engineering controls (e.g., tent enclosure, wetting of surfaces) to control generation of dust when conducting dust-generating activities indoors (e.g., demolition of concrete foundations).

M. Decontamination Program:

1. Establish decontamination procedures for personnel and equipment.
2. The decontamination plan shall include provisions for hand wash facilities, and lunch/break areas, and a description of proper housekeeping practices.

N. Air Monitoring Program:

1. Describe the area air monitoring program to be conducted during all intrusive site work, soil handling, and below-grade equipment installation, when workers may be exposed to potentially contaminated soil. Minimum air monitoring requirements must include continuous real time measurements for oxygen, hydrogen sulfide, carbon monoxide, and LEL (methane).
2. Describe the area air monitoring program to be conducted during equipment removal and demolition affecting materials coated with lead paint when airborne dust may be generated.
3. The air monitoring programs shall identify the analytical methodology required for each task-specific activity to ensure regulatory compliance.

O. Emergency Response/Contingency Plan:

1. Describe instruction and procedures for evacuation of personnel.
2. Describe instructions and procedures for methods of reporting fires. If the Contractor will be conducting activities such as welding, hot cutting or burning, grinding, or working with flammable materials such as paints, glues, and solvents, or any activity that could cause sparks, the Contractor shall provide a minimum of two Class ABC fire extinguishers (minimum 10 pounds) in the work area. The Contractor shall obtain an off-site "Hot Works Permit" from the PM/JV Site Safety Officer and submit copies to him/her upon daily verification of completion of hot work activities.
3. Describe instructions and procedures for medical emergencies, including emergency notification and response procedures and a description of the route to the hospital.
4. The medical emergency contingency plan shall include provisions for a minimum of two first aid kits (minimum 24-unit industrial first aid kit).
5. Describe procedures addressing emergencies and equipment failures and barrier failures during work activities.

P. Surveillance Methods:

1. Describe safety surveillance methods.
2. Provide schedules of both walk-through surveys and in-depth safety audits to be performed on site.

Q. Safety Inspection Sheets:

1. Provide safety inspection check lists to be used on a daily basis in evaluation of the site work and methods.

R. Safety Evacuation Drill: A quarterly evacuation drill shall be held in coordination with the Plant alarm signal under the control of the Plant Chief. Conducting the safety drill shall be coordinated during regular scheduled work hours and timed to

minimize disruption of major Contract work. Upon evacuation, the Contractor shall immediately notify the PM/JV Site Safety Officer that all personnel have evacuated.

- S. Accident Prevention: An Accident Prevention Plan and description of work-phase safety plan shall be developed and written by the CSP. Each phase of the Accident Prevention Plan shall include a description of the work activity, probable hazards related to the work, and positive precautionary measures to be taken to safeguard against and reduce or eliminate each particular hazard. In the event of an accident/injury, the Contractor shall immediately notify the PM/JV Site Safety Officer. Within two working days of any accident or incident, the Contractor shall complete and submit to the PM/JV Site Safety Officer an Accident (Incident) Report.
- T. The Unforeseen Hazardous Material Remediation allowance provided in Section 01020, Allowances is intended to cover only those extra costs incurred by the Contractor in meeting County directed health and safety or remedial action requirements. It is not intended to fund the Contractor for the hiring of his own consultants nor to fund the costs of the Contractor meeting obligations under OSHA.

PART 3 – EXECUTION

3.1 HAZARDOUS MATERIALS

- A. There may be materials present at the project site that may pose chemical hazards to site workers during construction activities.
- B. The Contractor shall be responsible for identifying suspect hazardous materials as they are encountered. Indication of the presence of hazardous materials, including odorous or stained soils and liquids, shall be immediately reported to the Engineer. If it is determined that the presence of hazardous material is not a threat to the health and safety of County to Contractor personnel, the Contractor shall continue planned work activities. Otherwise, the Contractor will be directed to take additional health and safety precautions as appropriate.
- C. All non-disposable equipment that has been in contact with contaminated soils, lead-containing debris, or other hazardous materials, shall be cleaned prior to leaving the site. Equipment decontamination shall be performed in an area to be directed by the Engineer. The Contractor shall be responsible for containing all procedures within the perimeter of the designated decontamination area.
 - 1. The solid materials and rinse water collected as the result of the decontamination procedures shall be stored in appropriate containers on-site

prior to disposal. Disposal of the wastes will be based on the results for testing performed by the Contractor and will be classified as non-hazardous or hazardous waste.

2. Rinse water that does not meet the criteria for discharge to a POTW shall be disposed of at an appropriate treatment and/or disposal facility. Payment for disposal of the decontamination wastes shall be made from the Hazardous Materials Remediation Allowance item as described in Section 01020, Allowances

3.2 MEDICAL SURVEILLANCE

- A. Physical examinations for personnel working onsite shall be provided prior to project start-up. The examinations shall address the chemical and physical hazards to which the employees will be exposed. The medical examination results shall be evaluated by a physician practicing occupational medicine to determine that the individual is medically qualified to wear a respirator and is physically fit for the work to be performed. The physician must certify that no physical condition or disease could be aggravated by exposure to the identified hazards. The results of the medical surveillance program shall be provided to the Engineer upon request.

3.3 PERSONNEL TRAINING

- A. Personnel employed to sample tank residuals, perform hazardous materials remediation, and supervisors shall be trained and thoroughly familiar with the safety precautions, procedures, and equipment required for controlling the potential hazards associated with this project. This training shall be documented in detail and recorded in the project's records.

3.4 FIRST AID AND EMERGENCY RESPONSE EQUIPMENT AND PROCEDURES

- A. The Contractor shall provide for appropriate emergency first aid equipment (including ANSI-approved eye wash stations, a portable stretcher/Stokes basket, and an industrial-type first aid kit) suitable for treatment of exposure to site physical and chemical hazards. Additionally, two ABC-rated fire extinguishers shall be maintained on site as well absorbent material of sufficient quantity to collect any spill which might occur during this project. A listing of emergency phone numbers and of contact for fire, hospital, police, ambulance, and other necessary contacts shall be posted at the Contractor's site. A route map detailing the directions to the nearest land hospital also shall be posted (and kept on the vessel as well, i.e., transport by vessel to Long Beach Hospital's Reynolds Channel emergency pier).

3.5 HEAT AND COLD STRESS

- A. The Contractor shall monitor all personnel for signs of heat or cold stress, as dictated by weather conditions. In addition, all field personnel shall be instructed to observe for symptoms of heat or cold stress in themselves and fellow workers

and methods to control them. The Contractor shall adhere to guidelines provided in the Threshold Limit Values and Biological Exposure Indices published by the ACGIH for heat and cold extremes.

3.6 ILLUMINATION

- A. Work areas shall be illuminated to a minimum of 10 foot-candles. Lighting shall be sufficient to determine whether material spills have occurred.

3.7 ELECTRICAL SAFETY

- A. All electrical services must be grounded and cord and plug equipment shall be used with ground fault circuit interrupter (GFCI) protected outlets. Where applicable, portable lights shall be suitable for hazardous locations and shall be connected to extension cords equipped with connectors or switches approved for hazardous locations. Such equipment, when used, shall be inspected to ensure it will not be a source of ignition. All air monitoring instrumentation shall be rated as intrinsically safe for Class I, Division I, Group D atmospheres.

3.8 SITE CONTROL AND WORK ZONES

- A. Personnel not directly involved with this project shall not be permitted to enter the work zone. For purposes of this Contract, the "Work zone" and Contractor's staging areas shall be the areas as shown on the drawings. The initial minimum level of PPE shall be in accordance with these Specifications. The boundary of the work zone shall be demarcated and posted clearly by the Contractor.

3.9 EXCAVATION SAFETY

- A. All demolition and excavating work shall be conducted in strict conformance with, at a minimum, 29 CFR 1926.650 through 29 CFR 1926.653, including requirements for sloping or shoring found in 29 CFR 1926.652. If the excavation must remain open during periods when the work site is unoccupied (i.e., overnight, over a weekend, and other similar off periods) barricades shall be placed around the excavation in such a manner to alert personnel to the danger and prevent them from falling into the trench (i.e. using road plates and barriers.)

3.10 COVID PROTECTION PLAN

- A. The Contractor shall provide a plan to protect employees and visitors from the hazards of COVID 19. The plan shall include daily checklists to confirm employees do not show symptoms of COVID 19, have not been exposed to others who have either tested positive or show symptoms, or have travelled outside of the local areas. The plan shall also address visitors who infrequently visit the Plant and how to track their information as well.

3.11 CONFINED SPACE ENTRY

- A. If any person is required to enter the or vault or an excavation greater than 4 feet, it is considered a confined space entry. Medical surveillance shall ensure that the worker is capable of entering a confined space. Workers required to enter confined space shall have the specialized training required under 29 CFR 1926 Subpart AA - Confined Spaces in Construction

3.12 EATING, DRINKING, SMOKING

- A. No eating, drinking, smoking, chewing tobacco or gum, or other hand-to-mouth activities shall be permitted in any of the work areas during the course of this project.

3.13 IGNITION SOURCES

- A. Ignition sources (e.g., cigarette lighters, matches, or other flame producing items) not required for the completion of the project, shall not be permitted in the work zones. Before any work is done that might release vapors, work areas shall be barricaded and posted, and burning or other work shall be eliminated from the area where flammable vapors may be present or may travel. No work shall be done if the direction of the wind might carry vapors into areas where they might produce a hazardous condition, or when an electrical storm is threatening the site of work. Sparks caused by friction of electrostatic effects also may be a source of ignition in flammable atmospheres, especially at low humidity. Proper grounding of metal objects and/or electrical equipment, together with the use of sparkless tools and localized adjustment of humidity, may reduce this hazard.

3.14 BREAK AREA AND SUPPORT ACTIVITIES

- A. All eating, drinking, smoking, and break facilities, as well as the Contractor's equipment storage, parking, and office shall be located outside the work zones as determined by the Contractor's Site Safety Representative and approved by the Engineer.

3.15 SANITATION

- A. The Contractor shall ensure that all onsite personnel have ready access to soap and clean water for washing and toilet facilities.

3.16 UNFORSEEN HAZARDS

- A. Should any unforeseen or site-specific safety-related threat, hazard, or condition become evident during the performance of work at this site, it shall be the Contractor's responsibility to bring such conditions to the attention of the Engineer both verbally and in writing as quickly as possible, for resolution. In the interim,

the Contractor shall take prudent action to establish and maintain working conditions and to safeguard employees, the public, and the environment.

3.17 SILICA

- A. The plan shall address the hazards of silica in accordance with OSHA 29 CFR 1926.1153 - Respirable crystalline silica. Select controls according to a hierarchy that emphasizes engineering solutions (including elimination or substitution) first, followed by safe work practices, administrative controls, and finally personal protective equipment. Avoid selecting controls that may directly or indirectly introduce new hazards.

3.18 TERMINATION

- A. Any disregard for the provisions of these Specifications shall be deemed just and sufficient cause for termination of the Contractor or any Subcontractor without compromise or prejudice to the rights of the Contractor.

+ + END OF SECTION + +

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SECTION 01356

SAFE AND HEALTHFUL WORKING CONDITIONS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for safe and healthful working conditions.

1.2 RELATED SPECIFICATIONS

- A. Section 01355, Hazardous Materials Control

1.3 PAYMENT

- A. No separate payment for the item "Safe and Healthful Working Conditions" will be made. The costs of same will be included in the Base Bid.

1.4 DEFINITIONS

- A. Safety staff shall mean the safety professional and his safety representative(s) or the safety person.

1.5 SPECIAL CONDITIONS

- A. In prosecuting the work of this Contract, the Contractor shall provide working conditions on each operation that shall be as safe and healthful as the nature of that operation permits. The various operations connected with the work shall be so conducted that they will not be unsafe or injurious to health; and the Contractor shall comply with all regulations and published recommendations of the New York State Department of Labor and all provisions, regulations and recommendations issued pursuant to the Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended, and with laws, rules, and regulations of other authorities having jurisdiction, with regard to all matters relating to safe and healthful working conditions. Compliance with governmental requirements is mandated by law and considered only a minimum level of safety performance. All work shall also be performed in accordance with safe work practice.
- B. The Contractor shall be responsible for the safety of the Contractor's employees, the public and all other persons at or about the site of the work. The Contractor shall be solely responsible for the adequacy and safety of all construction methods, materials, equipment and the safe prosecution of the work.
- C. The Contractor shall employ a Board of Safety Professionals (BCSP) Certified Safety Professional (CSP) familiar with all work under this contract whose duties shall be to initiate, review and cause implementation of measures for the protection

of health and prevention of accidents. The Contractor shall also employ full- time safety representative(s) whose sole duties shall be to work under the direct supervision of the safety professional, to implement the safety program for the work under this Contract.

- D. The safety staff shall be provided with an appropriate office on the job site to maintain and keep available safety records, up-to-date copies of all pertinent safety rules, regulations and governing legislation, material safety data sheets, and the site safety plan including information concerning foreseeable emergency conditions, location of emergency and telephone contacts for supportive actions.
- E. The Contractor shall stop work whenever a work procedure or a condition at a work site is deemed unsafe by the safety staff.
- F. The Contractor and subcontractors shall be required to issue Photo Identification badges for each employee required to be on site. Badge shop drawings and updated logs showing employee names and badge numbers shall be issued to the Engineer for approval.

1.6 SUBMITTALS

- A. The Contractor shall submit a Health and Safety Plan (HASP) as described in Section 01355, Hazardous Materials Control.
- B. Within 30 days of receiving a Notice to Proceed, the Contractor shall submit the name of a CSP, employed by the Contractor, responsible for project safety management, and of the safety representative(s) who will work under his direction.
- C. A resume, along with other qualifications, of the CSP and the safety representative(s), must be submitted to the Engineer for review and approval. The resume shall include such items as: experience, education, special safety courses completed, safety conferences attended and certification and registrations. Documentation and/or personal references confirming the qualifications may also be required. The persons proposed as safety person, safety professional or safety representative(s) may be rejected by the Engineer for failure to have adequate qualifications or other cause.

1.7 QUALIFICATIONS

- A. CSP: Recognition as a safety professional shall be based on a minimum of: Certification by the Board of Certified Safety Professionals as a Certified Safety Professional and five years of professional safety management experience in the types of construction and conditions expected to be encountered on the site.
- B. Safety Representative: Qualifications of the safety representative(s) shall include a minimum of: five years of relevant construction experience, three years of which were exclusively in construction safety management, successful completion of a 8

Hour OSHA Hazardous Waste Operations course that addresses 29 CFR 1910.120(q), and Confined Space training.

- C. The safety staff shall be completely experienced with and knowledgeable of all applicable health and safety requirements of all governing laws, rules and regulations as well as of good safety practice. The safety staff shall not include the project manager, engineer, or superintendent, or anyone else working on the project. The safety staff shall have no other duties except those directly related to safety.

PART 2 – PRODUCTS

2.1 HEALTH AND SAFETY PLAN

- A. The Contractor shall commit to writing a specific site health and safety plan before the start of any construction in accordance with Section 01355, Hazardous Materials Control.

2.2 ACCIDENT REPORTS

- A. The Contractor shall promptly report to the Engineer and the PM/JV Site Safety Officer all accidents involving injury to personnel or damage to equipment and structures, investigate these accidents and prepare required reports and submit a monthly summary of these accidents. The Contractor must submit a preliminary accident report to the Resident Engineer and the PM/JV Site Safety Officer by the following day at the latest.
 - 1. The summary report, due by the 10th day of the following month, shall include descriptions of corrective actions to reduce the probability of similar accidents.
 - 2. In addition, the Contractor shall furnish to the Engineer a copy of all accident and health or safety hazard reports received from OSHA or any other government agency within one day of receipt.
- B. In addition to the reports which the Contractor is required to file under the provision of the Workmen's Compensation Law, he shall submit to the Engineer on or before the tenth day of each month a report giving the total force employed on his Contract in man-days during the previous calendar month, the number and character of all accidents resulting in loss of time or considered recordable by OSHA, and any other information on classification of employees, injuries received on the work, and disabilities arising therefrom that may be required by the Engineer.
 - 1. The submittal shall also contain an audit report for the prior month, including the safety training conducted, the above equipment logs, records of the condition of the work areas, safety and health records, OSHA and ANSI Z16.1 incidence rates for frequency and severity of recordable accidents, and an evaluation of the effectiveness of the HASP with any changes necessary.

2. The CSP or Safety Representative and the Contractor shall sign this audit report. The Engineer will review these reports for Contractor's compliance with the safety provisions of the Contract.

2.3 SAFETY AND RESCUE EQUIPMENT

- A. The Contractor shall have proper safety and rescue equipment, adequately maintained and readily available, for any foreseeable contingency. This equipment shall include such applicable items as: proper fire extinguishers, first aid supplies, safety ropes and harnesses, stretchers/Stokes basket, water safety devices, oxygen breathing apparatus, resuscitators, gas detectors, oxygen deficiency indicators, combustible gas detectors, etc.
- B. This equipment should be kept in protected areas and checked at scheduled intervals. A log shall be maintained indicating who checked the equipment, when it was checked, and that it was acceptable. This equipment log shall be updated monthly and be submitted with the monthly report. Equipment that requires calibration shall have copies of dated calibration certificates on site.
- C. Substitute safety and rescue equipment must be provided while primary equipment is being serviced or calibrated.

2.4 PROTECTIVE EQUIPMENT

- A. All personnel employed by the Contractor or his subcontractors or any visitors whenever entering the job site shall be required to wear appropriate personal protection equipment required for that area. The Contractor shall continuously provide all necessary personal protective equipment as requested by the Engineer for his designated representatives.

2.5 IDENTIFICATION BADGES

- A. The Contractor shall submit shop drawings of Identification Badge to the Engineer for approval.

2.6 HOT WORK PERMIT

- A. All hot work shall be in accordance with NFPA 51B.
- B. The Contractor shall complete and submit the Nassau County Hot Work Permit included in this Section as Attachment 01356-A, located after the "End of Section" designation.

PART 3 – EXECUTION

3.1 SAFETY STAFF DUTIES

- A. The CSP shall visit and audit all work areas as frequently as necessary (a minimum of once a week) and shall be available for consultation whenever necessary. The safety staff shall have full authority to implement and enforce the health and safety plan to take immediate action to correct unsafe, hazardous or unhealthful conditions.
- B. A member of the safety staff must be at the job site full time (a minimum of 8 hours per working day) whenever work is in progress. When multiple shift work is in progress more than one safety representative may be required.
- C. The safety staff shall as a minimum:
 - 1. Schedule and conduct safety meetings and safety training programs as required by law, the safety plan, and good safety practice. A specific schedule of dates of these meetings and an outline of materials to be covered shall be provided with the safety plan. The Engineer shall be advised in advance of the time and place of such meetings. County personnel shall be invited to attend the meetings. All employees shall be instructed on the recognition of hazards, observance of precautions, of the contents of the safety plan and the use of protective and emergency equipment.
 - 2. Determine that operators of specific equipment are qualified by training and/or experience before they are allowed to operate such equipment.
 - 3. Develop and implement emergency response procedures. Post the name, address and hours of the nearest medical doctor, name and address of nearby clinics and hospitals, and the telephone numbers of the appropriate ambulance service, fire, and the police department.
 - 4. Post all appropriate notices regarding safety and health regulations at locations, which afford maximum exposure to all personnel at the job site.
 - 5. Post appropriate instructions and warning signs in regard to all hazardous areas or conditions, which cannot be eliminated. Identification of these areas shall be based on experience, on site surveillance, and severity of hazard. Such signs shall not be used in place of appropriate workplace controls.
 - 6. Ascertain by personal inspection that all safety rules and regulations are enforced. Make inspections at least once a shift to ensure that all machines, tools and equipment are in a safe operating condition; and that all work areas are free of hazards. Take necessary and timely corrective actions to eliminate all unsafe acts and/or conditions, and submit to the Engineer each day a copy of his findings on the inspection check list report forms established in the safety plan.
 - 7. Submit to the Engineer, copies of all safety inspection reports and citations from regulating agencies and insurance companies within one working day of receipt of such reports.
 - 8. Provide safety training and orientation to authorized visitors to ensure their safety while occupying the job site.
 - 9. Perform all related tasks necessary to achieve the highest degree of safety that the nature of the work permits.

3.2 VISITORS

- A. All non-County personnel visitors that visit and tour the site shall sign the Visitors Log at the Plant's Administration Building, and sign waivers as directed by the County. The Resident Engineer must be aware of all tours/visits in conjunction with the Safety Evacuation Plan Protocol notification. All efforts should be made not to schedule site tours/visits at the time of scheduled evacuation drills.

+ + END OF SECTION + +

SECTION 01370

SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Submit a Schedule of Values allocated to the various portions of the work, within 21 days after the effective date of the Agreement.
- B. Upon request of the Engineer, support the values with data which will substantiate their correctness.
- C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

1.2 RELATED REQUIREMENTS

- A. General Conditions of the Construction Contract

1.3 FORM AND CONTENT OF SCHEDULE OF VALUES

- A. Type schedule on an 8-1/2-in by 11-in or 8-1/2-in by 14-in white paper furnished by the Owner; Contractor's standard forms and automated printout will be considered for approval by the Engineer upon Contractor's request. Identify schedule with:
 - 1. Title of Project and location.
 - 2. Engineer and Project number.
 - 3. Name and Address of Contractor.
 - 4. Contract designation.
 - 5. Date of submission.
- B. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Identify each line item with the number and title of the respective Section.
- D. For each major line item list sub-values of major products or operations under the item.
- E. For the various portions of the work:

1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.
2. For items on which progress payments will be requested for County approved stored materials, break down the value into:
 - a. The cost of the materials, delivered and unloaded, with all taxes paid.
Paid invoices are required for materials upon request by the Engineer.
 - b. The total installed value.

F. The sum of all values listed in the schedule shall equal the total Contract Sum.

1.4 SUBSCHEDULE OF UNIT MATERIAL VALUES

- A. Submit a sub-schedule of unit costs and quantities for:
 1. Products on which progress payments will be requested for County approved stored products.
- B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.
- C. The unit quantity for bulk materials shall include an allowance for normal waste.
- D. The unit values for the materials shall be broken down into:
 1. Cost of the material, delivered and unloaded at the site with all taxes paid.
 2. Copies of invoices for component material shall be included with the payment request in which the material first appears.
 3. Paid invoices shall be provided with the second payment request in which the material appears or no payment shall be allowed and/or may be deleted from the request.
- E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

* * * * *

SECTION 01400

PROTECTION OF UTILITIES

PART 1 – GENERAL

1.1 WORK INCLUDES

- A. Work includes all labor, materials, equipment and incidentals required to mark out and protect all public or private utilities, including concrete encased piping, within or adjacent to the Contract area.
- B. The Contractor is specifically directed to become familiar with the existence of aerial, surface or subsurface structures of municipal and other public or private service corporations within the construction site.
- C. A careful search has been made, in good faith, and known public or private utilities within or adjacent to the Contract area are shown in their approximate locations on the Contract Plans. However, there is no guarantee that all existing utilities have been found. All utilities may not be shown on the Contract Drawings.
- D. The Contractor's attention is also directed to the fact that during the life of the plant, the City of Long Beach and operators of utilities may make changes in their facilities.
- E. The Contractor shall determine the exact locations and elevations of all pertinent structures, utilities and facilities before construction work and new installations commence.
- F. Conflict between existing structures, utilities and facilities and new work shall be ascertained by the Contractor and called to the attention of the Engineer.
- G. The Contractor shall cooperate with the County and public utility corporations whose structures (aerial, surface or subsurface) are within the limits of or along the outside of the construction areas to make it possible for them to maintain uninterrupted service.
- H. The Contractor shall conduct operations in such a way as to delay or interfere as little as practicable with the work of utility corporations.
- I. The Contractor shall give the County and public utility corporations involved reasonable notice, but not less than 48 hours in advance of operations, which may or will affect their structures.
- J. The Contractor shall protect, in a suitable manner, all utilities encountered, including concrete encased piping, and shall repair any damage to structures, utilities and facilities caused by operations.
 - 1. If the nature of the damage is such as to endanger the satisfactory functioning

of the utilities and necessary repairs are not immediately made by the Contractor, the work may be done by the respective owning companies and the cost thereof charged against the Contractor.

- K. The Contractor shall take these conditions into consideration in making up the bid.
- L. It is understood and agreed that the Contractor has considered in his bid all of the permanent and temporary utility appurtenances and that no additional compensation will be allowed for any delays, inconveniences or damage sustained by him due to any interference from the utility appurtenances.

1.2 PUBLIC AND PRIVATE UTILITY MARKOUTS

- A. The Contractor shall be required to provide utility markouts for all private and public utilities. The limits for these markouts shall be the project limit shown on the Engineering Drawings. The Contractor shall submit the proposed utility subcontractor for approval.

1.3 MEASUREMENT AND PAYMENT

- A. No separate payment for the items "Protection of Utilities" will be made. The costs of same shall be included in the Base Bid.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01416

CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

1. CONTRACTOR shall provide labor, materials, tools, equipment, and incidentals as shown, specified, and required to cooperate with the Coordinating Special Inspector, individual special inspectors, and testing agencies employed by OWNER, to facilitate Special Inspections.
2. Supplement A, Statement of Special Inspections, included with this Section, lists testing and inspections required.
3. Requirements for vibration, seismic, and wind controls for non-structural components are in Section 15050, Vibration, Seismic, and Wind Controls.

B. Related Sections:

1. Section 15050, Vibration, Seismic, and Wind Controls.

1.2 DEFINITIONS

A. Coordinating Special Inspector: Professional engineer or architect, hired by OWNER, registered in the same state as the Site, responsible for coordinating and verifying the inspection and testing required by the Statement of Special Inspections included in this Section and reporting to the Building Official.

B. Building Official: Officer or other designated authority having jurisdiction charged with the administration and enforcement of the governing building code, or a duly authorized representative.

C. Special Inspections: Testing and inspection required in Supplement A, Statement of Special Inspections, of this Section.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. OWNER will employ and pay for services of the Coordinating Special Inspector, who will have not less than five years of experience in managing, monitoring, and inspecting building construction.
2. Inspectors will be qualified in the responsibilities of the Special Inspection for which each is responsible.

B. Regulatory Requirements:

1. Special Inspections will be in accordance with applicable building code and other Laws and Regulations, and Supplement A, Statement of Special Inspections, of this Section.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Samples: Representative Samples of materials when required by ENGINEER.
- B. Informational Submittals: Submit the following:
 1. Completed Supplement C, Contractor's Statement of Responsibility, as attached to this Section, addressing each system and component listed in the Quality Assurance Plan portion of Supplement A, Statement of Special Inspections, of this Section.
 2. Completed Supplement D, Fabricator's Certificate of Compliance, as attached to this Section, for fabrication of structural steel.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Prepare Supplement C, Contractor's Statement of Responsibility, of this Section which shall include:
 1. Acknowledgment of the requirements of the Quality Assurance Plan portion of Supplement A, Statement of Special Inspections, of this Section.
 2. Acknowledgment that necessary quality control shall be exercised in fabricating, handling, and installing, to comply with the Contract Documents.
 3. List CONTRACTOR's procedures for ensuring the quality of the Work necessary for compliance with the Contract Documents relative to each system or component listed in the Quality Assurance Plan portion of Supplement A of this Section.
 4. List personnel who control the quality of the Work relative to the Contract Documents and indicate their position in the CONTRACTOR's organization.
- B. Provide safe access to the Work to be tested and inspected.
- C. Provide assistance in obtaining and handling test samples at the Site.
- D. Facilitate inspections and tests.
- E. Provide access to Suppliers' and Subcontractors' operations as required.
- F. Notify Coordinating Special Inspector and ENGINEER sufficiently in advance of the Work for the Coordinating Special Inspector and ENGINEER to coordinate their personnel at the Site. Do not cover the Work to be inspected until Special Inspection has been completed and the results thereof are acceptable.

- G. Special Inspections required in this Section do not supersede or make unnecessary inspections and tests required under other Specification Sections or standard inspections required by Laws and Regulations.

1.6 COORDINATING SPECIAL INSPECTOR'S RESPONSIBILITIES

- A. Coordinating Special Inspector will:
1. Complete Supplement A, Statement of Special Inspections, of this Section to provide names of each inspector and testing agency for each Special Inspection required.
 2. Engage services of inspectors and testing agencies for Special Inspections in accordance with Supplement A, Statement of Special Inspections, of this Section and as required by Laws and Regulations.
 3. Coordinate activities of individual inspectors and testing agencies with CONTRACTOR.
 4. Provide interim reports of inspections and material testing to Building Official, OWNER, ENGINEER, and ENGINEER's consultants, including structural engineer and architect.
 5. To obtain certificate of use and occupancy from the Building Official, complete and provide to the Building Official, OWNER, and ENGINEER Supplement B, Final Report of Special Inspections, of this Section, documenting completion of Special Inspections and correction of discrepancies noted in the Special Inspections.

1.7 INSPECTOR RESPONSIBILITIES

- A. Perform specified inspections, sampling, and testing of materials and methods of construction; review and ascertain compliance with Laws and Regulations.
- B. Promptly notify Coordinating Special Inspector, OWNER, ENGINEER and CONTRACTOR of irregularities or deficiencies in the Work observed during Special Inspections. Corrective action, if required, will be determined by ENGINEER.
- C. Promptly submit two copies of each report of inspections and tests to Coordinating Special Inspector, ENGINEER, and CONTRACTOR including:
1. Date issued.
 2. Project title and number.
 3. Name and signature of inspector.
 4. Date of inspection or sampling and test.
 5. Record of temperature and weather.
 6. Identification of product and Specification Section.
 7. Location in Project.
 8. Type of inspection or test.
 9. Results of inspections and tests, and observations regarding compliance with Laws and Regulations, and standards.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SUPPLEMENTS

- A. The supplements listed below, following the “End of Section” designation, are part of this Section:
 - 1. Supplement A – Statement of Special Inspections
 - 2. Supplement B – Final Report of Special Inspections
 - 3. Supplement C – Contractor’s Statement of Responsibility
 - 4. Supplement D – Fabricator’s Certificate of Compliance

+ + END OF SECTION + +

Supplement A - Statement of Special Inspections

Project:

Location:

Owner:

Design Professional in Responsible Charge:

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to the Project as well as the name of the Coordinating Special Inspector and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompass the following disciplines:

☒ Structural ☐ Mechanical/Electrical
☐ Architectural ☐ Other: _____

The Coordinating Special Inspector shall keep records of all inspections and shall furnish inspection reports to the Building Official and the Registered Design Professional in Responsible Charge. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Inspections listed are periodic unless indicated to be continuous or required by code to be continuous. Interim reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: Weekly

or ☐ per attached schedule.

Prepared by:

(type or print name)_____
Signature_____
Date

 Design Professional Seal

Owner's Authorization:

Building Official's Acceptance:

Signature_____
Date_____
Signature_____
Date

Long Beach WPCP Consolidation
Pump Station Conversion

01416-5
0701 of 1950

Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- | | |
|--|--|
| <input checked="" type="checkbox"/> Soils and Foundations | <input type="checkbox"/> Spray Fire Resistant Material |
| <input checked="" type="checkbox"/> Cast-in-Place Concrete | <input type="checkbox"/> Wood Construction |
| <input type="checkbox"/> Precast Concrete | <input type="checkbox"/> Exterior Insulation and Finish System |
| <input type="checkbox"/> Masonry | <input type="checkbox"/> Mechanical & Electrical Systems |
| <input checked="" type="checkbox"/> Structural Steel | <input type="checkbox"/> Architectural Systems |
| <input type="checkbox"/> Cold-Formed Steel Framing | <input type="checkbox"/> Special Cases |

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. Coordinating Special Inspector		
2. Inspector		
3. Inspector		
4. Testing Agency		
5. Testing Agency		
6. Other		

Note: The inspectors and testing agencies will be engaged by Owner or Owner's Agent, and not by Contractor or Subcontractor whose Work is to be inspected or tested. Conflicts of interest must be disclosed to the Building Official prior to commencing the Work.

Quality Assurance Plan

Quality Assurance for Seismic Resistance

Seismic Design Category: B

Quality Assurance Plan Required (Y/N): No

Description of seismic force resisting system and designated seismic systems:

- Ordinary reinforced concrete moment frames (electrical building platform), ordinary reinforced concrete shear walls (equalization basin and bypass pump station).

Quality Assurance for Wind Requirements

Basic Wind Speed (three-second gust): 131 mph

Wind Exposure Category: C

Quality Assurance Plan Required (Y/N): No

Description of wind force resisting system and designated wind resisting components:

- Ordinary reinforced concrete moment frames (electrical building platform), ordinary reinforced concrete shear walls (equalization basin and bypass pump station).

Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspections are subject to the approval of the Building Official. The credentials of all inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When Engineer deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Agency Number* on the Schedule.

PE/SE	Structural Engineer – a licensed SE or PE specializing in the design of building structures
PE/GE	Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT	Concrete Field Testing Technician – Grade 1
ACI-CCI	Concrete Construction Inspector
ACI-LTT	Laboratory Testing Technician – Grade 1&2
ACI-STT	Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI	Certified Welding Inspector
AWS/AISC-SSI	Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT	Non-Destructive Testing Technician – Level II or III.
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International Code Council (ICC) Certification

ICC-SMSI	Structural Masonry Special Inspector
ICC-SWSI	Structural Steel and Welding Special Inspector
ICC-SFSI	Spray-Applied Fireproofing Special Inspector
ICC-PCSI	Prestressed Concrete Special Inspector
ICC-RCSI	Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT	Concrete Technician – Levels I, II, III & IV
NICET-ST	Soils Technician - Levels I, II, III & IV
NICET-GET	Geotechnical Engineering Technician - Levels I, II, III & IV

Exterior Design Institute (EDI) Certification

EDI-EIFS	EIFS Third Party Inspector
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Other

Long Beach WPCP Consolidation
Pump Station Conversion

01416-8
0704 of 1950

Soils and Foundations

Page 5 of 8

Item	Agency # (Qualif.)	Scope – For Frequency of Inspection Refer to IBC 1705.6
1. Excavations	PE/GE	<i>Verify excavations are extended to proper depth and have reached proper material (periodic).</i>
2. Shallow Foundations	PE/GE	<i>Verify materials below footings and slab-on-grade are adequate to achieve the design bearing capacity (periodic).</i>
3. Compacted Fill	PE/GE	<i>Perform classification and testing of compacted fill materials (periodic). As a minimum, perform one test per lift for every 2,500 square feet of fill placed.</i> <i>Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill (continuous).</i> <i>Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly (periodic).</i>
6. Other:		

Cast-in-Place Concrete

Item	Agency # (Qualif.)	Scope - For Frequency of Inspection Refer to IBC 1705.3
1. Mix Design	ACI-CCI ICC-RCSI	Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design.
2. Material Certification	PE/SE	Review trial batch or supporting test data to verify mix meets specified requirements. Confirm materials meet specified requirements.
3. Reinforcement Installation	ACI-CCI ICC-RCSI	Inspect size, spacing, cover, positioning and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters
4. Formwork Geometry		Inspect formwork for proper materials, dimensions and alignment.
5. Welding of Reinforcing	AWS-CWI	Visually inspect all reinforcing steel welds. Verify weldability of reinforcing steel other than ASTM A706. Inspect preheating of steel when required.
6. Anchor Rods	ACI-CCI ICC-RCSI	Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors.
7. Concrete Placement	ACI-CCI ICC-RCSI	Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated. (continuous)
8. Sampling and Testing of Concrete	ACI-CFTT ACI-STT	Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231) and temperature (ASTM C1064).
9. Curing and Protection	ACI-CCI ICC-RCSI	Inspect curing, cold weather protection and hot weather protection procedures.
10. Other:		

Structural Steel

Item	Agency # (Qualif.)	Scope - For Frequency of Inspection Refer to IBC 1705.2, 1705.11, 1705.12
1. Fabricator Certification/ Quality Control Procedures <input type="checkbox"/> Fabricator Exempt	<i>PE/SE</i> <i>AWS/AIS</i> <i>C-SSI</i> <i>ICC-SWSI</i>	<ul style="list-style-type: none"> Verify fabricator has certification from AISC for conventional buildings of the AISC Quality Certification Program and has approval by the Building Official. Review fabricator's certificate of compliance.
2. Material Certification	<i>AWS/AIS</i> <i>C-SSI</i> <i>ICC-SWSI</i>	Review certified mill test reports and identification markings on wide-flange shapes, high-strength bolts, nuts and welding electrodes
3. Bolting	<i>AWS/AIS</i> <i>C-SSI</i> <i>ICC-SWSI</i>	<i>Inspect installation and tightening of high-strength bolts. Verify that splines have separated from tension control bolts. Verify proper tightening sequence.</i> <i>Continuous inspection of bolts in slip-critical connections.</i>
4. Welding	<i>AWS-CWI</i> <i>ASNT</i>	<ul style="list-style-type: none"> Visually inspect all welds. Inspect pre-heat, post-heat and surface preparation between passes. Verify size and length of fillet welds. (continuous for all field welds) Ultrasonic testing of all partial and full-penetration welds.
5. Shear Connectors	<i>AWS/AIS</i> <i>C-SSI</i> <i>ICC-SWSI</i>	Inspect size, number, positioning and welding of shear connectors. Inspect studs for full 360 degree flash. Ring test all shear connectors with a 3 lb hammer. Bend test all questionable studs to 15 degrees.
6. Structural Details	<i>PE/SE</i>	Inspect steel frame for compliance with structural drawings, including bracing, member configuration and connection details.
7. Metal Deck	<i>PE/SE</i> <i>AWS-CWI</i>	<ul style="list-style-type: none"> Review manufacturer's certificate of compliance with ASTM standards specified. Verify decking section profile, gage, and properties conform to contract documents. Inspect welding and side-lap fastening of metal roof and floor deck.
8. Other:		

Anchor Systems

Item	Agency # (Qualif.)	Scope - For Frequency of Inspection Refer to IBC 1705.3, 1705.12.1
1. Material Certification	PE/SE	<ul style="list-style-type: none"> Confirm anchor type (including product name), anchor dimensions, and anchor material grade for each anchor application. Confirm post-installed anchor compliance with specified requirements and suitability for each application type by review of the anchor system ICC-ES Evaluation Service Report. For adhesive anchors, confirm adhesive type
2. Installation of Adhesive Anchors for Concrete, Grout-filled Masonry, and Hollow Concrete Masonry	ICC-RCSI ICC-SMSI	<ul style="list-style-type: none"> Review compliance with the installation requirements of the anchor system ICC Evaluation Service Report. Verify and record anchor type (including product name), anchor dimensions, anchor material grade, adhesive type, adhesive expiration date, concrete or masonry type, base material compressive strength, drill bit type, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, anchor embedment, curing period prior to tightening, and tightening torque. Inspect installation of each type and size of adhesive anchor by construction personnel on the site. Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads shall be inspected continuously. All other adhesive anchors shall be inspected periodically.
3. Installation of Concrete and Grout-filled Masonry Wedge Expansion Anchors	ICC-RCSI ICC-SMSI	<ul style="list-style-type: none"> Review compliance with the installation requirements of the anchor system ICC Evaluation Service Report. Verify and record anchor type (including product name), anchor dimensions, anchor material grade, concrete or masonry type, base material compressive strength, drill bit type, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, base material thickness, anchor embedment and tightening torque. Inspect installation of each type and size of wedge anchor by construction personnel on the site. (periodic)
4. Anchor Testing	ASNT	<ul style="list-style-type: none"> Perform tension pullout test on 10 percent of each post-installed anchor type and size.

Supplement B - Final Report of Special Inspections

Project:

Location:

Owner:

Owner's Address:

Architect of Record:

Structural Engineer of Record:

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector

(Type or print name)

Signature

Date

Licensed Professional Seal

Agent’s Final Report

Project:

Agent:

Special Inspector:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Agent of the Special Inspector

(Type or print name)

Signature Date

*Licensed Professional Seal or
Certification*

Supplement C - Contractor's Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated in the Quality Assurance Plan of Supplement A shall submit a Contractor's Statement of Responsibility.

Project:

Contractor's Name:

Address:

License No.:

Description of designated building systems and components included in the Contractor's Statement of Responsibility:

Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Project's seismic requirements, Quality Assurance Plan in Supplement A, and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the Contract Documents approved by the Building Official having jurisdiction.

Signature

Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the Contractor's organization, the method and frequency of reporting and the distribution of reports are attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

Supplement D - Fabricator's Certificate of Compliance

Each approved fabricator that is exempt from Special Inspection of shop fabrication and implementation procedures per section 1704.2 of the International Building Code must submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Project:

Fabricator's Name:

Address:

Certification or Approval Agency:

Certification Number:

Date of Last Audit or Approval:

Description of structural members and assemblies that have been fabricated:

I hereby certify that items described above were fabricated in strict accordance with the Contract Documents.

Signature

Date

Title

Attach copies of fabricator's certification or building code evaluation service report and fabricator's quality control manual.

SECTION 01495

SPILL PREVENTION AND CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. This section covers the Contractor's responsibilities with respect to spill prevention and control.
- B. References: Where conflicts arise between requirements of the above-listed regulatory requirements, the most restrictive of the requirements shall be followed.
 - 1. USEPA Remedial Action at Waste Disposal sites EPA/625/6-B5/006
 - 2. 40 CFR Part 300 national Oil and Hazardous Substances Pollution Contingency Plan
 - 3. 40 CFR Protection of Environment
 - 4. ASTM E119 Fire Resistance Directory

1.2 SUBMITTALS

- A. A Spill Prevention and Control Plan shall be provided to the Engineer.

1.3 GENERAL REQUIREMENTS

- A. The Contractor shall prepare and implement a Spill Prevention and Control Plan and maintain appropriate containment and/or diversionary structures, materials and equipment to prevent and control the maximum spillage of any specific item within the Scope of Work. All materials and equipment used in connection with this project shall be included. The plan shall include inspection and test procedures performed to ensure compliance.
- B. Laws and Regulations: The Contractor shall not pollute any area with any manmade or natural harmful materials. It is the sole responsibility of the Contractor to investigate and comply with all applicable Federal, State, County and municipal laws and regulations concerning the Spill Prevention and Control Plan.
- C. A Project Telephone Directory shall be incorporated into the plan.
- D. Written Discussions: In addition to the minimal prevention standards listed, the Plan shall include a complete discussion of conformance with the following applicable guidelines, other effective spill prevention and containment procedures, or if more stringent, with the State rules, regulations and guidelines.
 - 1. Facility Drainage
 - 2. Bulk Storage

3. Facility Transfer operations, pumping, and conveying materials
 4. Truck loading/unloading rack
- E. Design and Specifications: The Contractor shall provide a Spill Prevention and Control Plan with the following designs and specifications:
1. Appropriate containment and/or diversionary structures or equipment to prevent discharge of materials to the environment
 2. Dikes sufficiently impervious to contain spill materials
 3. Curbing
 4. Culverts, gutters, or other drainage systems
 5. Weirs, booms, or other barriers
 6. Sorbent materials
 7. Curbing drip pans
 8. Sumps and collection systems
- F. Inspections and Records: Inspections required by this Scope of Work shall be in accordance with written procedures developed for the facility of the Contractor. These written procedures and a record of the inspections, signed by the appropriate supervisor or inspector, shall be part of the Spill Control and Prevention Plan, and shall be maintained during the project and submitted to the Engineer for final closeout.
- G. Facility Lighting: Facility lighting shall be commensurate with the type and location of the facility. Consideration shall be given to the following:
1. Discovery of spills, occurring during hours of darkness, both by operating personnel, if present, and by non-operating personnel (security personnel, the general public, local police, etc.)
 2. Prevention of spills occurring through acts of vandalism.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL

- A. If materials are released, the Contractor shall provide a written description of the event, corrective action taken, and plans for preventing a recurrence, as well as a written commitment of manpower, equipment, and materials required to expedite control and removal of any harmful quantity of materials released.
- B. The Contractor shall notify the New York State Department of Environmental Conservation, Nassau County Department of Health, Nassau County Department of Public Works, and the Engineer within two hours of the release or spill.

3.2 TRAINING

- A. Personnel Training and Spill Prevention Procedures: The Contractor shall be responsible for properly instructing his personnel regarding applicable pollution control laws, rules, and regulations; and in the operation and maintenance of equipment to prevent the discharge of materials.
- B. Briefings: The Contractor shall schedule and conduct Spill Prevention Briefings for its operating personnel at intervals frequent enough to assure adequate understanding of the Spill Prevention and Control Plan for this project. Such briefings shall highlight and describe known spill events or failures, malfunctioning components, and recently developed precautionary measures.
- C. Evacuation Routes shall be marked on the project site.

3.3 TESTING

- A. Facility communication or alarm systems and spill control equipment must be tested and maintained by the Contractor as necessary to assure proper operation in time of emergency.

+ + END OF SECTION + +

++ NO TEXT ON THIS PAGE ++

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. Temporary facilities and controls shall be provided in the manner designated hereinafter. These temporary facilities shall be provided at the Long Beach WPCP worksite.
- B. Contractor shall coordinate and install all temporary facilities and controls in accordance with the requirements of the local authorities or utility companies having jurisdiction and in accordance with all state, federal and local codes and regulations.
- C. At the completion of the Work, or when the temporary facilities and controls are no longer required, subject to the approval of the County, the temporary facilities and controls shall be removed and the facilities prepared as specified in the contract document by the Contractor.
- D. Costs in connection with the temporary electric, lighting, heating and ventilation, and other miscellaneous temporary facilities and controls including but not limited to, installation, maintenance, relocation and removal shall be borne by the Contractor.

1.02 TEMPORARY WATER FACILITIES

- A. The Contractor shall provide and pay all costs for sanitary facilities, fire protection, Contractor's field offices, and for cleaning by all Contractors, Subcontractors and their workmen. The Contractor shall make all arrangements with the County for connection and use of potable water from the plant system for purposes of supplying the work area. The Contractor shall provide and install a temporary water pipe system from this location as required for the execution of the work. The temporary water pipe system shall be installed, buried at all roadway crossings.
- B. The Contractor is responsible for his own bottled water needs.
- C. The Contractor shall furnish and install a complete piping system for use of temporary water. The Contractor and Subcontractors shall provide their own hoses, valves and containers as required to service their own work force. The Contractor shall inspect the site and assess the existing conditions. The cost for designing and installing a temporary water system shall be included in the lump sum price.

- D. In the event that the Contractor requires more potable water than is available through the plant system, then the Contractor shall pay all costs for obtaining and providing the additional water from the local water company.
- E. The Contractor shall protect the temporary water pipe system from freezing by heat-tracing above ground piping and installing buried pipes at a minimum depth of four (4) feet. The system shall be extended and relocated as necessary to meet construction procedures and temporary water requirements.
- F. The Contractor shall provide any and all backflow prevention devices as required by the County when connecting the temporary water system to the County's water system.
- G. The Contractor shall install an isolation valve and remove the temporary city water connection in its entirety at the end of the project.

1.03 TEMPORARY SANITARY FACILITIES

- A. The Contractor shall provide and pay all costs for temporary toilet facilities in sufficient numbers, for the Contractor's and Subcontractors' personnel on this Project.
- B. Sanitary facilities shall be properly screened from public observation and shall be provided and maintained at suitable locations by the Contractor including Contractor's staging area, all as prescribed by state labor regulations and local ordinances.
- C. The Contractor may connect his trailer sanitary drain to the Plant's sanitary system. The Contractor shall remove the temporary sanitary system and patch the sanitary manhole at the end of the project.
- D. The Contractor shall rigorously prohibit the committance of nuisances within, on, or about the Work.
- E. County Sanitary Facilities and Locker rooms are prohibited from Contractors' and subcontractors' use.

1.04 TEMPORARY ELECTRICAL FACILITIES

- A. The Contractor shall furnish and install a temporary electrical facilities system which shall consist of a new temporary electric service point No.1 and associated distribution, a temporary general lighting system, a security lighting system, a safety lighting system, and service the Contractor's field office. The Contractor

shall inspect the site and assess the existing conditions. The cost for designing and installing a temporary electrical system shall be included in the lump sum price.

B. The Contractor shall submit a drawing showing the proposed temporary electrical facilities system layout for approval by the Engineer prior to installation.

1. Work Included: Temporary work shall include the following:

- a. Furnish and pay for all labor, material, and equipment for the installation of the temporary electrical facilities system. The installation shall comply with all applicable requirements of the National Electric Code and any other codes or bodies having jurisdiction.
- b. Furnish and pay for all labor material and equipment for the maintenance of the temporary electrical facilities system.
- c. Furnish and pay for labor, materials and equipment for removing all temporary facilities.

C. Requirements:

1. Temporary electrical facilities system shall be as herein specified and required for the contractor's use and shall be provided no later than thirty days after the date of Notice to Proceed.

D. Temporary Electric Service Point No.1:

1. The Contractor shall furnish, install, and maintain a temporary power distribution point local to the work area.
2. The service point No.1 distribution shall be branched and metered in accordance with the requirements specified under Section 16020 - Temporary Electrical System.
3. The Contractor shall make all necessary arrangements with PSE&G Long Island and shall provide the temporary electrical service point No.1 connection. The Contractor shall modify the identified temporary distribution point as required to provide temporary electric service for the Work shown and specified. The Contractor shall provide a temporary equipment necessary and required to provide the temporary electric system with the specified capacity. The Contractor shall provide separate distribution circuit breakers or fused switches for disconnection and overcurrent protection of the temporary electrical facilities fed from the service point which shall include the Contractor's field offices and the security lighting system for the Staging Area.
4. The Contractor shall furnish and install circuit breakers or fused switches, transformers, wiring and conduit as required for the temporary power distribution point.
5. Distribution circuit breakers or fused switches shall be furnished and installed at each location for disconnection and overcurrent protection of the temporary electrical facilities, including the temporary general lighting system, the security lighting system and the safety lighting system.

6. The Contractor shall keep the service point No.1 temporary power and lighting system alive each working day from 6:00 A.M. to 6:00 P.M., from Monday to Friday inclusive.
 7. The Contractor shall also keep the service point No.1 temporary power and lighting system alive before 6:00 A.M. or after 6:00 P.M., from Monday through Friday or at any time on Saturdays, Sundays, or holidays, as required to execute the work under this Contract.
 8. At the completion of the project, the Contractor shall remove the temporary electric service point No.1 and all associated facilities.
- E. Temporary General Lighting System:
1. The Contractor shall provide and maintain a temporary lighting system. The system shall conform to the applicable Federal and State codes, shall meet the illumination requirements specified herein, and shall meet the approval of the County.
 2. Temporary general lighting system shall provide 120-volt GFI type receptacles and lighting for access to and egress from the work and for safe and expeditious construction within designated enclosed areas of the structure or structures.
 3. Temporary general lighting system shall consist of wiring, switches, necessary insulated supports, poles, fixtures, receptacles, 100-watt lamps, guards, cutouts and fuses as specified shown or required.
 4. The Contractor shall furnish lamps, fuses, receptacles, and cords for the temporary general lighting system and shall replace broken and burned out lamps and blown fuses for the system.
 5. Temporary general lighting system shall be installed progressively in the structure as the areas are enclosed or as lighting becomes necessary because of partial enclosure.
 6. Required Illumination to the extent applicable for Work Lighting:
 - a. General: Five foot-candles.
 - b. Stairs: Ten foot-candles.
 - c. Construction Plant and Shops: Ten foot-candles.
 - d. For Detail and Finishing Work: Twenty foot-candles.
 - e. For Testing and Inspection: Thirty foot-candles.
 - f. At First-aid Stations: Thirty foot-candles.
 - g. Areas of OWNER'S Operations: One 300-watt lamp at intervals of 15 feet on centers.
 7. The Contractor shall maintain the temporary general lighting system in safe working order.
 8. The Contractor shall arrange and install the lamps in a manner so as to provide an even distribution of illumination as necessary and required over the work areas.
 9. If necessary and required, the Contractor shall install the receptacles in such a manner as to reach any point in the work areas with an extension cord not to exceed 40 feet in length.
 10. In case of overloading of circuits, the County will restrict the use of tools as required for the correct loading.

11. The temporary general lighting system shall be used for small power purposes only.
12. Handtools, such as drills, hammers and grinders, may be connected to the temporary general lighting system provided that they are suitable for 120-volt, single phase, 60 hertz operation and do not have a power requirement exceeding 1,500 volt amperes. Only one unit may be connected to a single receptacle and shall not be connected to lighting outlets. Cords of tools shall not exceed 40 feet in length.
13. No Contractor will be permitted to proceed with any portion of his work which in the opinion of the Engineer, is not adequately illuminated. If any Work by any other Contractor requires special lighting other than what is provided, the Contractor shall arrange for same.

F. Security Lighting System:

1. The Contractor shall furnish, install and maintain a security lighting system to illuminate the Staging Area and the construction site outside the building.
2. Security lighting system shall consist of floodlights equal to Crouse Hinds Cat. No. MVD 4HCW O PC DF AF VS AF 400-watt mercury vapor lamp, Cat. No. ML2590 photocell, Cat No. ML5547 vandal shield and Cat. No. 105 N11 bracket for wood pole mounting. Floodlights shall be mounted approximately 30 feet above the ground.
3. Each floodlight shall be complete with a constant wattage, high power factor ballast in a cast aluminum housing, a flat clear lens of heat and impact resistant glass, photo control, lamp and suitable mounting hardware.
4. Photometric performance shall be equal to that of the above specified unit with a beam spread of approximately 150 degrees horizontal to 80 degrees vertical and with a beam efficiency of not less than 55 percent.
5. Poles shall be 35-foot, class F wood and shall be securely set five feet in the ground.
6. Wiring for the security lighting system may be installed overhead. The security lighting system shall be properly maintained and energized at all times with each floodlight controlled by a photocell installed on the floodlight. The photocells shall be adjusted so that all floodlights are energized at approximately the same time. Broken and burned out lamps shall be replaced.
7. Security lighting system shall be installed and made operative within 30 days after the date of the Notice to Proceed.

G. Safety Lighting:

1. The Contractor shall provide, install and maintain sufficient lighting fixtures to provide adequate light to ensure safe access to, egress from, and passage through the construction areas between the hours of 4:30 P.M. and 7:00 A.M. Monday through Friday and 24 hours per day for Saturdays, Sundays, and Holidays. The lighting system shall be operated by a time clock. Fixtures shall be 100 watt and shall be provided, as a minimum at every landing of every stairway and every 50 feet along passageways. The safety lighting system shall be installed progressively in structures as the

designated areas are enclosed or as lighting becomes necessary because of partial enclosure. This lighting is not intended for construction purposes.

H. Contractors' Field Offices:

1. The Contractor shall extend the temporary electric service from the tie-in to the service point specified in Paragraph 1.3.D.3 to the Contractor's field office within the Staging Area.
2. The Contractor shall be responsible for providing his own telephone facilities as required.

I. Additional Facilities:

1. Should any portion of any Contractor's work require light or power in addition to that supplied by the temporary general lighting system herein described, he shall furnish, install and maintain such additional temporary lighting and power facilities at his own expense. Additional temporary lighting shall be sufficient for safe access to and egress from such work, and for safe expeditious construction.
2. The installation of additional facilities shall comply with all applicable requirements of the National Electric Code and any other codes of enforcing bodies having jurisdiction, and shall be installed so as not to interfere with the work of other Contractors.
3. Upon completion of the work under his contract, the Contractor responsible shall remove all additional facilities installed by him.

1.05 TEMPORARY HEATING FACILITIES

- A. Temporary construction heating shall be provided by the Contractor responsible for the Work involved for all cold weather protection of his own equipment, Work, and his employee's comfort at all times.
- B. The Contractor shall provide all temporary building heat for heating the interior of all structures and building areas, which is necessary for the protection of all Work and equipment of the Contract for the comfort of his employees or his Subcontractor's employees, after the building or structure is temporarily enclosed. Hot water or steam from the existing plant system will not be available for use as temporary heating. The following requirements shall apply:
 1. All temporary heating methods proposed by Contractor shall be submitted to the County for approval and must comply with all federal, state and county rules and regulations.
 2. Temporary construction heat for "cold weather protection" shall be provided by Contractor responsible for the Work involved. "Cold weather protection" shall be considered to include both temporary heat and protective covers or enclosures required during the construction period prior to the enclosure of new buildings or buildings and structures being remodeled. "Cold weather protection" shall be provided until all construction requirements under the Contracts are complied with, or until the enclosure of a new building or

structure complies with the requirements for temporary building heating as hereinafter specified in Paragraph 1.4.E.

- C. The Contractor is to provide temporary heat for the temporary building heating system. The systems shall be gas or oil fired; steam, hot water or warm air type. Electric heating will not be permitted.
- D. No salamanders or other direct fired equipment will be allowed in areas of existing buildings, or in new construction areas where the use of such equipment will damage or deteriorate the construction or finishes or is harmful to employees working in the area.
- E. Temporary building heating systems shall be complete, including pumps, radiators, unit heaters, water and heating piping, insulation, controls, or any other equipment necessary, all furnished and installed by Contractor. Systems shall include boilers, fuel, and fuel storage facilities or any other equipment necessary, all furnished and installed and paid for by the Contractor, including fuel and electrical costs. All fuel oil tanks shall be provided with adequate secondary containment and the fuel oil systems shall comply with Nassau County Fire Prevention Ordinance-Article III. Special notice is given to the Contractor that the electrical service and cost relative to obtaining temporary heating beyond those provided under the temporary electrical facilities shall be the responsibility of the Contractor and provided for under temporary heating. This includes, but is not limited to, the cost of providing temporary light if it should be required.
- F. A building, structure or gallery shall be considered to be temporarily enclosed when the area is covered by a permanent structural slab or deck and all openings through the permanent slab or deck are covered to prevent the entrance of rain or snow. Intermediate floor structures or multi floor buildings or structures shall be considered to be temporarily enclosed subject to the same requirements. The building shall be considered to be temporarily enclosed when one of the permanent exterior wall elements, concrete, block, or the permanent exterior wall, or facing material, is installed and all openings through that element are covered or temporarily enclosed to prevent the entrance of rain, snow, or direct wind. Openings through structures, intermediate floors or exterior wall elements shall be considered to be enclosed when that opening is covered with minimum ten mil plastic or minimum twelve (12) ounce waterproof duck canvas tarpaulins or with minimum three eighths inch thickness exterior grade plywood. Temporary covers or enclosures for openings shall be the responsibility of the Contractor.
- G. Temporary building heating shall be provided from the first day of October to the last day of the following April. The system shall be capable of maintaining a minimum of fifty-five degrees Fahrenheit (55°F) simultaneously in all areas of construction in buildings, structures or galleries. Temporary heating shall be provided on a twenty-four hours per day, seven days per week basis. Where it is determined by the County that higher temperatures are required in a particular

area to protect installed equipment or new construction, it shall be so, provided under this Contract.

- H. The Contractor shall provide and pay for all electric wiring and electrical accessories required for the temporary heating system.
- I. Temporary heating equipment shall not be located so as to interfere with the new construction Work. Heating system equipment shall not cause undue noise or fumes and shall be enclosed by wire fencing, or other means to provide protection to personnel.

1.06 TEMPORARY VENTILATION FACILITIES

- A. Temporary construction ventilation shall be provided by the Contractor for the protection of his equipment, Work and his employees' comfort and safety at all times.
- B. The Contractor shall provide all temporary building ventilation for ventilating all structures and building areas, both above and below ground level, which is necessary for the protection of all Work and equipment of this Contract or for the comfort and safety of his employees, his Subcontractor's employees, or the employees of the other Contractors, after the building or structure is enclosed.
- C. Ventilating systems may be forced or gravity type and shall be complete with fans, motors, inlets, outlets, ductwork, heaters, controls or any other equipment necessary, all furnished and installed by the Contractor responsible for the Work involved. The following additional requirements shall apply:
 - 1. All temporary ventilation methods proposed by the Contractor shall be submitted to the County for approval and must comply with all federal, state and county rules and regulations.
 - 2. Temporary ventilation shall be provided by the Contractor until the building or structure is enclosed.
 - 3. A building or structure shall be considered to be enclosed as hereinbefore specified in Paragraph 1.4, Temporary Heating Facilities.
 - 4. Ventilation air shall be heated to those temperatures specified for space or room temperatures as hereinbefore specified in Paragraph 1.4, Temporary Heating Facilities. Where dehumidification is required to prevent mildew or moisture forming on equipment, Work or structures in areas being ventilated, it shall be provided by the Contractor.
- D. The Contractor shall provide and pay for all equipment and labor to operate the temporary ventilation system after a building or structure is enclosed. Heating required for the ventilation system shall be provided by the temporary heating system specified in Paragraph 1.4.
- E. The Contractor shall provide and pay for all electric wiring and electrical accessories required for the temporary ventilation system.

- F. Temporary ventilation equipment shall not be located so as to interfere with the operation of the new construction Work. Protective devices shall be provided for the protection of the personnel.
- G. Temporary ventilation shall be supplied to all buildings or structures below grade at a minimum of three air changes per hour and the outside air shall be tempered to room temperature levels unless otherwise noted. Temporary ventilation shall be supplied to all new buildings or structures above grade only where required to protect equipment and Work being installed or for safety of employee.

1.07 PROTECTION OF WORK AND MATERIALS

A. Protection Requirements:

- 1. During the progress of the Work and up to the date of Final Payment, the Contractor shall be solely responsible for the care and protection of all Work and materials covered by the Contract. In order to prevent damage, injury or loss, actions shall include, but not be limited to, the following:
 - a. Store apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with the progress of the Work or the work of any other contractor or utility service company.
 - b. Provide suitable storage facilities for all materials, which are subject to injury by exposure to weather, theft, breakage, or otherwise.
 - c. Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.
 - d. Clean up frequently all refuse, rubbish, scrap materials, and debris caused by his operations, to the end that at all times the Site of the Work shall present a safe, orderly and workmanlike appearance.
 - e. Provide barricades and guard rails around openings, for scaffolding, for temporary stairs and ramps, around excavations, elevated walkways and other dangerous areas as deemed necessary by Engineer.
- 2. The Contractor shall protect the existing Work and material from damage by his workmen and shall be responsible for repairing any such damage at no additional cost to the County.
- 3. The Contractor shall protect trees, shrubbery and other natural features or structures from being cut, trimmed or injured in his areas of Work. Trees adjacent to the Site of Work shall be protected and temporary supports provided for long branches. Stored materials and equipment shall be in cleared spaces, away from all trees and shrubs, and confined to areas as directed by the Engineer.
 - a. Temporary fences or barricades shall be installed to protect trees and plants in areas subject to traffic.
 - b. No fires will be permitted at the Long Beach WPCP.
 - c. Within the limits of the Work, water trees and plants that are to remain, in order to maintain their health during construction operations.

- d. Cover all exposed roots with burlap that shall be kept continuously wet. Cover all exposed roots with earth as soon as possible. Protect root systems from mechanical damage and damage by erosion, flooding, run off or noxious materials in solution.
 - e. If branches or trunks are damaged, prune branches immediately and protect the cut or damaged areas with emulsified asphalt compounded specifically for horticultural use in a manner approved by Engineer.
 - f. All damaged trees and plants that die or suffer permanent injury shall be removed when ordered by the Engineer and replaced by a specimen of equal or better quality.
 - g. Coordinate Work in this Section with requirements of Sections 02200, Earthwork, and 02485, Grassing and Planting.
4. All Work and materials shall be protected in accordance with the requirements of the Agreement, Article VI, "Protection"; General Conditions, Articles GC 17, "Materials and Equipment, Approvals Substitutions and Deviations", GC 21, "Protection Requirements", and GC 24, "Barricades, Warning Signs and Lights".

B. Maintenance of Egress:

- 1. During the course of demolition and construction Work of this Project, the Contractor shall maintain and keep free of debris, materials or equipment points of required egress in accordance with the requirements of the Nassau County Fire Commissioner and Fire Safety Regulations.
- 2. The Contractor in his particular area of Work shall maintain egress as herein specified.
- 3. In active process areas, the Contractor shall not be permitted to store or stockpile material. Debris or other material shall be removed daily which may obstruct plant personnel from operating or maintaining active equipment and piping.

C. Temporary Construction Fencing:

- 1. The Work areas of the Project Site shall be enclosed at all times by temporary fencing to ensure security.
- 2. Temporary fencing shall not be less than six feet in height. Fabric shall be ten-gauge minimum, electrically welded wire, forming a rectangular mesh with opening two by four inches and three rows of double barb ten-gage wire on angle brackets measuring two feet vertically. Fabric shall be mounted on heavy duty steel tee spaced at intervals not exceeding ten feet.
- 3. The Contractor shall furnish, erect, relocate and maintain all temporary fencing. Upon completion of the Project all temporary fencing shall be removed and disposed of.
- 4. All Work in connection with the temporary fencing shall be done at no additional cost to the County.

D. Protection of Existing Structures:

- 1. Underground Structures:

- a. Underground structures are defined to include, but not be limited to, all sewer, water, gas, and other piping, and manholes, chambers, electrical and signal conduits, tunnels and other existing subsurface work located within or adjacent to the limits of the Work.
 - b. All underground structures known to the Engineer, except water, sewer, electric and telephone service are shown on the Drawings. This information is shown for the assistance of the Contractor in accordance with the best information available but is not guaranteed to be correct or complete.
 - c. The Contractor shall explore ahead of his trenching and excavation Work and shall uncover all obstructing underground structures sufficiently to determine their location, to prevent damage to them and to prevent interruption of the services which such structures provide. If the Contractor damages an underground structure, he shall restore it to original condition at his expense.
 - d. Necessary changes in the location of the Work may be made by the Engineer, to avoid unanticipated underground structures.
 - e. If permanent relocation of an underground structure or other subsurface facility is required and is not otherwise provided for in the Contract Documents, the Engineer will direct the Contractor in writing to perform the Work, which shall be paid for under the provisions of the Agreement.
2. Surface Structures:
 - a. Surface structures are defined as all existing buildings, structures and other facilities above the ground surface. Included with such structures are their foundations or any extension below the surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, piles, wires, posts, signs, markers, curbs, walks and all other facilities that are visible above the ground surface.
 3. Protection of Underground and Surface Structures:
 - a. The Contractor shall sustain in their places and protect from direct or indirect injury all underground and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done by the Contractor in a careful manner and as required by the County. Before proceeding with the Work of sustaining and supporting such structure, the Contractor shall satisfy the Engineer that the methods and procedures to be used have been approved by the County.
 - b. The Contractor shall assume all risks attending the presence or proximity of all underground and surface structures within or adjacent to the limits to the Work. The Contractor shall be responsible for all damage and expense for direct or indirect injury caused by his Work to any structure. The Contractor shall repair immediately all damage caused by his Work to the satisfaction of the owner of the damaged structure.

4. All other existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, and curbs, which are temporarily removed to facilitate installation of the Work shall be replaced and restored to their original condition at Contractor's expense.

E. Protection of Floors and Roofs:

1. The Contractor shall protect floors, roofs and stairs from overloads, dirt and damage during entire construction period. In areas subject to foot traffic, secure heavy paper, sheet goods, or other materials in place. For storage of products, lay tight wood sheathing in place. Cover walls and floors of elevator cars and surfaces of elevator car doors used by construction personnel.
2. Proper protective covering shall be used when moving heavy equipment, when handling materials or other loads, when painting, when handling mortar and grout and when cleaning walls and ceilings.
3. Use metal pans to collect all oil and cuttings from pipe, conduit, or rod threading machines and under all metal cutting machines.
4. Concrete floors less than 28 days old shall not be loaded without written permission of the Engineer. No floor, roof or slab shall be loaded in excess of the design loading shown on the Drawings.
5. Roof slabs shall not be loaded without written permission of the Engineer. Prohibit use of finished roofing surfaces for traffic of any kind, and for storage of any products. When activity must take place in order to carry out the Work, obtain recommendations of installer for protection of surface. Install recommended protection and remove on completion of that activity. Restrict use of adjacent unprotected areas.
6. The Contractor shall restrict access to roofs and keep clear of existing roofs except as required by the new Work.
7. If access to roofs is required, roofing, parapets, openings and all other construction on or adjacent to roof shall be protected with suitable plywood or other approved means.

F. Protection of Installed Products and Landscaping:

1. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of Work.
2. Control traffic to prevent damage to equipment, materials and surfaces.
3. Provide covering to protect equipment and materials from damage.
 - a. Cover projections, wall corners, and jambs, sills and soffits of openings, in areas used for traffic and for passage of products in subsequent Work.
4. Prohibit traffic of any kind across planted lawn and landscaped areas.

G. Protection from Flood:

1. The Contractor shall not allow any areas turned over to him for commencement of Work, to flood. The Contractor shall keep all existing and new facilities within his Work area free of any accumulations of water.

The Contractor shall provide, install, and operate sufficient pumps for this purpose. Continuous monitoring for floods and protection of structures from damage and flotation shall be provided. The Contractor shall install any combination of suitable dikes, well points, pumps, and the like to protect the Work until it is accepted.

H. Special Protection of Machinery and Equipment:

1. The Contractor shall take all protective measures to the satisfaction of the County necessary to insure that inclement weather or dust and debris from demolition does not enter any of the mechanical or electrical equipment rooms or enclosures. Enclosures shall be provided where necessary to prevent contamination of the air. All protective measures shall be furnished, installed, lighted, ventilated, maintained and removed at the Contractor's own cost.
2. Interior dustproof covers shall be a heavy reinforced polyethylene film curtain, minimum thickness 6 mils, supported by wood framing. All seams and penetration shall be sealed with duct tape on two sides. Junctions with existing walls, floors and ceilings shall be made with a double fold secured with a backing strip anchored to the existing wall, floor and ceiling.
3. The Contractor shall be responsible for all damage to existing structures, equipment, and facilities caused by his construction operations and must repair all such damage when and as ordered at no additional cost to the County. All work shall be done in accordance with the requirements of Section 01039, Demolition and Removal of Existing Structures and Equipment.

I. Emergency Repair Crews

1. In case the Contractor's operations disrupt plant operations, the treatment process or the operating facilities herein before described, at any time, he shall at his own cost immediately make all repairs or replacements and do all work necessary to restore the plant to operation to the satisfaction of the County. Such work shall progress continuously to completion on a 24-hour/day, 7-workday/week basis. The Contractor shall provide the services of emergency repair crews, available on call 24 hours per day.

1.08 ACCESS ROADS, PARKING, STAGING, STORAGE AND WORK AREAS

A. Contractor's Staging and Storage Area

1. The Contractor shall construct a Contractor's Staging Area as shown on the Contract Drawings. The Staging Area shall be leveled, graded and seeded after completion of the Contract.
2. The Staging Area shall be drained so that no ponding of runoff water shall occur in the Staging Area or adjacent areas.
3. The Contractor shall erect six-foot high galvanized chain link fencing and gates around the Staging Area as specified in Paragraph 1.6.C.
4. The Contractor shall provide pavement and utilities in the Staging Area and shall maintain all sections of the Staging Area in a suitable manner,

including the cutting of grass, weeding and preventing the accumulation of debris. The Contractor shall provide electrical utilities in the Staging Area.

5. At the completion of the project, the Contractor shall remove all debris not limited to gravel, grout, wood, etc., from the Staging Area off-site. The Contractor shall also grade the Staging Area level and furnish a minimum of six (6) inches of topsoil, which will be unloaded, graded and hydroseeded as directed by the Engineer.

B. Access Roads:

1. Access roads will be provided by the Contractor in accordance with the requirements of the General Conditions, Article GC 22, "Access Roads and Parking Areas", the Drawings and the applicable Technical Specifications.
2. The Contractor shall take all necessary precautions to protect traffic, including but not limited to, complying with the requirements of the General Conditions, Articles GC 23, "Traffic Regulations" and GC 24, "Barricades, Warning Signs and Lights".
3. The Contractor shall post speed limit signs to be adhered to at all times in the vicinity of the staging and work areas.

C. Parking, Storage and Work Areas:

1. No on-site parking is permitted.
2. The Contractor shall construct and maintain suitable storage areas for his use within the staging area designated on the Drawings.
3. The Contractor will be required to arrange his Work and dispose of his materials in such manner as to cause the least interference with the Work of other Contractors working within the same area.
4. No Contractor shall claim exclusive occupancy of areas within or adjacent to the limits of his Work under this Contract. The County and its employees and the Contractors for other contracts shall also have access to these areas.
5. The Contractor shall modify any storage areas to cause minimum damage to the landscape and shall comply with the directions of the County. At the completion of the Work the surfaces of the land used for storage areas shall be restored by the Contractor to the satisfaction of the County and the Engineer.

1.09 CONTRACTOR'S FIELD OFFICE

- A. The Contractor shall furnish, equip and maintain a field office for his use at the Site during the period of construction. The Contractor shall provide his own telephone service and shall have readily accessible, at the field office, copies of the Contract Documents, latest approved Shop Drawings and all Project related correspondence, Change Orders, etc.
- B. Contractor's field office shall be located in the Staging Area.
- C. The Contractor shall provide a Contractor's field office with the minimum facilities specified. Provide all required storage and work sheds.

1. Field Office and Furnishings:
 - a. Acceptable appearance, weatherproof building or trailer with lockable door.
 - b. Telephone service.
 - c. Six protective helmets for visitor's use.
 - d. Exterior identifying sign.
 - e. Company sign no larger than 4 feet by 8 feet.
2. Remove office and sheds upon Final Acceptance unless otherwise approved by the Engineer.

1.10 NOISE CONTROL

- A. Wherever possible, Contractor shall locate all equipment as far away from residential areas as possible. The Contractor shall limit noise from his activities so that overall noise leaving the plant, as measured at the plant property line, is 65 dB(A) measured for any one hour from 7 am – 10 pm and to 55 dB(A) measured for any one hour from 10 pm – 7 am.
- B. Contractor shall provide noise suppression enclosures around the equipment. When the noise from equipment is greater than 80 dB at a distance of 5 feet from the noise source, the enclosures shall be provided with internal acoustic insulation.
 1. Enclosures shall be constructed of a minimum of 3/8-inch plywood.
 2. The sound panels shall be minimum 4-inch thick, rated at STC-60, as manufactured by Industrial Acoustics Co. or approved equal.
 3. The area shall remain operational during construction. Partitions provided by the Contractor to isolate the construction area shall provide internal acoustical isolation as define in the paragraphs above.

1.11 SECURITY

- A. It shall be the responsibility of the Contractor to make whatever provisions he deems necessary to safely guard all Work, materials, equipment and property from loss, theft, damage and vandalism. The Contractor's duty to safely guard property shall include the County's property and other private property from injury or loss in connection with the performance of the Contract.
- B. The Contractor may make no claim against the County for damage resulting from trespassing.
- C. The Contractor shall repair all damage to the property of the County and others arising from failure to provide adequate security.

- D. If existing fencing or barriers are breached or removed for purposes of obstruction, the Contractor shall provide and maintain temporary security fencing equal to the existing one, in a manner satisfactory to the Engineer and the County.
- E. Security measures taken by the Contractor shall be at least equal to those usually provided by the County to protect his existing facilities during normal operation.
- F. Maintain the security program throughout construction until the date of Substantial Completion and occupancy precludes need for Contractor's security program.
- G. The Contractor's employees shall be issued identification badges, which shall be displayed at all times, as per Section 01356, Safe and Healthful Working Conditions, Paragraph 1.5.F.

1.12 ENGINEER'S FIELD OFFICE

- A. It shall be the Contractor's Responsibility to furnish the following equipment items and maintenance services for the contract period or for a period not to exceed two months after the work has received final acceptance by the County.
- B. No Construction shall commence until the trailer is provided, furnished as herein specified and made available to the Engineer. The office shall be erected at a location approved by the Engineer and as shown on the Contract Drawings. The Engineer's field office shall be separate from any office used by the Contractors.

The office shall be 25' long (including hitch), 10' wide, a minimum ceiling height of 8 feet, 2 exterior doors and 6 windows. All windows and the door shall be equipped with adequate locking devices, alarmed and be weatherproof and screened to provide adequate ventilation.

Windows shall be the type that will open and close as required. A flush type toilet shall be provided, and shall be located in an enclosed separate room, in compliance with applicable sanitary codes. The field office shall be equipped with a lavatory with hot and cold running water and venetian blinds. Adequate electric lighting and heating shall be provided at all times. The sanitary facilities shall be connected by the Contractor to an existing manhole. The Contractor shall provide door switch with terminals for intrusion alarm indication.

- C. The Contractor shall provide door switches on all doors with terminals for intrusion alarm indication. Water services, electric and sanitary services shall be provided and shall be maintained in proper order by the Contractor throughout construction.

D. The Contractor shall provide telephone service to the field office, including all Verizon coordination.

E. The furnishings shall be as follows:

Four (4) Office chairs. (Stackable type)

Four (4) Folding chairs and a folding table.

One (1) Bracketed wall table (3 feet by 5 feet)

Two (2) Desks

One (1) Draftsman's stool.

One (1) Each hand operated fire extinguisher, Class ABC.

One (1) Telephone set with 1 dedicated telephone line for the exclusive use of the Engineer and his authorized representatives.

One (1) Two Mbit/s down/1Mbit/s up or greater internet connection (Verizon FIOS, Optimum Online or equal).

One (1) First aid kit (#25 kit as manufactured by Acme Cotton Products or equal).

One (1) Rechargeable lantern type light (Flashlight).

One (1) printer, scanner and fax machine with 11 x 17 capability as manufactured by Canon, ImageClass MF7480 or equal. A dedicated telephone line (separate from telephone set line) with supplies and maintenance service for the machine for the duration of the project shall be provided.

Two (2) Laptop computer systems as manufactured by Dell or equal. The Contractor shall provide the following items as provided by Dell or equal.

<u>Catalog Number/ Description</u>	<u>Product Code</u>	<u>Qty</u>
Processor: 4 th gen Intel® Core™ i5-4210U Processor (1.7 GHz, 3M cache)	154210	1
Operating System: Windows 7 Professional English/ French 64bit (Included Windows 8.1 Pro License)	DW17P6M	1

Office Productivity Software: Microsoft® Office Home and Business 2013, English, French and Spanish	13HB	1
Dell Data Protection Encryption Security SW: DDPE Personal Edition License + ProSupport for Software 1 year	PDPE1Y	1
Adobe Creativity and Productivity Software: Adobe® Acrobat® XI Standard, Digital Delivery	ADBXIC	1
Security Software: No Security Software	NOSS	1
Operating System Recovery Options: Windows 8.1 English OS Recovery - DVD	M81D6E	1
Optical Software: No Power DVD	PDVDW7	1
Camera Software: Software for Integrated Camera	SCW7	1
Video Card: Intel® Integrated HD Graphics 4400	UMA	1
Base Options: Intel® Core™ i5-4210U processor, Integrated Graphics, Express Card	4210	1
Hard Drive: 500 GB Solid State Hybrid Drive	500SDH	1
Latitude 15 5000 Series: Latitude 15 5000 Series	E5540	1
Memory: 4GB (1x4 GB) 1600MHz DDR3L Memory	4G1D6	1
Keyboard: Internal English Single Point Keyboard	ENGSP	1
Optical Drive: 8X DVD +/- RW	DVDR8	1
Wireless Driver: Intel® Dual Band Wireless-AC 7260 + BT 4.0 Driver	DR7260	1
Wireless: Intel® Dual Band Wireless-AC 7260 802.11AC Wi-Fi + BT 4.0 Half Mini Card	IW7260	1
Power Cord:	USE5	1

US Power Cord		
Documentation:	DOCENG	1
System Documentation, English		
Primary Battery:	6C	1
6-cell (65Wh) Lithium Ion battery with ExpressCharge™		
E-Star:	ESTAR	1
Energy Star		
Processor Branding:	I5INTEL	1
Intel® Core™ i5 Processor Label		
Non- Microsoft Application	WIN7DG	1
Software:		
Additional Software for Window 7 Downgrade		
Power Supply:	65WE5	1
65W A/C Adapter (3-pin)		
Camera:	NTCAM	1
Light Sensitive Webcam and Noise Cancelling Digital Array Mic		
LCD:	HD	1
15.6" HD (1366x768) Wide Anti- Glare WLED-backlit		
Palmrest:	SPNOFP	1
No Fingerprint Reader (Single Pointing) Palmrest		
Systems Management:	NOVPRO	1
No Out-of-Band Systems Management		
Packaging:	MINCFG	1
Ship Material, Min-Config		
Regulatory Label:	NTOUCH	1
Regulatory Label		
System Recovery:	NRDVD	1
No Resource DVD		
FGA Module:	FG0052	1
Alpine 15_R1_106/US/BTS		
Dell Backup & Recovery:	DBRBSC6	1
Dell backup and recovery basic		
Transportation from ODM to region:	BTS	1
BTS Shipment		
Placemat:	ENGGD	1
System Documentation, English		
UPC/POD Label:	POD	1
POD Label		
Intel Rapid Start and Smart Connect:	NONE	1

No Intel Rapid Start or Smart Connect

Provide for each laptop G-data total projection for duration of project.

One (1) 10/100 Ethernet router with at least 4 Smith Ports.

One (1) microwave oven.

One (1) Stove/refrigerator combination unit.

Bottled drinking water supplied by a service to the site; provide refrigerated drinking fountains with a spigot. Disposable drinking cups shall be furnished and supplied at all times.

Fire-Resistant File Cabinets:

1. Description: Four drawers, legal size, UL Class D Label.
2. Number Required: 2
3. Product and Manufacturer: Provide one of the following:
 - a. Model 4 CFD by Schwab Safe Company.
 - b. Fireking International, Incorporated
 - c. Or equal.

F. All facilities, equipment and utilities furnished under this section shall be provided and maintained in good working order at all times. In addition, the Contractor shall furnish daily janitorial services and necessary washroom supplies. All utility costs for telephone, DSL, etc. shall be paid for by the Contractor for the duration of the project.

G. Two months after final acceptance of the work or when ordered by the Engineer, whichever is sooner, the trailer and the field office equipment and facilities furnished by the Contractor limited to the chairs, tables, stool, telephone set, fax machine, copy machine, computer system, microwave oven, stove/refrigerator combination unit, bottled water system and file cabinets shall revert to the Contractor who shall remove them and leave the site in a satisfactory condition, as approved by the Engineer.

1.13 OWNER'S TEMPORARY FACILITIES

- A. The Contractor shall furnish and install Interim Facilities for the Long Beach WPCP staff, consisting of a new field office trailer complex with plumbing,

heating, and electrical. The Interim Facilities trailers are to be in full compliance with the current requirements of all applicable laws, ordinances and regulations.

- B. The Interim Facilities shall be furnished prewired, plumbed, heated and cooled.
- C. The Interim Facilities shall be maintained for the duration of the Project until the new Long Beach Consolidation Pump Station is tested and approved by the County.
- D. The new facility shall include, heating and cooling systems, ventilation, domestic water, sanitary sewer, lighting, electricity. The Contractor shall be responsible for relocating telephone and internet service systems from the Service Building to the new Interim Facilities.
- E. The Contractor shall provide services to relocate the Long Beach WPCP furnishings, files and equipment to the Interim Facilities as directed by the Engineer. As a minimum, the Interim Facilities shall consist of two 50-foot tractor trailer truckloads.
- F. The Contractor shall connect the main incoming panelboard in the Interim Facilities to the temporary power supply. Disconnection of the temporary power shall also be included in this Work.
- G. The Contractor shall connect the Interim Facilities to the temporary water and waste connections. This shall include, but not be limited to, trenching, backfilling, site restoration, and all couplings necessary to make a permanent connection. Disconnection of the temporary water and waste, including permanently capping the pipes shall also be included in this Work.
- H. The Contractor shall provide and pay in full for all of the following services for the Interim Facilities:
 - a. Electric energy usage (monthly utility bills);
 - b. Security System;
 - c. Fire Alarm System;
 - d. Phone System;
 - e. Heat/Ventilation/Air Conditioning;
 - f. Water and Sanitary Drainage;
 - g. Furnish, replace and replenish electric light bulbs and fluorescent tubes, toilet paper, paper towels, soap, potable water, fuel, and all else required to maintain the trailers in a clean and well-maintained condition.
 - h. The Contractor shall maintain and repair all services described above, to the satisfaction of the Engineer,

- I. The Contractor shall furnish and maintain the Interim. The Interim Facilities shall be located in the area designated in the Contract Documents.
- J. Trailers furnished by the Contractor shall be new, present a clean and neat exterior appearance and shall be maintained in a state of good repair. Trailers which, in the opinion of the Engineer, require exterior painting or maintenance shall not be allowed on the site.
- K. The Structures and Equipment shall submit for prior approval the following information:
 - a. Description of the Interim Facilities, and a listing of the office space (in square feet) by room.
 - a. Plan Drawing of the Interim Facilities, drawn to scale indicating the Contractor's designed layout of all specified furniture and equipment.
 - b. Contractor shall provide interior design of Interim Facilities.
 - c. Data sheets for all electronic devices, furniture to be provided under this Section.
 - d. Electrical one-line diagram.
- L. The Contractor shall locate, lease, including paying all deposits, monthly rental, utility (heat, electric, water, air conditioning, telephone, internet service, alarm central station, fire and theft insurance, etc.) accessory and maintenance fees and miscellaneous fees, for a furnished office for Long Beach WPCP Staff of two people for the duration of the construction of the Long Beach Consolidation Pump Station, plus the additional time that will take for the Force Main contract (S35109-01S) to be completed. The office shall be located as shown in the Contract Documents and ready for occupancy within 60 calendar days of the Notice to Proceed.
- M. The office space provided shall be provided with the following:
 - a. Sheet rocked and finished walls, with acoustical tile hung ceilings or equivalent prefabricated walls and ceilings.
 - b. Hollow core interior wooden office doors with metal frames.
 - c. At least 3 watts per square foot of lighting provided by overhead LED lighting.
 - d. LED security light fixtures located above exterior doors with integral photocell control.
 - e. Exit signs and emergency battery wall pack lighting fixtures installed throughout the Interim Facilities per NFPA101 recommendations.
 - f. One private office for two persons with lockable doors.
 - g. One copy area.
 - h. One kitchen area equipped with furniture relocated from the Service Building and a new microwave.
 - i. Heating system that shall be thermostatically controlled and capable of maintaining 70 degree F temperature in all rooms when the exterior air temperature reaches 10 degrees F.

- j. Central air conditioning units that shall be capable of maintaining a temperature of 75 degrees F in all rooms when the exterior air temperature reaches 95 degrees F.
 - k. Be freshly painted (colors to be selected by the Engineer).
 - l. Burglar and fire alarms wired to central station.
 - m. Maintenance for repairs and upgrades of all of the above equipment shall be included.
 - n. Compliance with ADA shall be required for all facilities.
 - o. Provide two male shower with locker room (lockers to be relocated from Service Building).
 - p. One lab room with a sample sink, two 8-foot long power strips, two 8-foot long countertops, and 16 feet of wall-mounted cabinets.
 - q. All electrical systems (panelboards, conduit, wire, etc.) as required for a fully operational system
- N. The Contractor shall maintain and repair the Interim Facilities complex and its equipment and services in a first-class condition as stipulated, to the satisfaction of the Resident Engineer during the performance of the Work under this Contract for the entire duration of the Contract.
- O. Accessories: Furnish and install the following as directed by the Engineer:
- a. Four dry chemical fire extinguishers, UL listed 1A-10BC
 - b. Kitchen Accessories - In addition to the furniture to be relocated from the Service Building
 - i. One electric bottle-less water filtration system with hot and cold outlets.
 - ii. One microwave oven.
 - iii. 3 linear feet of overhead kitchen cabinets.
 - c. Bathroom Accessories
 - i. The bathroom shall be ventilated at 75 cfm per toilet.
 - ii. Two (2) mirrors.
 - iii. One (1) medicine cabinet
 - d. Laundry Facilities
 - i. Relocate washer and dryer from the Service Building.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

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SECTION 01516

TEMPORARY FIRE PROTECTION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. The Contractor shall provide temporary fire protection at the Long Beach WPCP Service Building area and at all areas associated with the project site throughout the Project, until the County takes occupancy. Remove temporary fire protection when the County takes occupancy.
2. The Contractor shall comply with Section 901.7 and 1404.5 of the Fire Code of New York State (2010).
3. The Contractor shall pay all costs associated with temporary fire protection, including installation, maintenance, and removal.
4. The Contractor shall conform to provisions of this Section and Laws and Regulations.

B. Reference Standards and Regulatory Requirements:

1. Comply with applicable provisions of:
 - a. NFPA Standard No. 10, Portable Fire Extinguishers.
 - b. NFPA Standard No. 241, Safeguarding Building Construction and Demolition Operations.
 - c. Fire Code of New York State, Section 901.7.
 - d. Fire Code of New York State, Section 1404.5
2. Temporary fire protection shall conform to Laws and Regulations.

1.2 REQUIRED TEMPORARY FIREFIGHTING EQUIPMENT

- A. Provide portable fire extinguishers, rated not less than 2A or 5B in accordance with NFPA Standard No. 10 for each temporary building and for every 3,000 square feet of floor area under construction.
- B. Provide portable fire extinguishers 50 feet maximum from all points in protected area.

1.3 FIRE PREVENTION AND SAFETY MEASURES

- A. Prohibit smoking in hazardous areas and inside of the County's buildings. Provide visible, suitable warning signs in areas that are continuously or intermittently hazardous.
- B. Storage of Flammable and Combustible Products:
 1. Use metal safety containers for storing and handling flammable and combustible liquids and materials.

2. Do not store flammable or combustible liquids and materials in or near stairways or exits.
- C. Maintain clear exits from all points at the Site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01560

ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.1 GENERAL

- A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and adjacent areas. Remove physical evidence of temporary facilities at completion of Work.

1.2 NOISE CONTROL

- A. Contractor's vehicles and equipment shall be such as to minimize noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and in no case will noise levels be permitted which interfere with the Work of the County or others.

1.3 DUST CONTROL

- A. The Contractor shall be responsible for controlling objectionable dust caused by his operation of vehicles and equipment, clearing or for any reason whatever, in accordance with the General Conditions Article GC-25, "Dust Control and Spillage."

1.4 PEST AND RODENT CONTROL

- A. Provide rodent and pest control as necessary to prevent infestation of construction or storage area.
 - 1. Employ methods and use materials, which will not adversely affect conditions at the Site or on adjoining properties.
- B. Provide seals in accordance with the General Conditions, Article GC-26, "Vermin Control."

1.5 WATER CONTROL

- A. Provide methods to control surface water and water from excavations and structures to prevent damage to the Work, the Site, or adjoining properties.
 - 1. Control fill, grading and ditching to direct water away from excavations, pits, tunnels and other construction areas; and to direct drainage to proper runoff courses so as to prevent any erosion, damage or nuisance.
- B. Provide, operate and maintain equipment and facilities of adequate size to control surface water.

- C. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the Site or to adjoining areas and in conformance with all environmental requirements.
- D. All work must conform to the Storm Water Pollution Plan.

1.6 POLLUTION CONTROL

- A. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.
- B. Provide equipment and personnel, perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids.
 - 1. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.
- C. Take special measures to prevent harmful substances from entering public waters.
 - 1. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.
- D. Provide systems for control of atmospheric pollutants.
 - 1. Prevent toxic concentrations of chemicals.
 - 2. Prevent harmful dispersal of pollutants into the atmosphere.
- E. Contractor's equipment used during construction shall conform to all current federal, state and local laws and regulations.

1.7 EROSION CONTROL

- A. Plan and execute construction work and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold the areas of bare soil exposed at one time to a minimum.
 - 2. Provide temporary control measures such as berms, dikes and drains.
- B. Construct fills and waste areas by selective placement to eliminate surface silts or clays which will erode.
- C. Periodically inspect earthwork to detect any evidence of the start of erosion, apply corrective measures as required to control erosion.

1.7 HAZARDOUS MATERIALS CONTROL

- A. Refer to Section 01355, Hazardous Materials Control.

1.8 RAINWATER/SNOW, VENTILATION, AND TEMPERATURE CONTROL
AT DRY PIT/WET WELL

- A. The Contractor shall adopt measures to prevent rainwater and snow from entering the working area at the wet well and dry well of the new Long Beach Pump Station Consolidation once the existing roof slab is removed for the duration of construction. To maintain working conditions at the lower level of the facility while removing the roof slab, the contractor shall prepare and submit a plan to the County detailing the strategy that shall be followed to stop or minimize rain water and/or snow from entering the working space. The plan shall include measures to pump out any rainwater that may make its way inside the working area for any reason despite the measures taken to stop or minimize the rainwater from entering.
- B. The Contractor shall provide the means to maintain a safe working environment at the wet well and dry well areas while the existing roof slab is being removed and throughout the duration of construction. The working environment includes but it is not limited to:
 - a. Maintaining a comfortable working temperature.
 - b. Providing temporary ventilation to ensure workable conditions.
 - c. Providing temporary lighting to ensure workable conditions.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

++ NO TEXT ON THIS PAGE ++

SECTION 01610

TRANSPORTATION AND HANDLING OF MATERIALS AND EQUIPMENT

PART 1 – GENERAL

1.1 GENERAL

- A. The Contractor shall make all arrangements for transportation, delivery and handling of equipment and materials required for prosecution and completion of the Work.
- B. Shipments of materials to the Contractor or Subcontractors shall be delivered to the Site only during regular working hours. Shipments shall be addressed and consigned to the proper party-giving name of the Project, street number and city. Shipments shall not be delivered to the County except where otherwise directed.
- C. If necessary to move stored materials and equipment during construction, the Contractor shall move or cause to be moved materials and equipment without any additional compensation.

1.2 DELIVERY

- A. Arrange deliveries of products in accordance with construction schedules and in ample time to facilitate inspection prior to installation.
- B. Coordinate deliveries to avoid conflict with Work and conditions at site and to accommodate the following:
 - 1. Work of other contractors, or the County.
 - 2. Limitations of storage space.
 - 3. Availability of equipment and personnel for handling products.
 - 4. County's use of premises.
- C. Do not have products delivered to the Project Site until related Shop Drawings have been approved by the Engineer.
- D. Do not have products delivered to the Site until required storage facilities have been provided.
- E. Have products delivered to the Site in manufacturer's original, unopened, labeled containers. Keep the Engineer informed of delivery of all equipment to be incorporated in the Work.
- F. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts and to facilitate assembly.

- G. Immediately on delivery, inspect shipment to assure:
 - 1. Product complies with requirements of the Contract Documents and reviewed submittals.
 - 2. Quantities are correct.
 - 3. Containers and packages are intact, labels are legible.
 - 4. Products are properly protected and undamaged.

1.3 PRODUCT HANDLING

- A. Provide equipment and personnel necessary to handle products by methods to prevent soiling or damage to products or packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring or otherwise damaging products or surrounding surfaces.
- C. Handle products by methods to prevent bending or overstressing.
- D. Lift heavy components only at designated lifting points.
- E. Materials and equipment shall at all times be handled in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them. Do not drop, roll or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

1.4 REMOVING, HAULING, AND INSTALLING EQUIPMENT AND MATERIALS

- A. The Contractor shall inspect all items including all boxes, crates and packages containing equipment and materials for damage that may have occurred during shipment prior to its removal from the truck or other conveyance. Any damage shall immediately be reported to the Engineer. The Contractor shall then carefully remove the equipment and materials from the truck or trucks on which it is shipped. The equipment and materials shall then be transported to the place of installation at the job Site. The Contractor shall be liable for loss or damage that the equipment and materials may receive while being unloaded, transported, stored or installed. The Contractor shall employ competent mechanics experienced in the installation of the types of equipment and materials to be furnished, and shall ensure that all equipment and materials are installed in accordance with the recommendations of the manufacturer. Bolts, nuts and other fastenings shall be furnished by the Contractor, and shall comply with the applicable requirements as specified. Equipment that arrives at the job site during normal working hours shall be unloaded as soon as practicable.

1.5 COORDINATE STORAGE AND INSTALLATION

- A. The Contractor shall coordinate storage and installation of new equipment with construction schedule for existing and new structures.

1.6 CONTRACTOR'S USE OF COUNTY LIFTING EQUIPMENT

- A. The Contractor shall not be permitted to use any existing lifting equipment at County facilities unless the following procedure is followed:
1. Contractor shall employ the services of a qualified representative of the lifting equipment manufacturer to inspect all equipment. The manufacturer shall certify that said equipment is in safe operating condition and meets the rated load capacities. The County makes no claim that any existing lifting equipment is in operable condition or meets the requirements of the Contractor. All costs for inspections, certifications and repairs shall be the responsibility of the Contractor.
 2. Upon submittal of the required certifications and receipt of written authorization from the County, the Contractor will assume full responsibility for the operation, maintenance and regular inspection of the lifting equipment for the duration of his work.
 3. Upon completion of his work, the Contractor shall employ the services of a qualified representative of the lifting equipment manufacturer to re-inspect the equipment. The manufacturer shall recertify that said equipment is in safe operating conditions. All costs for inspections, certifications and repairs shall be the responsibility of the Contractor.
 4. Upon submittal of the required certifications and acceptance by the County, the County will resume responsibility for the equipment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

++ NO TEXT ON THIS PAGE ++

SECTION 01650

STARTING OF SYSTEMS

PART 1 – GENERAL

1.1 GENERAL

- A. The Contractor shall initially start up and place all equipment installed by him into successful operation according to manufacturers' written instructions and as instructed by manufacturers' field representatives. Provide all material, labor, tools, equipment, and expendables required.
- B. General Activities Include:
 - 1. Cleaning.
 - 2. Removing temporary protective coatings.
 - 3. Flushing and replacing greases and lubricants, where required by manufacturer.
 - 4. Lubrication.
 - 5. Check shaft and coupling alignments and reset where needed.
 - 6. Check and set motor, pump and other equipment rotation, safety interlocks, and belt tensions.
 - 7. Check and correct if necessary leveling plates, grout, bearing plates, anchor bolts, fasteners, and alignment of piping which may put stress on pumping equipment connected to it.
 - 8. All adjustments required.
- C. Provide initial filling of lubricants and all other required operating fluids.
- D. Also provide filters, chemicals, and other expendables required for initial start up of equipment unless otherwise specified.

1.2 MINIMUM START-UP PROCEDURES

- A. Bearings and Shafting:
 - 1. Inspect for cleanliness, clean and remove foreign materials.
 - 2. Verify alignment.
 - 3. Replace defective bearings, and those which run rough or noisy.
 - 4. Lubricate as necessary, in accordance with manufacturer's recommendations.
- B. Drives:
 - 1. Adjust tension in V belt drives, and adjust varipitch sheaves and drives for proper equipment speed.
 - 2. Adjust drives for alignment of sheaves and V belts.
 - 3. Clean and remove foreign materials before starting operation.

- C. Motors:
 - 1. Check each motor for comparison to amperage nameplate value.
 - 2. Correct conditions which produce excessive current flow, and which exist due to equipment malfunction.
 - 3. Check each motor for proper rotation.
- D. Pumps:
 - 1. Check glands and seals for cleanliness and adjustment before running pump.
 - 2. Inspect shaft sleeves for scoring.
 - 3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
 - 4. Verify that piping system is free of dirt and scale before circulating liquid through the pump.
- E. Valves:
 - 1. Inspect both hand and automatic control valves, clean bonnets and stems.
 - 2. Tighten packing glands to assure no leakage, but permit valve stems to operate without galling.
 - 3. Replace packing in valves to retain maximum adjustment after system is judged complete.
 - 4. Replace packing on any valve which continues to leak.
 - 5. Remove and repair bonnets which leak.
 - 6. Coat packing gland threads and valve stems with a surface preparation of "Moly Cote" or "Fel Pro", after cleaning.
- F. Verify that control valve seats are free from foreign material, and are properly positioned for intended service.
- G. Tighten all pipe joints after system has been tested.
 - 1. Replace gaskets which show any sign of leakage after tightening.
- H. Inspect all joints for leakage.
 - 1. Promptly remake each joint which appears to be faulty, do not wait for rust to form.
 - 2. Clean threads on both parts, apply compound and remake joints.
- I. After system has been tested, clean strainers, dirt pockets, orifices, valve seats and headers in fluid system, to assure freedom from foreign materials.
- J. Open steam traps and air vents where used, remove operating elements.
 - 1. Clean thoroughly, replace internal parts and put back into operation.
- K. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
- L. Set and calibrate equipment.
- M. Inspect fan wheels for clearance and balance.

1. Provide factory authorized personnel for adjustment when needed.
- N. Check each electrical control circuit to assure that operation complies with Specifications and requirements to provide desired performance.
- O. Inspect each pressure gage and thermometer for calibration.
 1. Replace items which are defaced, broken, or which read incorrectly.
- P. Repair damaged insulation.
- Q. Vent gasses trapped in any part of systems.
 1. Verify that liquids are drained from all parts of gas or air systems.

1.3 INITIAL PLANT START-UP

- A. Prior to start-up of the plant facilities, the Contractor shall have prepared and pre tested all equipment to check its ability for sustained operation, including inspections and adjustments by manufacturer's servicemen, as specified in Section 01660 and this Section. Also, all training by vendors shall have begun and all O&M manual submittals shall be completed prior to start-up.
- B. After the facilities are sufficiently complete to permit start up, the Contractor shall furnish competent personnel to start up the plant facilities. The Contractor will be responsible for start-up of all facilities constructed under this Contract. During the initial start-up period the Contractor shall check and provide for satisfactory mechanical operation of the plant facilities. Prior to start up, the Contractor shall prepare a schedule detailing the proposed start up and his plans for manpower and auxiliary facilities to be provided. The start-up schedule is subject to approval of the Engineer. Start-up of the plant by the Contractor shall include the operation and maintenance of all mechanical facilities such as pumps, and like equipment, and the ventilating, air conditioning (or heating), and electrical systems. The start-up period shall be a minimum of 10 consecutive 24-hour days of satisfactory operation of the facility or the number of days called for in the Technical Specifications. Start-up of either the heating or air conditioning systems is dependent upon the time of year that the plant start up is initiated. The Contractor will be required to return at the beginning of the next heating or air conditioning season (whichever is applicable) to start the appropriate system.
- C. After completing the start-up of the Long Beach Consolidation Pump Station , the Contractor shall be responsible for the start-up and activation of the 24-inch Force Main built under Contract S35109-01S. The Contractor shall coordinate with the S35109-01S Contract as needed to address any issues during the start-up and activation of the Force Main.
- D. When the start-up period is completed, the County will assume responsibility for operation of the new facilities, provided that all major items of the Work are

operating satisfactorily and operation and maintenance training has been completed satisfactorily. If any or all of the new facilities are not operating satisfactorily at the end of the start-up period, the Contractor shall continue to operate those facilities that are incomplete or not operating satisfactorily until they are complete and acceptable to the County.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01660

QUALITY CONTROL

PART 1 – GENERAL

1.1 GENERAL

- A. All materials and equipment will be tested and inspected to insure full and complete compliance with the Specifications as determined by the County. All testing shall be in accordance with the American Society for Testing Materials and other Specifications as specified herein. Responsibility for performing testing shall be in accordance with the Detailed Specifications.
- B. The County will perform the tests tabulated in the General Conditions, Article GC 19, "Inspection and Testing".
- C. The Contractor shall perform all other testing laboratory services and furnish all test reports in accordance with the requirements of the General Conditions, Article GC 19, "Inspection and Testing".
- D. The Contractor shall perform all leak testing of concrete structures as described herein.

1.2 FIELD TESTING OF EQUIPMENT

- A. General:
 - 1. Field testing of equipment shall conform to the requirements of the General Conditions, Article GC 19, "Inspection and Testing", the Technical Specifications and as hereinafter specified.
- B. Preliminary Field Tests, Yellow Tag:
 - 1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall check the equipment for alignment, direction of rotation and absence of defects.
 - 2. Purpose of tests is to determine if equipment:
 - a. Is properly installed.
 - b. Complies with operating cycles.
 - c. Is operational and free from overheating, overloading, vibration or other operating problems.
 - 3. The Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
 - 4. The Contractor shall furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.
 - 5. The Contractor shall make all changes, adjustments and replacements

required to place equipment in service and test it.

6. The Engineer and the County shall be given sufficient prior notice to witness tests.
7. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer or his designated representative, and attached to the equipment. The tag shall not be removed.
8. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

C. Final Field Tests, Blue Tag:

1. Upon completion of the installation, and at a time approved by the Engineer, equipment will be tested by operating it as a unit with all related piping, ductwork, electrical controls and mechanical operations.
2. To the maximum extent possible, the Contractor shall perform final field tests of equipment prior to initial start-up and operation of the Project. Where this is not practicable, final field tests shall be performed during initial start-up and operation of the Project.
3. Purpose of the tests is to demonstrate that equipment is:
 - a. Properly installed.
 - b. Completely ready for operation by the County personnel.
 - c. In compliance with design conditions, material specifications and all other requirements of the Contract Documents.
4. The Contractor shall submit the test procedure for approval by the Engineer. The procedure shall specify the duration and the parameters of the test.
5. The Contractor shall notify the Engineer at least 24 hours prior to beginning of tests. The Contractor shall keep notes and data on tests and submit copy to the Engineer. The Engineer and the County's operating personnel shall witness all tests.
6. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his designated representative.
7. Each pump shall be tested at maximum rated speed for the number of points specified in the Technical Specifications, but no less than four points, on the pump curve for capacity, head and electric power input. The rated motor nameplate current and power shall not be exceeded at any point within the specified range. Vibrometer readings shall be taken when directed by the Engineer and the results recorded.
8. Pumps with drive motors rated at less than five horsepower shall only be tested for excess current or power when overheating or other malfunction becomes evident in general testing.
9. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the County.
10. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
11. Upon acceptance of the field tests a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be

removed and no further construction Work will be performed on the unit, except as required during start-up operations and directed by the Engineer.

12. All costs in connection with such tests including all materials, equipment, instruments, labor, etc. shall be borne by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

++ NO TEXT ON THIS PAGE ++

SECTION 01700

MAINTENANCE OF PLANT OPERATIONS

PART 1 – GENERAL

1.1 GENERAL

- A. The intent of this Section is to have Contractor perform his Work in such a manner that continuous, uninterrupted treatment of the waste flows (water) and all essential Plant services and facilities are maintained operational throughout the construction period.
- B. Except for the scheduled shutdowns specified in this Section, the existing plant will be maintained in continuous operation by the City of Long Beach during the entire construction period. The Contractor shall be responsible for preparing, installing and performing all work related to bypassing wastewater flow. Work under this Contract shall be scheduled and conducted by Contractor such that it will not impede any treatment process, create potential hazards to operating equipment and Plant Personnel, reduce the quality of the plant effluent or cause odor or other nuisance. In performing the Work shown and specified, Contractor shall plan and schedule Work to meet both constraints outlined in this Section and plant operating requirements.
- C. The Work covered in the following paragraphs may not be all inclusive of all Work which may affect plant operations. All operations which involve the demolition, isolation or tie-in to the existing plant equipment and/or systems will be submitted for approval.
- D. Temporary pumping or fluming will be required during this project for the maintenance of sanitary sewer flow which are to be rerouted.
- E. Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without additional cost to the County, it does not require the County and/or the City of Long Beach to perform additional work, and that all requirements of these Specifications are fulfilled.
- F. The Contractor shall not shut off or disconnect any operating system of the Plant. All Plant equipment operation and equipment shutdowns shall be executed by the City of Long Beach. The Contractor shall put in place a Lock Out Tag Out (LOTO) system for the safety of their workers in conjunction with Plant's LOTO.
- G. The Contractor should be aware that existing valves, dampers, sluice gates, and other shutoff devices may not be tight closing and that supplemental pumping

and/or other means may have to be provided by the Contractor to isolate the system as intended.

- H. This Section of the Specifications contains several references to equipment, piping, material and appurtenances to be removed or reinstalled. The Contractor shall also refer to the Drawings and other applicable Sections for definition of the equipment, piping, material and appurtenances to be removed and turned over to the County or to become the property of the Contractor and removed from the site.
- I. Related Sections:
 - 1. Section 02050, Demolition, Removals and Modifications.
 - 2. Section 13123, Pre-Engineered Shelter
 - 3. Section 11217, Mechanical Bar Screen
 - 4. Section 16020, Temporary Electrical Systems
 - 5. Section 16300, Utility Electrical Services

1.2 GENERAL CONSTRAINTS

- A. Paragraph 1.3 of this Section specifies the sequence and shutdown duration (where applicable) for Plant units which are to be taken out of service. The operational status of new or existing equipment and systems other than the designated shall not be interrupted by the Contractor during the specified time periods. New equipment may only be used after the specified testing and acceptance of the systems by the County.
- B. The following constraints shall be applied to all equipment and appurtenant utility systems on the Plant site.
 - 1. Load limits on Access Roads: Existing and new underground facilities such as electrical duct banks, pipelines, etc., in, under and crossing plant roads have been designed for a maximum wheel load of AASHTO H-20. The Contractor shall not exceed this weight limit.
 - 2. Access to Plant Site: An unobstructed traffic route through all Plant gates must be maintained at all times.
 - 3. Internal Roads Access: Vehicular access to all treatment units and buildings must be maintained at all times.
 - 4. Personnel Access: Treatment Plant Personnel must have access to all areas that remain in operation throughout the construction period.
 - 5. Potable Water System: The existing potable water system shall be kept in operation at all times.
 - 6. Plumbing Facilities: Sanitary facilities in the existing structures shall be operational at all times for Plant operating personnel. All other building plumbing systems such as roof and floor drains, pumping, etc. shall be maintained for all structures.
 - 7. Storm Drainage: Storm drainage on the site shall be operational at all times.
 - 8. Building Heating and Ventilating: In the Contractor's work areas and areas affected by the Contractor's operations, building heating and ventilating shall

be both provided and maintained by the Contractor. Temperatures to be maintained in any area occupied by Plant Personnel such as offices, lunchrooms, locker rooms, toilet rooms, etc., shall be at least 65°F. Temperatures to be maintained in all other interior Plant areas, whether new, existing or temporary, shall be maintained at a minimum of 55°F as specified in Section 01500, Temporary Facilities and Controls.

9. Power, Light and Communication Systems: Electric power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas unless otherwise shown or specified.
10. Draining Process Pipes and Conduits:
 - a. Unless otherwise specified, the contents of pipes and conduits undergoing modifications shall be transferred to the Plant drain sewer system using hoses, piping, or pumps (if hydraulic conditions so require them) by the Contractor
 - b. If a drain is not available on the pipe to be drained, then a wet tap shall be made by the Contractor using an approved tapping saddle and valve. No uncontrolled spillage of a pipe's contents shall be allowed.
 - c. All spillages shall be immediately washed down by the Contractor to the floor drains, sumps and sump pump discharge piping flushed out by the Contractor to prevent clogging and septic odors.
 - d. Contractor shall dewater all existing pipes, as necessary, to perform the work. All dewatering and isolation activities will be coordinated with the City and the County.
11. Dead End Valves or Pipe: The Contractor shall provide blind flanges on all valves or pipe that dead-end a line on a temporary or permanent basis as specified in Section 02050, Demolition, Removals and Modifications.
12. Flow Control Precautions:
 - a. When flow in a sewer line is plugged, blocked or diverted by the Contractor, the Contractor shall take sufficient precautions to protect the public health and to protect the sewer lines from damage that might result from sewer surcharging. Further, the Contractor shall take precautions to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

1.3 SHUTDOWNS

A. General:

1. Shutdown shall be defined to indicate that a portion of the normal operation of a Plant unit has to be suspended or taken out of service in order to perform the specified work. For each shutdown, the Contractor shall compile an inventory of its labor and materials required to perform the tasks, an estimate of the time required and a written description of steps required to complete the tasks. Contingency time shall be provided where existing shut-off devices do not close tight and supplemental pumping and/or other devices are required

to maintain dry conditions. The inventory, the estimate and written procedure shall be submitted to the County for review 60 calendar days prior to the proposed start date of the shutdown. The Contractor shall also request in writing, from the County, approval for each shutdown a minimum of fourteen calendar days prior to the proposed date. No shutdown shall be initiated until the list of materials and labor is verified on site at least one week prior to the proposed start date.

2. Work required which will interrupt the normal Plant operations shall be accomplished at such times that will be convenient to the City of Long Beach.
3. The Contractor shall provide 7-day advance notice of needed shutdowns to all Plant and Operations staff.
4. The Contractor shall also have on hand, located in close proximity to the Work area, all tools, equipment and materials, both temporary and permanent, necessary to complete each work category, without interruption. Adequate numbers of personnel shall be scheduled for each shutdown, so that the work may be accomplished within the specified time frame. Prefabrication of all piping, ductwork and other assemblies shall be completed to greatest degree possible, prior to any shutdowns. The County and the City of Long Beach shall be satisfied that the Contractor has complied with these requirements, to the fullest extent possible, before shutdowns will be authorized.

B. Shutdowns of Mechanical and Electrical Systems: The Contractor and the City of Long Beach shall lock out and tag circuit breakers and switches operated by the City of Long Beach and shall check cables and wires to be sure that they are de-energized to ground potential before Work begins and that all mechanical isolation devices are functional. Upon completion of the Work, the Contractor shall remove the locks and tags and advise the City of Long Beach that the facilities are available for use. The City of Long Beach will then remove their locks and place facilities back into use.

C. Staging of Electrical Resupply of Treatment Plant:

1. All shutdowns shall be scheduled in advance during periods of dry weather. Shutdowns will be permitted one at a time during normal working hours between Monday and Friday and after acceptance by the County.
2. Prior to each shutdown perform all necessary field investigations of equipment and circuits necessary for the resupplies required and identify all necessary equipment and tools that will be required to execute the work.
3. During the shutdown period, the work shall be executed in a continuous fashion with sufficient manpower so that the circuits become operational within the shortest time possible and not exceeding the shutdown times allocated.
4. During the shutdown period, the remaining circuits shall remain operational to the maximum extent possible. The work under the next shutdown shall not proceed until the previous work becomes operational. The work shall be considered operational when the modification is complete, has been proven, tested, and accepted by the County.

5. The scheduled shutdowns and the recommended sequential order of the work is presented in Table 01700-B. The Contractor shall have the option of requesting alternate sequences provided it is done without additional costs to the County and provided all criteria and restrictions are fulfilled.
6. All shutdowns shall be at the discretion of the County. The County will review the Contractor's plan and select what will be taken out of service first and will establish the order of subsequent shutdowns. The shutdown schedule and sequential order established will be subject to revision by the County should conditions change or as may be required to satisfy operational aspects of the facility.

1.5 OVERTIME

- A. Overtime Work by the Contractor necessary to conform to the requirements of this Section and related Sections shall be performed by the Contractor and the Contractor shall make no claims for extra compensation as a result thereof.

1. MAINTENANCE OF PLANT OPERATIONS (MOPO) AND SEQUENCE OF CONSTRUCTION

- A. In order to maintain a continuous plant operation during construction, a MOPO Description Section is included in Part 3 - Execution. The category order and item order within each category are not intended as an exact sequence of work or a listing of priorities. However, each item procedural steps are intended to recommend a sequence and timing in order to maintain the continuous operation of the Plant.
- B. The Contractor shall note that all necessary shutdowns may not be included in the MOPO Descriptions. As the need for additional shutdowns becomes evident, the Contractor shall notify the Engineer, who with assistance and approval of the County and the City of Long Beach, will arrange for necessary shutdowns at no extra cost for the County.
- C. Contractor is advised that work in multiple areas of the Plant performed simultaneously may be required in order to complete the entire scope of the Contract within the allotted time.
- D. Refer to "Detailed MOPO Descriptions", located in Part 3 - EXECUTION.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

Detailed MOPO Description Constraints and Requirements

Stage 1: Install Force Main from Sta 0+76 to 2+39 and Relocate Process Pipes

- A. The Contractor shall prepare site in accordance with the general notes of drawing C-01.
- B. The contractor shall provide continuous access to the Long Beach WPCP.
 - a. The 24-inch force main shall be installed from Sta 0+75 to Sta 2+39 as shown in the contract drawings.
 - b. The contractor shall provide a temporary road to facilitate access to the Long Beach WPCP while the construction of the force main takes place.
 - i. Use construction mats for temporary road.
 - c. The force main must be installed before the construction of the Temporary Bypass Pump Station (Stage 2) can commence.
- C. Contractor shall locate buried utilities in the vicinity of the work.
- D. Contractor shall minimize the disturbance to existing utilities that will remain in place and shall obtain approval from the County for any relocation of buried utilities. All costs associated with the relocation of utilities and obtaining approvals shall be included in the contract price. The Contractor shall coordinate with Long Beach WPCP Personnel before the demolition and/or relocation of any of the active or abandoned pipes within the facility can commence. The following list details the buried utilities that shall need to be removed and/or relocated as shown in the contract drawing (refer to Table 01700-A for details of process shutdowns):
 - a. Relocate existing 20-inch D.I. trickling filter recirculation force main.
 - i. The 20-inch diameter trickling filter recirculation force main conveys trickling filter effluent from the Recirculation Pump Station to the 48-inch trickling filter influent. The 20-inch trickling filter force main will be relocated between the limits shown in the contract drawings by installing two tapping valves with a 20-inch bypass pipe section. The check valves at the Recirculation Pump Station are damaged and may not hold flow from backflowing into the wet well. The installation of the two tapping valves may therefore be completed employing the following recommended steps:
 1. Prepare the site by excavating and exposing the 20-inch trickling filter recirculation force main at the location of the northern most tapping valve location.
 2. Once the layout of the tapping valve along with all the necessary equipment is ready for the installation, and at a low flow period, stop the pumps at the Existing Long Beach Pump Station and at the Recirculation Pump Station.
 3. Drain the remaining flow from the 20-inch trickling filter recirculation force main by opening all of the valves at the Recirculation Pump Station.
 4. Once the wastewater is drained out of the 20-inch trickling filter recirculation force main, the pipe can be cut in dry, and the northern most tapping valve may be installed.

5. The second tapping valve, located south of the Trickling Filters, may then be installed at any time by stopping the pumps at the Recirculation Pump Station and closing the northern most tapping valve. There will be no need to stop the Existing Long Beach Pump Station to install the second tapping valve.
 6. Contractor shall coordinate with plant personnel to agree on proper timing to discontinue any of the forward flows described above.
 7. Refer to the Table 01700-A for process related shutdown times.
- b. Demolish and cap existing 20-inch D.I. trickling filter recirculation force main.
 - i. A section of the 20-inch trickling filter recirculation pump station force main shall be demolished and capped between the limits shown in the contract drawings. Contractor to close the valve upstream of the section of the pipe being demolished before proceeding with the demolition.
 - c. Demolish and cap 3-inch abandoned chlorine pipe.
 - i. Demolish and cap the 3-inch abandoned chlorine pipe as shown in the contract drawings.
 - d. Relocate 8-inch C.I. primary sludge force main.
 - i. The 8-inch diameter primary sludge force main conveyances sludge from the Primary Settling Tank to the Digester Building. The 8-inch primary sludge force main will be relocated between the limits shown in the contract drawings by installing two tapping valves with an 8-inch bypass pipe section. The installation of the two tapping valves may be completed employing the following recommended steps:
 1. Prepare the site by excavating and exposing the 8-inch primary sludge force main at the location of the western most tapping valve.
 2. Turn off the sludge pumps at the Primary Settling Tank and drain the force main.
 3. Once the wastewater is drained out of the 8-inch primary sludge force main, the pipe can be cut in dry, and the western most tapping valve may be installed.
 4. The second tapping valve, located downstream of the first tapping valve, may then be installed at any time by stopping the pumps at the Recirculation Pump Station and closing the western most tapping valve.
 5. Contractor shall coordinate with plant personnel to agree on proper timing to discontinue the primary sludge flow.
 6. Refer to the Table 01700-A for process related shutdown times.
 - e. Relocate 8-inch D.I. secondary sludge force main.
 - i. The 8-inch diameter secondary sludge force main conveyances sludge from the Final Settling Tank to the head of the Primary

Settling Tank. The 8-inch secondary sludge force main will be relocated between the limits shown in the contract drawings by installing two tapping valves with an 8-inch bypass pipe section. The installation of the two tapping valves may be completed employing the following recommended steps:

1. Prepare the site by excavating and exposing the 8-inch secondary sludge force main at the location of the eastern most tapping valve.
 2. Turn off the sludge pumps at the Final Settling Tank and drain the force main.
 3. Once the wastewater is drained out of the 8-inch secondary sludge force main, the pipe can be cut in dry, and the eastern most tapping valve may be installed.
 4. The second tapping valve, located downstream of the first tapping valve, may then be installed at any time by stopping the pumps at the Final Settling Tank and closing the eastern most tapping valve.
 5. Contractor shall coordinate with plant personnel to agree on proper timing to discontinue the secondary sludge flow.
 6. Refer to the Table 01700-A for process related shutdown times.
- f. Remove and cap 6-inch VTP sanitary sewer pipe and install a flexible connection using temporary pumping to divert sanitary flow.
- i. The sanitary sewer manhole located at the coordinates N 0+68, E 0+72, conveys flows through the 6-inch VTP sewer pipe from the processes described below to the Existing Long Beach Influent Pump Station. The 6-inch sewer pipe shall be demolished, and a temporary bypass system shall be installed to convey the flow. A temporary pump shall be installed at the above-mentioned manhole. A flexible hose shall be installed to divert the flow between the limits shown in the contract drawings. The bypass system shall remain in operation throughout the entire period of construction:
 1. Sand filter backwash. Flow runs continuously on automatic mode. Flow may be interrupted upon coordination between contractor and Long Beach WPCP personnel.
 2. Final Settling Tank skimming. Flow runs once a day on manual mode. Contractor to coordinate with Long Beach WPCP on proper timing flow stoppage.
 3. Filtrate. Flow runs once a week on manual mode. Contractor to coordinate with Long Beach WPCP on proper timing flow stoppage.
 4. Final Settling Tank Decant. Flow runs once a week on manual mode. Contractor to coordinate with Long Beach WPCP on proper timing flow stoppage.

- ii. Once the temporary bypass pumping system is installed, tested, and approved by the County and the City, plug pipe opening at the west face of manhole.
 - iii. Contractor to determine the flow rates expected from each processes to properly size pumping unit and pipe size.
- g. Demolish 8-inch RCP storm pipe and catch basins as shown in the contract drawings.
 - i. Contractor to ensure stormwater flow to be properly diverted and sediments removed once storm drainage pipe is demolished.
- h. Relocate the 2-inch water service pipe.
 - i. Contractor to coordinate with Long Beach WPCP personnel to close the main water valve prior the removal of the 2-inch water service pipe.
 - ii. Once water service is interrupted from entering the facility, the 2-inch pipe can be demolished between the limits shown in the contract drawings.
 - iii. Install the new 2-inch water service pipe, fire hydrant, and yard hydrant, as show in the contract drawings.

Stage 2: Construct Temporary Bypass Pump Station and Temporary Electrical Facility

- A. The Contractor shall prepare the Site for the Temporary Bypass Pump Station and Temporary Electrical Facilities and shall provide barriers and/or fencing to prevent damage to existing facilities due to traffic and large equipment.
- B. The Temporary Bypass Pump Station shall consist of bar screen, three pumps, associated piping, valves, flow meter and controls as shown on the drawings.
- C. The Temporary Bypass Pump Station shall be installed at the constructed as shown on the Contract Drawings.
- D. The construction of the Bypass Pump Station shall not proceed until the overhead primary supply wiring has been relocated by PSE&G Long Island.
- E. The Temporary Electrical Facility will be constructed to transfer the Long Beach WPCP power and controls currently located at the Service Building. The Temporary Electrical Facility shall consist of temporary switchboard, temporary transformer and temporary diesel generator and associated conduits and cable. Power to the Temporary Bypass Pump Station and all other temporary services, including Plant Operators' trailers will be provided from the Temporary Electrical Facility. The temporary electrical system is described in Specification Section 16020.

- F. The Contractor shall make all necessary arrangements with PSEG Long Island to obtain the temporary service supplies at service point No.1 and No.2. as described by and in accordance with Section 16020 – Temporary Electrical Systems and Section 16300 – Utility Electrical Services. Arrangements shall be made with PSEG Long Island immediately after notice to commence work in accordance with the Specification.
- G. Install temporary transformer and all temporary electrical conduits and cables to feed the Temporary Electrical Facility.
- H. Install temporary generator at the location indicated in the contract drawings.
- I. Install and furnish Owner's Temporary Facilities per specification Section 15000. The Owner's Temporary Facility shall be approved and accepted by the County before it can be occupied.
- J. The Mechanical Bar Screen shall discharge screenings into a dumpster available at the Long Beach WPCP. Two dumpsters of 3 CY capacity are available for the Contractor's use during construction. Contractor shall ensure that the dumpsters are accessible by the sanitation truck for screenings disposal daily.
- K. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharge or damage to tributary sewers and that will protect public and private property from damage.

Stage 3: Connect Temporary Bypass Pump Station and Temporary Electrical Facility

- A. Construct Diversion Chamber around the 48-inch sanitary pipe without plant's flow interruption. A flow through plug can be employed to allow the construction of the chamber without interrupting existing pump station flow. The construction of the diversion chamber may be completed employing the following recommended steps:
 - a. Excavate and expose the top of the 48" RCP existing sanitary pipe where flow will be diverted.
 - b. During low flow conditions, the top of 48" RCP existing sanitary pipe can be removed.
 - c. Insert and extend the flow through plug across the width of proposed chamber. The ends of the inflatable plugs will provide the seal. The plug shall be sized to cause minimal resistance to the flow and shall be secured in the pipe against movement.

- d. Once the flow through plug is installed and accepted by the County and the City of Long Beach, the diversion chamber can be constructed in dry as shown in the construction drawings.
 - e. The flow through plug will be removed after completion of Diversion Chamber construction.
- B. Construct the bypass connection of the 24-inch temporary force main from the Temporary Bypass Pump Station to the 24-inch existing force main at the head of the grit chamber. The temporary bypass connection consists of a 24-inch wye and 24-inch plug valve installed at the existing 24-inch force main. Two tapping valves shall be installed at either side of the existing 24-inch force main at the area of the bypass connection. The construction of the bypass connection may be completed employing the following recommended steps:
- a. Prepare the site by excavating and exposing the existing 24-inch force main at the location of the bypass connection.
 - b. Turn off the Existing Long Beach Pump Station and drain the existing 24-inch force main.
 - c. Once the wastewater is drained out of the 24-inch force main, the pipe can be cut in dry, and the first tapping valve may be installed.
 - d. The Existing Long Beach Pump Station shall be restored to normal operation conditions.
 - e. The second tapping valve shall be installed repeating the steps from the first tapping valve installation.
 - f. A section of 24-inch pipe diameter shall be installed connecting the two tapping valves.
 - g. Once the system is tested and accepted by the County and the City of Long Beach, the isolated section of the pipe can be bypassed, the pipe drained, and the section cut. The 24-inch wye and the 24-inch plug valve can then be installed in dry.
 - h. Contractor shall coordinate with plant personnel to agree on proper timing to discontinue the plant flow from the Existing Long Beach Pump Station.
 - i. The Existing Long Beach Pump Station shall be shut down for a maximum period of 3 hours at a time.
 - j. Refer to the Table 01700-A for process related shutdown times.

- C. Connect the Temporary Electrical Facility to existing equipment in a staged sequence to minimize impacts to plant operations as specified in specification 16020 – Temporary Electrical System. Test equipment and systems in accordance to the specifications. Upon completion and acceptance of the Temporary Electrical Facility, the Temporary Bypass Pump Station testing can commence.

- D. Temporary Bypass Pump Station Testing: The Temporary Bypass Pump Station shall be tested prior to beginning a demonstration period. The Contractor shall close the influent gates of the Existing Long Beach Pump Station to allow the flow to fall back into the Temporary Bypass Pump Station. Testing shall occur during owners normally scheduled workdays, Monday through Thursday, between the hours of 8:30 a.m. and 3:00 p.m. Testing shall NOT be allowed Friday through Sunday, on the Owner's scheduled Holidays, or on the day immediately prior to an Owner's scheduled Holiday.
- E. Demonstration Period: Upon completion of testing, Contractor shall operate the Temporary Bypass Pump Station 24 hours a day, for as long as necessary but no less than one calendar week, without failure, to demonstrate reliable operation of the entire system, including but not limited to pumps, screen and controls, to the satisfaction of the County.
- F. Install new 60-inch manhole at coordinates W 0+42, N 0+56 and divert influent flow into Temporary Bypass Pump Station. The construction of the new manhole and the diversion of flow may be completed employing the following recommended steps:
- a. A temporary pneumatic inflatable plug shall be installed downstream of the sanitary manhole located at coordinates W 0+42, N 0+48 to stop forward flow.
 - b. The section of 48-inch sewer pipe upstream of manhole located at coordinates W 0+42, N 0+48 can then be drained, and work can be completed in dry conditions.
 - c. Install new manhole at coordinates W 0+42, N 0+56 and new 48-inch pipe as shown in contract drawings. Manhole shall be plugged at the northeast face to contained influent flow.
 - d. Once the new manhole ins installed and the plug is accepted by the County and the City of Long Beach, the contractor shall remove the pneumatic inflatable plug.
- G. Demolish the 24-inch existing force main from the Existing Pump Station to the bypass location. The 24-inch force main shall be taken out of service and removed after the temporary bypass station is completed and accepted by the County and the City of Long Beach.
- H. Demolish existing conduit banks.
- I. Pump stoppage and operation of the Existing Pump Station will be performed by Long Beach WPCP personnel only as required for construction, testing and acceptance of the Temporary Bypass Pump Station. Flow transfer between the

pump stations shall be coordinated by the Contractor with the operating personnel.

- J. In addition to training requirements detailed in Section 11115 – Submersible End Suction Pumps – Wet Pit (Bypass) and Section 11217 – Mechanical Bar Screen, Contractor shall provide a minimum of four (4) days of training on operation of the bypass pump station for Long Beach WPCP Personnel.
- K. Upon successful completion of the demonstration period, approval of the Temporary Bypass Pump Station and completion of training, Long Beach WPCP personnel will be responsible for the operation of the temporary pump station. All emergencies, maintenance, repairs and other operations above the daily expected operations, will be the Contractor's responsibility.
- L. During Temporary Bypass Pump Station operations, the Contractor shall protect the bypass pump station and existing collection system from damage. The Contractor shall be responsible for any damage to the bypass pump station.
- M. The Contractor shall be available 24 hours a day, 365 days a year to respond to any failures or emergency situations impacting the Temporary Bypass Pumping Station. At a minimum, the Contractor shall follow the 3-hour response time, requiring qualified personnel to be on Site within 3 hours after the initial alarm notification to immediately perform the necessary repairs to return the malfunctioning equipment back into service.
- N. Maintenance service: Contractor shall properly maintain the bypass pumping system, and shall insure a responsible and competent mechanic/operator shall be on call at all times.
- O. Bypass pumping shall be provided from the time the Temporary Bypass Pump Station becomes operational to substantial completion of the Long Beach Consolidation Pump Station. Substantial completion is achieved when the new pump station and the new force main are connected, tested and approved by the County

Stage 4: Demolish Existing Long Beach Pump Station.

- A. Install sheeting, bracing, and dewatering in the area of the existing Long Beach Pump Station.

- B. Demolish the superstructure of the existing Long Beach Pump Station.
- C. Demolish below grade structure of existing Long Beach Pump Station with the exception of the existing dry pit. The existing dry pit shall remain in place as shown on the drawings. Contractor shall provide all bracing and supports to protect the structure that will remain.

Stage 5: Build Long Beach Consolidation Pump Station and Connect New 24-inch Force Main

- A. Construct the Long Beach Consolidation Pump station.
- B. Install 24-inch effluent force main to the location shown on the drawings. Limits of contract shown in drawings. Contractor shall coordinate all activities with contract S35109-01S.
- C. Testing of the Long beach Consolidation Pump Station shall occur once the tie-in to the South Shore Water Reclamation Facility is completed and the force main under Contract S35109-01S (by others) has been installed, tested and accepted by County.
- D. Test all equipment where is testing specified. Long Beach Consolidation Pump Station must be approved and accepted by the County prior to start operation.
- E. The sewer system shall be returned to gravity flow into the Main Pump Station upon construction completion. Mechanical plug shall be removed from 48" sanitary line. Smaller sanitary lines if rerouted for the period of construction to diversion chamber shall be left in place.

Stage 6: Decommission and removal of Temporary Bypass Pump Station and Temporary Electrical Facility

- A. Remove all the following temporary piping installed to maintain the Long Beach WPCP in operation.
 - a. Relocated existing 20-inch trickling filter recirculation force main.
 - b. Relocated 8-inch primary sludge force main.
 - c. Relocated 8-inch secondary sludge force main.
 - d. Flexible hose connection and temporary pumping at manhole located at the coordinates N 0+68, E 0+72.
- B. Install retaining wall at the end of driveway of Grit Building as shown in the contract drawings.

- C. Finalize grading and paving in the area east of the Grit Building as indicated in the contract drawings.
- D. The Temporary Bypass Pump Station shall be decommissioned upon completion of construction and acceptance of the Long Beach Consolidation Pump Station.
- E. All wastewater within Temporary Bypass Pump Station shall be discharged into the wastewater collection system. All equipment and appurtenances including the pumps, pipes, valves, fittings, flow meter, screen and control panels shall be removed and turned over to the County.
- F. The Temporary Electrical Facility shall be demolished in its entirety. All reusable equipment shall be protected during removal and turned over to the County.
- G. The Bypass Pump Station underground structure shall be isolated from the sewers, all wastewater shall drained, and the structure shall be cleaned and disinfected. . Subsequently, mechanical plugs shall be installed to isolate screen channel from Diversion Chamber and to cover all pipe orifices within the wet well. Seals shall be provided for leak proof installation. All wall penetrations remaining after removal of piping and conduits shall be closed and sealed. Concrete channel shall be closed on top after removal of the screen.
- H. The 24" temporary force main piping shall be removed.
- I. The Contractor shall restore the Site as required under this Contract after removal of the completion of construction.

TABLE 01700-A SCHEDULE OF PROCESS SHUTDOWNS-CONTINUITY OF PLANT TREATMENT			
Shut down No.	Description	Process Equipment Out-of-Service During Shutdown	Maximum Duration *
1	20-inch trickling filter recirculation force main relocation	Recirculation Pump Station	8 Hours
		Existing Long Beach Pump Station	3 Hours
2	8-inch primary sludge force main relocation	Primary sludge pumps	8 Hours
3	8-inch secondary sludge force main relocation	Secondary sludge pumps	8 Hours
4		Sand filter backwash	4 Hours

	6-inch sanitary sewer relocation	Final Settling Tank Skimming	12 Hours
		Filtrate	24 Hours
		Final Settling Tank Decant	24 Hours
5	2-inch water service pipe relocation	Water service	12 Hours
6	24-inch temporary force main installation – tapping valve (x 2)	Existing Long Beach Pump Station	3 Hours
7	Testing of temporary bypass pump station – close influent gates	Existing Long Beach Pump Station	-

* All times shown represent the maximum time frame that any of the described systems can be interrupted at periods of low influent flow. All times shall be coordinated with Long Beach WPCP Personnel.

TABLE 01700-B
SCHEDULE OF ELECTRICAL SHUTDOWNS-RESUPPLY OF TREATMENT PLANT

Shut down No.	Description	Process Equipment Out-of-Service During Shutdown	Maximum Duration
A	Resupply Panel DP-SM	Sewer Maintenance Building.	4 Hours
B	Resupply MCC A	Recirculation Station.	4 Hours
C	Resupply MCC B	Recirculation Station.	4 Hours
D	Resupply Main Disconnect DGB	Digester Control Building	4 Hours
E	Resupply Tank Motor Starters	Primary Settling Tanks, one tank circuit at a time.	2 Hours per circuit
F	Resupply Pump Motors, Rack Drives and Conveyor Motor Starters and associated controls	Grit Collection System, one circuit at a time on a circuit by circuit basis.	2 Hours per circuit
G	Resupply Heater and Lighting Circuits	Grit Collection Areas, one circuit at a time on a circuit by circuit basis.	2 Hours per circuit
H	Resupply Heater and Lighting Circuits	Primary Tank and Draw Pits, one circuit at a time on a circuit by circuit basis.	2 Hours per circuit

++ END OF SECTION ++

Section 01700

DETAILED MOPO DESCRIPTIONS

Index to MOPO Items

Item No.:	Description:	Page:
1	Electrical shutdown of each treatment unit component of the Long Beach WPCP for transferring loads to the new temporary electrical facility.	01700-19

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MAINTENANCE OF PLANT OPERATIONS

Item Number:	Item Description:	Time Constraints:	Processes Out of Service:	Procedure:
1	Long Beach WPCP temporary electrical system; units' shutdowns	To be coordinated with Long Beach WPCP personnel	Refer to Section 16020 of the contract documents	The Temporary Electrical Facility will provide power and controls to the entire Long Beach WPCP during the new pumping station construction. The electrical shutdowns of the existing equipment will be coordinated with plant personnel to transfer the electrical loads from the Long Beach WPCP to the Temporary Electrical Facility. Shutdowns will be coordinated to ensure that each Long Beach WPCP treatment unit is disrupted in a manner that does not negatively impact the overall wastewater treatment of the facility. Each unit will be handed individually, one at a time. The new power supply will be transferred through either feeder loads or circuit systems to the temporary facility.

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SECTION 01710

CLEANING

PART 1 – GENERAL

1.1 GENERAL

- A. Execute cleaning, during progress of the Work, at completion of the Work, and as required by the General Conditions, Article GC-33, "Cleaning".
- B. Requirements of Regulatory Agencies:
 - 1. In addition to the requirements herein, maintain the cleanliness of the Work and surrounding premises within the Work limits so as to comply with federal, state, and local fire and safety laws, ordinances, codes and regulations.
 - 2. Comply with all federal, state and local anti-pollution laws, ordinances, codes and regulations when disposing of waste materials, debris and rubbish.
- C. Scheduling of Cleaning and Disposal Operations:
 - 1. So that dust, wash water or other contaminants generated during such operations do not damage or mar painted or finished surfaces.
 - 2. To prevent accumulation of dust, dirt, debris, rubbish and waste materials on or within the Work or on the premises surrounding the Work.
- D. Waste Disposal:
 - 1. Dispose of all waste materials, surplus materials, debris and rubbish off the plant Site.
 - 2. Do not burn or bury rubbish and waste materials on the plant Site.
 - 3. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 4. Do not discharge wastes into streams or waterways.
- E. Cleaning Materials:
 - 1. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
 - 2. Use each type of cleaning material on only those surfaces recommended by the cleaning material manufacturer.
 - 3. Use only materials which will not create hazards to health or property.
- F. During Construction:
 - 1. Keep the Work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish, in accordance with the General Conditions, Article GC-33, "Cleaning."
 - 2. Keep dust generating areas wetted down.
 - 3. Provide suitable containers for storage of waste materials, debris and rubbish until time of disposal.

4. Dispose of waste, debris, and rubbish off Site at legal disposal areas.
- G. When Project is Completed:
1. The Contractor shall clean and maintain the Site in accordance with Division 1, Section 01760, Project Closeout.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 GENERAL

- A. The Contractor shall maintain and provide the Engineer with Project record documents as specified below except where otherwise specified or modified in the Specifications or in the General Conditions, Article GC-5, "Drawings and Specifications" and Article GC-36, "Record Drawings."
- B. The Contractor shall provide a surveyor licensed in the State of New York to provide an as-built survey of all buried infrastructure installed under this Contract.

1.2 MAINTENANCE OF DOCUMENTS

- A. Maintain the Contractor's field office in clean, dry, legible condition, complete sets of the following: Contract Drawings, Specifications, Addenda, approved Shop Drawings, Samples, photographs, Change Orders, other Modifications of Contract, test records, survey data, Field Orders, and all other documents pertinent to Contractor's Work.
- B. Provide files and racks for proper storage and easy access. File in accordance with the filing format of the Construction Specification Institute (CSI) unless otherwise approved by the Engineer.
 - 1. Make documents available at all times for inspection by the Engineer and the County representative.
 - 2. Record documents shall not be used for any other purpose and shall not be removed from the office without the Engineer's approval.

1.3 RECORDING UPDATED INFORMATION

- A. General:
 - 1. Label each document "PROJECT RECORD" in 2-inch high printed letters.
 - 2. Keep record documents current, and updated at least monthly.
 - 3. Do not permanently conceal any Work until required information has been recorded.
- B. Contract Drawings: Legibly mark to record actual construction including:
 - 1. Depths of various elements of foundation in relation to datum.
 - 2. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
 - 3. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 - 4. Field changes of dimensions and details.

5. Changes made by Change Order or Field Order.
 6. Details, not on original Contract Drawings.
- C. Specifications and Addenda: Legibly mark up each Section to record:
1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 2. Changes made by Change Order or Field Order.
 3. Other matters, not originally specified.
- D. Shop Drawings: Maintain as record documents and legibly annotate Drawings to record changes made after review.
- E. Site Survey: The Contractor shall provide a survey the entire site once the project is completed and accepted by the County. The survey shall incorporate all of the new and existing infrastructure including, but not limited to all buildings, fence line, roadways, sidewalks, and all buried infrastructure installed under this Contract including but not limited to the sanitary force main, water mains, storm drains, manholes, chambers, valves and all associated appurtenances.
- a. The future boundaries of the Long Beach Consolidation Pump Station property shall be delineated by the fence line as depicted in the contract documents. The Site Survey shall identify the final limits and features of the fence line.
 - b. Survey shall locate all surface features within the Long Beach Consolidation Pump Station property such as walls, pavement areas, curbs, walks, buildings, above grade structures, manholes, catch basins, driveways aprons, fire hydrants, valve boxes, poles, fences, signs, boulders, rip rap, trees, etc.
 - c. Provide one foot contour lines within the Long Beach Consolidation Pump Station Property. Major contour lines shall be at 5-foot elevations and minor contour lines shall be at one foot elevations.
 - d. Verify location of structures and obtain first floor elevations.
 - e. Survey of buried transmission main and force main pipe shall include each joint of pipe, fitting and valve. The elevation of pipes and fittings shall the installed crown / top of pipe.
 - f. Survey of buried storm or sanitary drains shall be the installed invert elevation of all pipe from structure to structure.
 - g. Surface features of buried infrastructure (manhole rims elevations, valve boxes, etc.) shall be surveyed.
 - h. All buried infrastructure shall be surveyed prior to backfilling activities. Pipe or infrastructure backfilled prior to survey shall be re-excavated, surveyed, backfilled, compacted, and restored shall be come at no additional cost to the Owner.
 - i. For the portion of the force main installed by horizontal directional drilling, the as-built shall provide the "as-drilled" survey in accordance with Specification Section 02415.
 - j. All surveyed information shall be in the same vertical datum and horizontal coordinate system as provided on the Contract Documents.

1.4 FINAL SUBMISSION OF RECORD DOCUMENTS

A. Record Drawings:

1. At the completion of the Work, Contractor shall furnish to the Engineer record drawings two (2) full size paper and on CD-R one (1) electronic bound AutoCAD drawing set in Release the release that was current at time of Bid, and one (1) compiled PDF set showing the actual in-place installation of these items installed under this Contract. The AutoCAD drawings shall conform to the Bay Park Program and specific contract CAD Plans. The Contract Drawings shall be used as a starting point in developing these Drawings. Drawings shall show the Work in plan and sections as required for clarity with reference dimensions and elevations for complete Record Drawings. All Drawings must be submitted for approval of the Engineer. Documentation shall be furnished not later than 30 days after completion of the Work and prior to Final Payment.
2. Within sixty (60) days of projected substantial completion, the Contractor shall provide a list of as built shop drawings that will be provided as record drawings that show details not provided on the updated Contract Drawings. The list is subject to the approval of the Engineer. The as built shop drawings shall at a minimum cover:
 - a. Schematic (Elementary) Diagrams: This shall include but not be limited to complete schematics including items furnished by others for the following:
 - 1) Motor control circuits for starters furnished under this Contract.
 - 2) Substation controls.
 - b. Wiring (connection) diagrams: These shall be included for all pre-wired equipment furnished under this Contract.
 - c. Interconnection diagrams: These shall include all interconnections to be furnished under this Contract.
 - d. Conduit and cable schedules: These shall include all conduit and cable furnished under this Contract.
 - e. Dimension of outline drawings: These shall include all equipment furnished under this Contract.
 - f. Power and lighting layout drawings: These shall include all conduits and wiring furnished under this Contract.
3. As built shop drawings shall be submitted in the same manner as described in Specification Section 01300 Submittals with the following variations:
 - a. Submittal number shall have the prefix AB and revision suffix shall restart at A, eg AB-15111-001-A.
 - b. As built submittals shall be returned only Approved or Not Approved.
4. Site Survey: Within 30 days of completion and acceptance of applicable testing of buried infrastructure, Contractor shall provide as-built survey drawings of installed infrastructure prepared, signed, and sealed by a surveyor licensed in the State of New York.

B. Submittal:

1. At completion of Project, deliver record documents to the Engineer.

2. Accompany submittal with transmittal letter containing:
 - a. Date.
 - b. Project title and number.
 - c. Contractor's name and address.
 - d. Title and number of each record document.
 - e. Certification that each document as submitted is complete and accurate.
 - f. Signature of the Contractor, or his authorized representative.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

++ END OF SECTION ++

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 GENERAL

- A. Provide operation and maintenance data in the form of instructional manuals for use by the County's personnel for:
 - 1. All equipment and systems.
 - 2. All valves, gates and related accessories.
 - 3. All instruments and control devices.
 - 4. All electrical gear.

1.02 LUBRICATION SURVEY

- A. Provide a lubrication survey, made by a lubricant supply firm, subject to the approval of the Engineer, and paid for by the Contractor.
- B. Lubrication survey shall list all equipment, the equipment manufacturer's lubrication recommendations, and an interchangeable lubricants tabulation standardizing and consolidating lubricants whenever possible. Include lubricant type, quantities and frequencies for each piece of equipment.
- C. The Contractor shall supply all lubricants, applicators and labor for lubricating the equipment, in accordance with manufacturer's recommendations, for field-testing and prior to final acceptance. A supply of required lubricants sufficient for start-up and one year of operation shall also be supplied by the Contractor.
- D. Twelve copies of the approved lubrication survey shall be furnished prior to final acceptance.

1.03 SPARE PARTS AND SPECIAL TOOLS

- A. Spare Parts:
 - 1. As soon as practicable after approval of the list of equipment, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply. This information shall also be included in the Operations and Maintenance Manuals.
 - 2. The Contractor shall also furnish a list of parts, and supplies that are either normally furnished at no extra cost with the purchase of the equipment, or specified to be furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for the particular installation for a period of one year or the guarantee period, whichever is greater.
 - 3. All parts shall be securely boxed and tagged, and clearly marked on the box

and individually for identification as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten years.

B. Special Tools:

1. The Contractor shall furnish at no additional cost to the County with each piece of equipment as a minimum, two complete sets, or the number of sets called for in the Technical Specifications, of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.
2. The Contractor shall submit, for approval by the Engineer, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.

1.04 OPERATION AND MAINTENANCE MANUALS

A. Final Operations and Maintenance Manuals:

1. As a prerequisite to obtaining payments for equipment furnished under this Contract in excess of fifty percent of the Contract amount, the Contractor shall prepare, submit and obtain the Engineer's approval of an operation and maintenance manual for each item of equipment supplied under this Contract. Each item of equipment shall be identified with the equipment identification number given in the Contract Documents or as furnished by the Engineer. Each manual shall be prepared specially for this installation and shall include all approved Shop Drawings, all pertinent and legible instructions, technical bulletins and other printed matter required to provide fully accurate and comprehensive information for the safe and proper operation, maintenance and repair of the equipment item. It shall include, but not be limited to the following:
 - a. Catalogs, diagrams, schematics, drawings, instructional bulletins and manuals marked by underlining, checking, the use of arrows or the obliteration or removal of extraneous data, so as to pertain only to the specific equipment item for which the manual is supplied. Original reprints of manufacturers' catalog information and maintenance data shall be furnished; photocopies or facsimile (FAX) copies will not be acceptable.
 - b. Complete electrical schematics and wiring diagrams. Complete wiring between terminal points must be shown. Computerized diagrams are not acceptable.
 - c. Drawings, diagrams and illustrations shall be original quality and clearly legible. Facsimile copies are not acceptable. Reduced drawings shall not be reduced to less than one-half of the original size. All lines, dimensions, lettering and text must be clearly legible.
 - d. Reference to features and elements of equipment, such as operational limits of time, speed, pressure, temperature, etc., shall be clear,

complete and compatible with authoritative published engineering reference documents. Torque ratings shall be given for all bolted connections. All functional components, electrical systems, equipment, etc., shall be shown on diagrams and discussed in the text so as to identify their proper system relationship. Operation, service, trouble-shooting, checkout and in-line and bench repair procedures, identifying specific system characteristics of the equipment, shall be provided. Detailed start-up and shutdown procedures shall be included as a separate section for each piece of equipment or system.

- e. Recommended procedures and frequencies for preventive maintenance such as inspection, adjustment, lubrication, calibration and cleaning shall be provided including pre-startup checklists for each piece of equipment and long-term shutdown maintenance.
 - f. Equipment parts shall be identified by manufacturer's part number and located with relation to other components of the equipment utilizing "exploded" type drawings for clarity. Complete parts lists shall be included, which indicate the part number, the part description, applicable serial and model numbers, current unit prices and the name, address and telephone number of the nearest equipment manufacturer's representative and nearest service and spare parts warehouse. Complete instructions for the ordering of all replaceable parts shall be noted in this section of the Manual. Recommendations as to spare parts and spares inventory levels shall be made. Lead time and shelf life values and preservation, packaging and labeling methods shall be recommended.
 - g. All copyrighted material used in the manual or in any operation required in the performance of the Contract will be preceded by the Contractor obtaining the copyright holder's written permission to use such material. The Contractor shall hold the County and the Engineer free of any legal responsibility for its use.
2. Each operation and maintenance manual shall be bound in a durable, permanent, stiff cover binder of one (more if required) volume with a complete index of the manual's contents arranged by subject matter and in order of presentation in each volume. Applicable equipment item numbers, as shown in the Contract Documents, shall be prominently included at their appropriate location in the index. The title of the manual shall be securely affixed to the binder in two places: the front cover and the binder back edge. The title shall identify the Project by number and name, state the volume is an O&M manual, generally classify the equipment and state the manufacturer's name, equipment model number and equipment identification number.
- a. Covers shall permit easy removal of pages and shall be of the three-post, metal-hinged, self-expanding type and shall not be overfilled. Covers shall be oil, moisture and wear resistant and approximately 9 by 12 inches in size.
 - b. Page size shall be 8-1/2 by 11 inches; paper shall be 60 pound and holes reinforced with plastic cloth or metal.

- c. Drawings, diagrams and illustrations shall be attached foldouts up to 11 by 17 inches in size; larger sizes shall be inserted in the attached clear plastic envelopes marked as to contents.
3. Contractor's submittal to the Engineer for approval shall consist of three complete sets of each operation and maintenance manual and two copies of an itemized listing providing cross-reference identification between the Specification Sections of the Contract Documents, the approved Shop Drawings, and the operations and maintenance manual submittal. One copy of the manual and itemized listing will be returned to the Contractor stamped either "Approved" or "Disapproved", the latter when the Manual submittal is considered inadequate, inaccurate or lacking essential information. Discrepancies will be noted on the return itemized listing of a "Disapproved" submittal. The Contractor shall rectify all unapproved submittals by replacing submitted portions or adding additional data, as required, to the manual. The manual's index of contents and the itemized, cross-referenced listing shall be revised to reflect all revisions or additions made. Then two copies of the entire package shall be resubmitted to the Engineer for approval.
4. Upon approval of the operation and maintenance manuals, the Contractor shall submit ten copies of the manual and the itemized listing to the County.

1.05 MAINTENANCE AND LUBRICATION SCHEDULES

- A. For all items of equipment furnished, Contractor shall provide a list including the equipment name, and address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained. In addition, a maintenance and lubrication schedule for each piece of equipment shall be submitted with the Shop Drawings. Submission shall be in fifteen copies. The schedules shall be in the form indicated below.

Sample Maintenance Schedule			
Item	Action	Frequency	Remarks

Sample Lubrication Schedule				
Item	Manufacturer's Recommendations	Type Lubricant	Quantity Per Tank	Frequency

1.06 EQUIPMENT START-UP SERVICES

- A. Equipment start-up period, shall begin after satisfactory completion and acceptance of the field tests described in Section 01660 and shall end before the certified date of substantial completion for the part of the Work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the Work, the period shall begin upon substantial completion of the Project.
- B. During the equipment start-up period the Contractor shall furnish, at no additional cost to the County, the services of factory-trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
 - 1. Assist in the start-up and operations of the equipment.
 - 2. Conduct training of plant personnel in the proper operation and maintenance of the equipment.
- C. The County shall:
 - 1. Provide the necessary plant personnel for training in the operation and maintenance of the equipment during their regularly assigned work shifts.
- D. The Contractor shall pay for all chemicals consumed up to the date of "certified substantial completion", and in addition shall provide the quantities of fuel and chemicals specified in Section 01660, Quality Control.

- E. The Contractor shall be available to promptly repair all Work during the start-up period so as to cause minimum disruption to the total plant operation.
- F. Upon completion of a minimum of ten consecutive twenty-four hour days of satisfactory operation, or the number of days called for in the Technical Specifications, the County will assume operation and operating cost of the equipment. If the equipment malfunctions during this start-up period, the start-up period will be repeated until satisfactory operation is achieved.
- G. In the event a system, equipment or component proves defective or is unable to meet specified performance criteria, the Contractor shall replace the defective item, and the minimum two years guarantee period, or the guarantee period called for in the Technical Specifications for the item, shall start after satisfactory replacement and testing of the item.

1.07 TRAINING

- A. As part of these services, the Owner will provide the necessary plant personnel for training in the operation and maintenance of the equipment. The Owner's personnel shall operate all equipment. The number of personnel to be trained, the class size and number of days the training shall be given shall be as indicated in the respective equipment specifications. Where the number of personnel and/or class size is not indicated in the respective equipment specifications, the Contractor shall assume a class size of 20 personnel.
- B. The training shall consist of both classroom and field instruction. The purpose of field instruction shall be to reinforce topics covered in the classroom and to identify the location of any valves, pushbuttons, control panels switches, and other equipment required for operation; and to identify the location of any maintenance equipment such as grease fittings, oilers, isolation valves, safety lockout switches, and other equipment.
- C. All training, unless otherwise specified, shall take place at the work site at a place specified by the Owner and shall be conducted by qualified training specialists.
- D. Separate training sessions shall be conducted for the Owner's mechanical operations and maintenance personnel and for the Owner's electronic and electrical maintenance personnel.
- E. The Contractor shall coordinate the manufacturers training services with the Owner and the Engineer, providing a minimum of fourteen (14) days prior notice of training, subject to the approval of the Engineer and the Owner.

- F. In order to provide training for an adequate number of the Owner's operation and maintenance personnel, all training sessions shall be provided twice and shall be scheduled by the Owner to accommodate their shift schedule. All training shall be conducted during the hours of 8:00 AM to 12 AM until conclusion of the training course.
- G. The Contractor shall deliver all training material to the Engineer and the Owner a minimum of fourteen (14) days prior to the scheduled training.

1.08 POWER POINT PRESENTATION

- A. The Contractor shall provide a Power Point Presentation for each plant training session.
- B. The manufacturer shall have the right of ownership of one copy of the power point presentation utilized for training.
- C. The contractor must submit, for approval by the Engineer and the Owner, a power point presentation (s) covering the equipment supplied. Include the presentation in CD disk form for content review as part of the submittal package. Approval of such power point(s) shall be contingent upon their content meeting the lesson plan requirement of this Section. When the power point presentation (s) are approved by the Engineer and the Owner, the Owner shall have the right to permanent ownership and use of at least one complete copy.
- D. The power point presentation must include a section identifying the Complete System Overview including all related and associated equipment specific to that particular system and how the specific piece of equipment operates within that system.
- E. The Power Point Presentation must be Site Specific covering all related system items being presented in the training session. Handouts should mirror this presentation to include and be specific to the entire presentation.

1.09 LESSON PLANS

- A. The Contractor shall submit the equipment manufacturer's lesson plans which shall include specific information about each item of equipment or equipment system, including controls. Lesson plans shall include but not be limited to the following information and meet the following requirements.

1. The Contractor shall submit the equipment manufacturer's lesson plans for approval by the Engineer no less than sixty (60) days prior to the date that the training is to take place.
2. Lesson plans shall indicate the estimated duration of each segment of the training and the training audience that the instruction is to address. The training audience refers to the Owner's mechanical operation and maintenance personnel and the Owner's electronic/electrical maintenance personnel, as appropriate.
3. The lesson plan shall indicate when training aids are used or referred to during the course of instruction.
4. An outline of required lesson plan contents is included below:

B. Equipment Description:

1. Purpose and function of equipment and auxiliary equipment and systems.
2. Physical arrangement of equipment components and electrical supply.
3. General function of controls, including automatic and manual operation, interlocks, and shutdowns.

C. Equipment Operation:

1. Operating requirement for equipment to perform satisfactorily.
2. Typical operating characteristics.
3. Start-up and shutdown procedures.
4. Use of controls.

D. Equipment Monitoring:

1. Recommended routine instrument readings and operational checking.
2. Early warning signs of developing operational or equipment problems.
3. Procedures for handling non-routine problems such as alarms, power failures, component failures, etc.

E. Equipment operational troubleshooting procedures.

F. Safety and Housekeeping:

1. Safety features of the equipment.
2. Safe practices.
3. Housekeeping practices.

G. Description of the use of the equipment manufacturer's O&M Manual as regards operation.

H. Preventive Maintenance Requirements:

1. Maintenance needs for equipment.
2. Identification of procedure to satisfy maintenance need (relate to equipment manufacturer's O&M Manual, which should have detailed descriptions of maintenance procedures).
3. Outline or summarize procedures.
4. Recommended schedule for performing preventive maintenance.
5. Provide preventive maintenance record forms (if available).

I. Maintenance Inspection Program:

1. Parts, components and areas of equipment to inspect for routine preventive maintenance.
2. Recommended frequency of inspection.
3. Inspection procedures.
4. Problem identification.

J. Maintenance Troubleshooting:

1. Sections in O&M Manual detailing troubleshooting procedures.
2. Summarize troubleshooting procedures.
3. Testing equipment used in troubleshooting.
 - a. Demonstration of use of specialized testing equipment if supplied with equipment.
 - b. Other testing equipment.
4. Tests used to verify troubleshooting findings.

K. Disassembly and Assembly:

1. Summarize disassembly and assembly procedures.
2. O&M Manual coverage of subject.
3. Testing to verify success of corrective maintenance.

L. Equipment Calibration:

1. Calibration needs and tolerances.
2. Calibration equipment.
3. O&M Manual listing of calibration ranges, tolerances and settings.

1.10 TRAINING AIDS

- A. Training aids shall be used as an integral part of the training program. Training aids shall include PowerPoint presentations, as per Section 1.10, and pictorial handouts specific to the equipment supplied. Handouts shall be legible and printed on good quality stock. Handouts shall be submitted when lesson plans are submitted.

- B. Additional training aids shall be used for maximum training effectiveness and shall include the following as appropriate:
 - 1. Audio visual aids, for example, PowerPoint presentations, films, videotapes, slides, overhead transparencies, posters, blueprints, diagrams, and catalogue cuts.
 - 2. Models and samples, for example, cutaways, spare parts, tools, miniature models, equipment assemblies, and damaged parts.
- C. The use of additional training aids shall be identified in the lesson plan, and a description of the additional training aids shall be given.

1.11 QUALIFICATIONS OF TRAINING SPECIALISTS

- A. The Contractor shall submit the equipment manufacturer's documentation of the qualifications of their proposed training specialists for approval by the Engineer sixty (60) days prior to the date of proposed training. The documentation shall include the experience of the training specialists in operation and maintenance of the equipment and a summary of training experience. The documentation shall be submitted for approval with the lesson plan submittal. Lesson plans that do not include such documentation will be considered incomplete.
- B. Only those training specialties whose qualifications have been approved by the Engineer shall conduct training.

+ + END OF SECTION + +

SECTION 01760

PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 FINAL CLEANING

- A. At the completion of the Work, the Contractor shall remove temporary structures, construction signs, tools, scaffolding, materials, supplies and equipment which he or any of his Subcontractors may have used in the performance of the Work.
- B. The Contractor shall broom clean paved surfaces and rake clean other surfaces of grounds.
- C. The Contractor shall thoroughly clean all materials, equipment and structures; all marred surfaces shall be touched up to match adjacent surfaces; dirty filters and burned-out lights replaced as required. The Contractor shall clean and polish all interior and exterior glass surfaces so as to leave glass surfaces in a clean and new appearing condition.
- D. The Contractor shall remove spatter, grease, stains, fingerprints, dirt, dust, labels, tags, packing materials, rubbish, and other foreign items or substances from interior and exterior surfaces, equipment, signs and lettering.
- E. Remove paint, clean and restore all equipment and material nameplates, labels and other identification markings.
- F. The Contractor shall maintain cleaning until Project, or portion thereof, is occupied by the County.

1.2 INSPECTIONS

- A. At the time of substantial completion an inspection shall be held in accordance with the requirements of the Agreement, Article XXXVI, "Substantial Completion Payment". At this time the Contractor shall also provide all necessary documentation as required by the above referenced Article.
- B. At the time of completion of all the Work a final inspection shall be held in accordance with the requirements of the Agreement, Article XXXVII, "Final Payment". The Contractor shall also provide all necessary documentation as required by the above referenced Article, and comply with all the requirements of the General Conditions, Article GC-38, "Project Closeout".
- C. Follow-up Inspection:
 - 1. At the time of the completion of the guarantee period as specified in the Agreement, Article XX, "Maintenance and Guarantee," the Engineer will

make arrangements with the County and the Contractor for a follow-up inspection and will send a written notice to said parties to inform them of the date and time of the inspection.

2. After the inspection, the Engineer will inform the Contractor of any corrections required.
3. When the corrections have been satisfactorily completed, the Engineer will forward a certificate for the release of Bonds.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 02050

DEMOLITION, REMOVALS, AND MODIFICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to complete the Work of demolition, removal, and disposal. Included are all modifications to existing facilities as shown and required to complete the Work.
2. Included, but not limited to, are the demolition, removal, and disposal of existing structures, removal and disposal portions of any existing equipment including piping not required for the operation of the plant as indicated on the Drawings and as specified hereinafter.
3. The Contractor shall furnish all labor, materials and equipment to demolish portions of structures and to remove anchors, supports, piping, equipment and accessories designated to be removed on the Drawings.
4. The removal of all equipment, piping, and all other materials from the demolition of structures shall, when released by the Engineer, be done by the Contractor for the materials removed by him and shall become Contractor's property, unless otherwise noted. The debris shall be disposed of off site in a manner not contrary to the Contract requirements.

B. Related Sections:

1. Section 02200, Earthwork.

1.2 SUBMITTALS

A. Schedule: Submit for approval the following:

1. The Contractor shall submit a detailed description of methods and equipment and sequence for demolition and removal for the Engineer's review.

1.3 PROTECTION

A. General:

1. Demolition and removal Work shall be performed by competent workmen experienced in the various types of demolition and removal Work required, and shall be carried through to completion with due regard to the safety of the Owner's employees, workmen on the Site and the public. The Work shall be performed with as little nuisance as possible.
2. The Work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, and all governing codes and as hereinafter specified.
3. The Contractor shall make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal.
4. The Contractor shall provide interior and exterior shoring, bracing and support to prevent movement, settlement, or collapse of existing structures or facilities. The Owner assumes no responsibility for the actual condition of the structures or facilities adjacent to the Work or the structures or facilities designated for removal or modification.
5. Do not bring explosives on site. No explosives will be permitted for this Project.

B. Execution:

1. The Contractor shall provide, erect and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
2. The Contractor shall provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
3. The Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new Work is being done, connections made, materials handled or equipment moved.
4. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing buildings affected by the operations under this Section shall be protected by dustproof partitions and other adequate means.
5. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.

6. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall conduct operations with minimum traffic interference.
7. The Contractor shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.
8. The Contractor shall carry out all operations so as to avoid interference with operations and work in the existing facilities and the work under other contracts.
9. The Contractor shall be solely responsible for making all necessary arrangements and for performing all necessary work involving the discontinuance or interruption of all utilities or services.
10. Any equipment, piping and appurtenances removed without proper authorization, which are necessary for the operation of the existing plant or of the plant expansion, shall immediately be replaced to the satisfaction of the Engineer at no cost to the Owner.

C. Notification:

1. At least 48 hours prior to commencement of demolition or removal, the Contractor shall notify the Engineer in writing of his proposed schedule therefor. The Owner shall inspect the existing equipment and (review with the Contractor) those items that are to remain the property of the Owner. No removals shall be started without the permission of the Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. The Work required shall be done with care, and shall include all required shoring, bracing, etc. The Contractor shall be responsible for any damage which may be caused by demolition and removal Work to any part or parts of existing structures or items designated for reuse or to remain. The Contractor shall perform patching, restoration and new Work in accordance with applicable technical sections of the Specifications and in accordance with the details shown on the Drawings.
- B. Surfaces of walls, or other areas which are exposed by any of the removals specified herein, and which will remain as architecturally finished surfaces, which have holes, scars, chipped or other damaged surfaces revealed by the removal shall be repaired by the Contractor with the same or matching materials as the existing surface or as may be otherwise approved by the Engineer.
- C. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the

lowest practical level. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
2. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the Work.

D. All supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise specified or required. The concrete bases, anchor bolts and other supports shall be removed to approximately one inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas. The superstructure wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified under applicable sections of the Specifications, as shown on the Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate sections of the Specifications, as shown on the Drawings and as directed and approved by the Engineer.

E. Deposition of Materials and Equipment:

1. The Contractor shall dispose of all demolition materials, equipment, debris, and all other items not marked by the Owner to remain as property of the Owner, off the site and in conformance with all existing applicable laws and regulations.

F. Wherever piping is to be removed for disposition, the piping shall be drained by the Contractor and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.

G. Where alterations occur, or new and old Work join in, the Contractor shall cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, so as to leave the altered Work in as good a condition as existed prior to the start of the Work. The materials and workmanship employed in the alterations, unless otherwise shown on the Drawings or specified, shall comply with that of the various respective trades, which normally perform the particular items of work.

H. The Contractor shall remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the Work.

3.2 STRUCTURAL REMOVALS

- A. The Contractor shall remove concrete and structures to the lines and grades shown unless otherwise directed by the Engineer. Where no limits are shown, the limits shall be 4 inches outside the item to be installed.
- B. Determine the thickness of existing concrete to be removed and the extent to which it is reinforced. No additional compensation will be made because of variations from the thickness shown or for variations in the amount of reinforcement.
- C. All concrete, concrete block, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other items contained in or upon the structure shall be removed and taken from the site, unless otherwise approved by the Engineer. Demolished items shall not be used in backfill.
- D. After removal of parts or all of slabs and like work which tie into new Work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and finished surfaces exposed.
- E. Where new anchoring materials including bolts, nuts, hangers, welds and reinforcing steel are required to attached new Work to the existing work, they shall be included under this Section, except where specified elsewhere.

3.3 PAVEMENT, CURB AND SIDEWALK REMOVALS

- A. Remove existing pavement, including bases and surface courses, stabilized sub-bases, curbs, and gutters as required to construct new facilities or as shown. Before removing, saw a straight joint at least 1-1/2-inches deep between sidewalk and pavement designated for removal and that left in place. Curbs and gutters shall be removed to the nearest construction joint beyond the end of demolition symbol shown on the Drawings.
- B. Determine the thickness of existing pavement, base, sub-base, curb, gutter, driveway pavement, and sidewalk to be removed, and the extent to which they are reinforced. No additional compensation will be made because of variations from the assumed thickness or from the thickness shown or for variations in the amount of reinforcement.
- C. Provide for satisfactory transition between replaced pavement and sidewalks and the portions remaining in place.

3.4 MECHANICAL REMOVALS

- A. Equipment removals shall consist of dismantling and removing of existing piping, equipment, and other appurtenances as specified, shown, or required for the completion of the Work. It shall include cutting, capping, draining, and plugging as required, except that the cutting of existing piping for the purpose of making connections thereto will be included under Division 15.
- B. When underground piping is to be altered or removed, the remaining piping shall be properly capped. Abandoned underground piping may be left in place unless it interferes with new Work or is shown or specified to be removed.
- C. Any demolition or changes to potable water piping and other plumbing and heating system work shall be made in conformance with all applicable codes. Portions of the potable water system that may have been altered or opened shall be pressure tested and disinfected in accordance with Division 15 and local codes. Other plumbing piping and heating piping shall be pressure tested only.
- D. Provide all caps, plugs, blind flanges, shut-off valves and other work and materials required to remove from service existing piping and necessary to keep existing piping in service where shown or required.

3.5 MISCELLANEOUS REMOVALS

- A. The Contractor shall remove miscellaneous concrete walls, slabs, pipe supports, and curbs where shown on the Drawings or where necessary for the construction of new structures or modification of existing structures.

3.6 MODIFICATIONS AND CLOSURES

- A. Modifications shall conform to all applicable Specifications, the Drawings, and the directions and approvals of the Engineer.
- B. Where alterations require cutting or drilling into existing floors and walls the holes shall be repaired in an approved manner. The Contractor shall repair such openings with the same or matching materials as the existing floor, wall, or roof or as otherwise approved by the Engineer. All repairs shall be smoothly finished unless otherwise approved by the Engineer.
- C. Where parts of existing structures are to remain in service, demolish the portions to be removed, repair damage, and leave the structure in proper condition for the intended use. Remove concrete and masonry to the lines designated by drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp straight corners that will result in neat joints with new construction or be satisfactory for the purpose intended. Where existing reinforcing rods are to extend into new construction, remove the concrete so that the reinforcing is clean and undamaged. Cut off other reinforcing flush with the surface.

- D. New Work shall be keyed into the existing in an acceptable manner. New reinforcing steel shall be welded to the existing reinforcing. Welding shall conform to AWS D12.1, Reinforcing Steel Welding Code. In general, the same or matching materials as the existing adjacent surface shall be used. The finished closure shall be a smooth, tight, sealed, permanent closure with all exposed surfaces smooth finished and acceptable to the Engineer.

3.7 TITLE TO EQUIPMENT AND MATERIALS

- A. The Contractor shall have no right or title to any of the equipment, materials or other items to be removed from the existing buildings or structures unless and until said equipment, materials and other items have been removed from the premises. The Contractor shall not sell or assign, or attempt to sell or assign any interest in the said equipment, materials or other items until the said equipment, materials or other items have been removed.
- B. The Contractor shall have no claim against the Owner because of the absence of such fixtures and materials.

3.8 CONDITION OF BUILDINGS, STRUCTURES AND EQUIPMENT

- A. The Owner does not assume responsibility for the actual condition of buildings, structures and equipment to be demolished and removed.
- B. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner so far as practicable.
- C. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walk-through survey only. Neither the Engineer nor the Owner will be responsible for interpretations or conclusions drawn therefrom by the Contractor.

3.9 MAINTENANCE AND CLEAN UP

- A. The Contractor shall maintain the buildings, structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.
- B. The Contractor shall provide on-site dump containers for collection of waste materials, debris and rubbish, and he shall wet down dry materials to lay down and prevent blowing dust.
- C. At least once a week during the progress of the demolition and removal Work or as directed by the Engineer, the Contractor shall clean the Site and properties (including sweeping roadways with a mechanical sweeper), and dispose of waste materials, debris and rubbish.

++ END OF SECTION ++

SECTION 02100

CLEARING, GRUBBING, AND SITE PREPARATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals required to perform clearing and grubbing as shown and specified in the Contract Documents.
2. The Work includes removing from the Site and disposing of trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish, and other objectionable material. The disposal and transportation of Emerald Ash Borer (EAB) shall follow New York DEC regulations.
3. Pay all costs associated with transporting and disposing of debris resulting from clearing.
4. Limits of Clearing and Grubbing: Clear and grub the areas indicated on the Drawings as the limit of disturbance (LOD).

B. Related Sections:

1. Section 02050, Demolition, Removals, and Modifications

1.2 SUBMITTALS

A. Action Submittals: Submit the following for Engineer's approval

1. Shop Drawings:
 - a. Plan view identifying trees and other large vegetation to be removed if different from that shown or indicated in the Contract Documents.
 - b. Plan view showing proposed limits of clearing and grubbing, if different from limits of disturbance (LOD) shown or indicated in the Contract Documents.

1.3 WARRANTY

- ###### A.
- Contractor shall warrant that Work performed under this Section will not permanently damage trees, shrubs, turf, and plants designated to remain, or other adjacent work, facilities, or property. If damage resulting from Contractor's operations becomes evident during the correction period, Contractor shall replace damaged items and property at no additional cost to Owner.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. Protection:

1. Throughout the Project, protect existing site improvements, including streets, drives, and Underground Facilities to remain (if any), and adjacent property and structures. Repair damage caused by Contractor to original condition or replace in kind, to satisfaction of Engineer, at no additional cost to Owner.
2. Protect trees, shrubs, vegetation, and grassed areas to remain by providing temporary fencing, barricades, wrapping, or other methods shown, specified, or accepted by Engineer. Correct at Contractor's expense damage caused by Contractor outside the limits of clearing Work.
3. Do not remove trees without approval of Engineer, unless shown or indicated for removal.
4. Do not locate construction equipment, stored materials, or stockpiles within drip line of trees and vegetation to remain.

B. Site Preparation:

1. Obtain, pay costs associated with, and comply with applicable permits required for clearing and grubbing Work.
2. Delineation of Clearing and Grubbing Limits:
 - a. Locate and clearly flag trees and vegetation to remain, and other materials to remain in the clearing and grubbing limits. Locate and clearly flag salvable vegetation to be relocated.
 - b. Provide flagging to delineate limits of areas to be cleared or grubbed. Review at Site with Engineer before commencing removal of trees, vegetation, and other materials to be removed.
 - c. Replace flagging that is lost, removed, or destroyed, until clearing and grubbing Work is complete and Engineer allows removal of flagging.
3. Erosion and Sediment Controls:
 - a. Provide applicable erosion and sediment controls before commencing clearing and grubbing Work.
 - b. Continue providing erosion and sediment controls as clearing and grubbing Work progresses to previously uncleared, ungrubbed areas of the Site.

3.2 CLEARING AND GRUBBING

- #### A. Remove and dispose of all trees, shrubs, stumps, roots, brush, logs, rubbish, and debris within limits of clearing and grubbing shown or indicated in the Contract Documents, unless otherwise shown or indicated.
- #### B. Trees and Shrubs Improperly Destroyed or Damaged:
1. For each tree or shrub to remain that is destroyed or damaged beyond repair by Contractor, provide two replacements of the same species at locations to be designated by Engineer.

- C. Trees and shrubs to remain that have been damaged or require trimming shall be treated and repaired. Trees and shrubs intended to remain, that are damaged beyond repair or that are removed, shall be replaced by Contractor at no additional cost to Owner.
- D. Disposal of Cleared and Grubbed Materials:
 - 1. Dispose at appropriate off-Site location trees, stumps, rubbish, debris, and other cleared and grubbed material. Cleared or grubbed materials may remain at the Site only when allowed in the Contract Documents or when approved by Engineer in writing. Do not use cleared or grubbed material as fill, backfill, or in embankments.
 - 2. Dispose of cleared and grubbed material in accordance with all Laws and Regulations.
 - 3. Do not burn clearing debris at the Site.
- E. Removal of Site Improvements: Comply with Section 02050, Demolition, Removals, and Modifications.

+ + END OF SECTION + +

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SECTION 02200 EARTHWORK

PART 1 – GENERAL

1.1 – DESCRIPTION

- A. This Section includes performing all excavating, backfilling and disposing of earth materials as shown, specified and required for the purpose of site preparation, erosion control, surface drainage, constructing pipelines, concrete work, grading and other facilities
- B. This Section also includes performing all earthwork necessary for repair and replacement of roads, walks, pavements, grading, structures and other facilities as required to complete the Work as shown and specified. All materials necessary for fill, backfill, granular embedment and crushed stone are also included.
- C. This Section also includes providing all backfill materials, including select fill, common fill, granular embedment, topsoil, crushed stone, and the satisfactory disposal of surplus and unacceptable materials.
- D. All necessary preparation of subgrade is included in this Section.
- E. All temporary means required to prevent discharge of sediment to water courses from dewatering systems or erosion are included in this Section.

1.2 – RELATED SPECIFICATIONS

- A. Section 02050 – Demolitions, Removals, and Modifications.
- B. Section 02100 – Clearing, Grubbing and Site Preparation.
- C. Section 02529 – Concrete Curbs, Gutters and Sidewalks
- D. Section 02240 Dewatering
- E. Section 03300 – Cast-in-Place Concrete.
- F. Section 16133 – Underground Ducts – Ducts in Concrete.
- G. Section 16134 – Electric Manholes.

1.3 – PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for Item 1 – General Construction Contract , as described in Section 01150 – Measurement and Payment.

1.4 – REFERENCES

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes and standards refer to the most current issue available at the time of Bid.
1. ASTM A36, Structural Steel.
 2. ASTM A328, Steel Sheet Piling.
 3. ASTM D422, Particle-Size Analysis of Soils.
 4. ASTM D698, Moisture-Density Relations of Soils, using 5.5-lb (2.5-kg) Rammer and 12-inch (304.8 mm) Drop.
 5. ASTM D1556, Density of Soil in Place by the Sand-Cone Method.

1.5 – SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:
1. Samples:
 - a. At least fourteen (14) calendar days prior to the date of anticipated use, submit to the County for approval a representative sample of all on-site and off-site material required. Notify the County in writing of the source of each sample.
 2. Manufacturer's Data:
 - a. Manufacturer's specifications, performance characteristics and operating instructions for the compaction equipment.
 3. Concrete Barrier:
 - a. Product data and cut sheets
 4. Monitoring Plan of Existing Structures.
 5. Ground Penetrating Radar (GPR) survey at the location where the bypass pump station will be built.

1.6 – QUALITY ASSURANCE

- A. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction, and the requirements set forth in Attachment C of the Specifications.
- B. Tests:
1. The County shall make tests and determine acceptability of the fill or material as listed below:
 - a. Select Fill Samples: Gradation, ASTM D 422.
 - b. Compacted Select Fill: Compaction, ASTM D 698 and ASTM D 1556.
 2. The testing laboratory shall submit copies of the following reports directly to the Engineer with a copy to the Contractor:
 - a. Gradation tests on borrow material.
 - b. Field density tests.
 - c. Optimum moisture-maximum density curve for each soil used for backfill.

1.7 – DELIVERY, STORAGE AND HANDLING – (NOT USED)

1.8 – DESIGN REQUIREMENTS – (NOT USED)

1.9 – JOB CONDITIONS

A. Site Information:

1. Copies of boring logs are included as Supplemental Information. This data is furnished for information only, and it is expressly understood that the County will not be held responsible for any interpretations or conclusions drawn therefrom by the Contractor.
2. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the County.

B. Existing Structures:

1. Shown on the Contract Drawings are certain utilities, surface and underground structures located on or adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the Contractor. The Contractor shall explore prior to the required excavation in order to determine the exact location of all structures and utilities. They shall be supported and protected from injury by the Contractor. If they are broken or injured, they shall be restored immediately by the Contractor at no additional cost to the County.
2. Prior to execution of the Work, check and verify governing dimensions and elevations. The Contractor and the County shall jointly survey the condition of adjoining structures. Photographs and records shall be made of any prior settlement or cracking of structures, pavements, and the like, that may become the subject of possible damage claims.
3. Establish benchmarks on all existing structures and submit the benchmark elevations to the County. Monitor elevations prior to dewatering and installation of sheet piling, and continue daily monitoring during the dewatering period and until sheet piling is removed or until directed to do so by the Engineer. The Contractor shall retain the services of a licensed land surveyor registered in the State of New York to perform the monitoring work. All data shall be recorded and furnished to the Engineer daily. The Contractor shall immediately stop work and notify the County if any changes in benchmark elevations, additional cracking, sagging or other noticeable damage occur. Work shall not proceed prior to approval by the County.

C. Existing Utilities:

1. Locate existing underground utilities in the areas of Work. If utilities are to remain in place in accordance with the Contract Documents, provide adequate means of protection during earthwork operations.

2. Should uncharted or incorrectly charted piping or utilities be encountered during excavation, consult with the County in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the Engineer.
3. Do not interrupt existing utilities serving facilities occupied and used by the County or others, except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.
4. Demolish and completely remove existing underground utilities indicated to be removed. Coordinate with the County for shut-off of services if lines are active.
5. Use a Ground Penetrating Radar (GPR) survey at the location where the bypass pump station will be built prior starting work in this area. Survey shall be submitted to the County for review.

D. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this Work and post with warning lights. Provide "Jersey" type concrete barriers with reflective tape. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 - a. Jersey type precast concrete barriers shall conform to NYS DOT specifications and requirements.
2. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
3. Obtain approval from the Engineer prior to removing, trimming or disturbing trees, shrubs, plants, fences, rails, walks, structures or other facilities that are encountered on the line of the excavation.
4. Structures, utilities, sidewalks, pavements and other facilities removed or disturbed shall be replaced to their original condition, unless otherwise shown, specified or directed.

E. Dust Control: Conduct all operations and maintain the area of Work, including sweeping and sprinkling of roadways, so as to minimize creation and dispersion of dust. In addition, the Contractor shall be responsible for controlling dust caused by operating vehicles and equipment, clearing or for any reason whatsoever, in accordance with the General Conditions, Article GC-25 "Dust Control and Spillage".

F. Roadways and Walks: Excavated material and materials of construction shall be so deposited, and the Work shall be so conducted, as to leave open and free for pedestrian traffic all crosswalks and for vehicular traffic a roadway not less than 10-feet in width. Hydrants, valves and other facilities which may require access during construction shall be kept accessible for use. During the progress of the Work, the Contractor shall maintain such crosswalks, sidewalks and roadways in satisfactory condition, and the Work shall at all times be conducted so as to cause minimal inconvenience to the County.

PART 2 – PRODUCTS

2.1 – MATERIALS

Long Beach WPCP Consolidation
Pump Station Conversion

02200-4

A. General:

1. General fill materials shall be obtained from off-site excavation work.
2. Select fill materials shall be obtained from off-site sources.
3. Crushed stone materials shall be obtained from off-site sources.
4. Topsoil, except for topsoil stripped from the work areas meeting the requirements, shall be obtained from off-site sources.

B. Soil Materials:

1. Select Fill: Place select fill where shown or specified below and around structures, pipelines, roads, tanks, walks and other work. Select fill shall be well-graded granular material or bank run gravel, free from organic matter. Not more than 80-percent by weight shall pass through a No. 40 sieve; not more than 10-percent by weight shall pass through a No. 200 sieve; and 100-percent shall pass a 3-inch square sieve.
2. General Fill (Common Fill): Provide approved soil materials for backfill and fill, free of organics, clay, rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials and other deleterious matter. Not more than 30-percent by weight shall pass through a No. 200 sieve, except for topsoil.
3. Granular embedment: Crushed rock or pea gravel with not less than 95-percent passing a 1/2-inch sieve, not less than 95-percent retained on a No. 4 sieve and maximum 5-percent passing a No. 10 sieve.
4. Crushed stone: Crushed rock conforming to the following gradation:

<u>Sieve Size (inches)</u>	<u>Percent Retained on Sieve (%)</u>
2	0
1-1/2	0-10
1	30-65
3/4	85-100
3/8	95-100

2.2 – MANUFACTURERS – (NOT USED)

PART 3 – EXECUTION

3.1 – INSPECTION

- A. Provide the Engineer with sufficient time and means to examine the areas and conditions under which excavating, filling, and grading are to be performed. Work shall not proceed until all unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

3.2 – INSTALLATION

A. Site Preparation:

Long Beach WPCP Consolidation
Pump Station Conversion

02200-5

1. The portions of the Site on which the Work is to be constructed shall be cleared of all objectionable materials and debris in accordance with Section 02100 – Clearing, Grubbing and Site Preparation.
- B. Stripping and Storing of Topsoil:
1. Topsoil is defined as friable clay loam surface soil found in a depth of not less than 6-inches. Topsoil shall be substantially free of subsoil, clay lumps, stones, and other objects over 2-inches in diameter, and without weeds, roots and other objectionable material.
 2. Strip topsoil which is satisfactory to whatever depths are encountered and in such a manner as to prevent intermingling with the underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping. Where trees are shown or directed to be left standing, stop topsoil stripping a sufficient distance from such trees to prevent damage to the main root system.
 3. Stockpile topsoil in storage piles where approved by the Engineer. Construct storage piles to freely drain surface water. Cover storage piles to prevent windblown dust. Topsoil in excess of quantity required shall remain the property of the County. Stockpile and cover excess-stripped topsoil in an area approved by the Engineer.
 4. If Contractor chooses to dispose of topsoil, then the Contractor shall furnish and install topsoil from an offsite source at no additional cost to the Owner.
- C. Erosion Control:
1. General:
 - a. In general, the construction procedures outlined herein shall be implemented to ensure minimum damage to the environment during construction.
 - b. Whenever possible, access and temporary roads shall be located and constructed to avoid environmental damage. Provisions shall be made to regulate drainage, avoid erosion and minimize damage to vegetation. Special care shall be taken to eliminate depressions that could serve as mosquito pools.
 - c. Where areas must be cleared for storage of materials or temporary structures, provisions shall be made for regulating drainage and controlling erosion, subject to the approval of the Engineer.
 - d. In the event of any temporary work stoppage, take necessary steps to prevent any temporary or permanent environmental damage to the area undergoing construction.
 2. Control Measures:
 - a. Temporary measures shall be applied to control erosion and to minimize the siltation of the existing drains, streambeds and natural ponding areas. Such measures shall include, but not be limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, grasses, slope drains and other methods. These temporary measures shall be applied to erodible materials exposed by any activities associated with the construction of the Work.

- b. Temporary measures shall be coordinated with the construction of permanent drainage facilities and other work to the extent practicable to assure economical, effective and continuous erosion and siltation control.
 - c. Provide special care in areas with steep slopes. Disturbance of vegetation shall be kept to a minimum to maintain stability. Remove only those trees and shrubs and grasses that must be removed for construction. Protect the rest to preserve their aesthetic and erosion-control values.
 - d. Install erosion and sediment control practices as specified herein. The practices shall be maintained in effective working condition during construction and until the drainage area has been permanently stabilized.
 - e. Temporarily stabilize each segment of graded or otherwise disturbed land, including the sediment-control devices not otherwise stabilized by seeding and mulching or by mulching alone.
3. Temporary Seeding and Mulching:
- a. All disturbed areas shall be limed and fertilized prior to temporary seeding.
 - b. Disturbed areas shall be maintained in a rough graded condition and temporarily seeded and/or mulched until completion of the Work.
 - c. All areas on which temporary seeding has not been made by November 1st, shall be treated with mulch.
 - d. Mulching shall be used in conjunction with seeding on critical areas and during poor weather. Use alone for temporary stabilization during months of November through April.
 - e. Suitable Materials for Mulching:
 - i. Unrotted straw or salt hay: 1-1/2 to 2-tons/acre.
 - ii. Wood-fiber or paper-fiber (hydroseeding): 1500-lbs/acre.
 - f. Straw or salt hay mulches should be immediately anchored using peg and twine netting or a mulch anchoring tool or liquid mulch binders.
 - g. After stabilization remove all straw bale dikes, debris, etc., from the site.
 - h. Refer to contract documents for locations and types of permanent turf.

D. Excavation:

1. General:

- a. Perform all excavation required to complete the Work as shown and specified. All material excavated shall be unclassified. Excavations shall include all materials such as earth, sand, clay, gravel, hardpan, boulders, organic materials, decomposed rock, pavements, rubbish and all other materials within the excavation limits.
- b. Excavations shall be open-type, shored and braced as where necessary to prevent injury to workmen and to new and existing structures or pipelines.
- c. Excavations shall be made in the dry. Stockpile satisfactory excavated materials in areas approved by the County, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
- d. Dispose of all excavated material and waste materials as specified herein under Part 3.2 (H) – Removal of Unsuitable Materials.

2. Pipeline Excavation:
 - a. No more than 100-feet of trench may be opened in advance of pipe-laying.
 - b. Trench width shall be minimized to greatest extent practical but shall conform to the following:
 - i. Sufficient to provide room for installing, jointing and inspecting piping, but in no case wider at top of pipe than pipe barrel outside diameter plus 2-feet.
 - ii. Enlargements at pipe joints may be made if required and approved by the Engineer.
 - iii. Sufficient for sheeting, bracing and sloping.
 - iv. Sufficient to allow thorough compacting of granular embedment adjacent to bottom half of pipe.
 - v. Do not use excavating equipment which requires the trench to be excavated to excessive width.
 - c. At road crossings, the trenching width shall be minimized by the use of sheeting, trench boxes or similar protection methods.
 - d. Where existing piping or ductbank cross the new pipeline or structural excavation, they shall be adequately supported and protected from damage due to construction. All methods for supporting and maintaining these facilities shall be subject to approval by the Engineer. Care shall be taken to insure that the existing pipeline grades and alignment are maintained and that the pipe joints are not disturbed. Backfill shall be carefully placed and tamped to prevent damage or future settlement. Any damage or misalignment of the existing piping due to construction or settlement shall be repaired at the expense of the Contractor.
3. Structure Excavation:
 - a. Excavation shall be made to the grades shown on the Contract Drawings and to such widths as will give suitable room for construction of the structures, for bracing and supporting, pumping and draining. The bottom of the excavations shall be rendered firm and dry and in all respects acceptable to the County.
 - b. Excavation shall be accomplished by methods which minimize disturbance of subgrade soils. For structures having multiple bearing levels or adjacent structures at different levels, excavation and foundation construction shall first be accomplished at the lowest levels to prevent undermining foundations and disturbing adjacent bearing soils at higher levels.
 - c. Excavation equipment shall be satisfactory for carrying out the work in accordance with the Specifications. Earth shall not be plowed, scraped, or dug with machines so near to the finished subgrade as to result in excavation or disturbance of material below subgrade.
 - d. When excavation for foundations has reached final depths, the County shall be notified and shall inspect conditions. If materials and conditions are not satisfactory to the County, the County shall issue instructions as to the procedures.

- e. For structures not pile-supported, during final excavation to subgrade level, take precautions required to prevent disturbance of material. Hand excavate the final 6-inches as necessary to obtain a satisfactory undisturbed bottom.
- 4. Roadway Excavations:
 - a. Roadway excavation shall consist of excavation for the roadways in conformity with lines, grades, cross sections and dimensions shown on the Contract Drawings and shall include the excavation of all unsuitable material from the subgrade.
 - b. The subgrade shall be compacted to a 90-percent maximum density.
- 5. Unsuitable or Over-Excavation:
 - a. If any over-excavation occurs through error of the Contractor or for convenience of the Contractor, it shall be refilled at the expense of the Contractor with concrete, select fill or other material satisfactory to the County.
 - b. If the Contractor fails to properly dewater the excavation or trench, or disturbs the subgrade or otherwise fails or neglects to conduct the excavation work in a manner that provides the surface of the subgrade in proper condition for construction, the Contractor shall remove all disturbed material and replace it with concrete, select fill, or other approved material at the expense of the Contractor. The condition of the subgrade shall meet with the approval of the County before any work is placed thereon.
 - c. For structures not pile supported, if, in the opinion of the County, the material, in its undisturbed natural condition, at or below the grade of the excavation indicated on the Drawings is unsuitable for foundations, or if organic or silty soil extends below excavation depth, it shall be removed to such depth and width as the County may direct and be replaced with select fill or other suitable material as directed by the County.
- 6. Where the structure or pipeline is to be placed below the ground water table, well points, cofferdams or other acceptable methods shall be used to permit construction of said structure or pipeline under dry conditions. Dry conditions shall prevail until concrete has reached sufficient strength to withstand earth and hydrostatic loads and until the pipelines are properly jointed, tested and backfilled. In addition, protect excavation from flooding until all walls and floor framing up to and including grade level floors are in place and backfilling has begun. Water level shall be maintained below top of backfill at all times.
- 7. Pumping of water from excavations shall be done in such a manner so as to prevent the carrying away of unsolidified concrete materials and to prevent damage to the existing subgrade.
- 8. Any areas where trench excavation is left open, the Contractor shall provide plating over trench excavation at the end of each workday.

E. Sheeting, Shoring and Bracing:

- 1. General:
 - a. Sheeting, shoring and bracing shall be used where necessary to prevent injury to workmen, structures, or pipe lines. Jetting for sheeting installation is prohibited.

- b. All municipal, county, state and federal ordinances, codes, regulations and laws shall be observed. All trenches shall be shored with the minimal protection of sheeting listed in OSHA Regulations, 29 CFR, Part 1926, Subpart P – Excavations, Trenching and Shoring. The Contractor shall comply with latest revisions of all OSHA regulations for all excavations, sheeting, shoring, and bracing whether they are individually listed here or not.
 - c. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
 - d. Unless otherwise shown, specified, or ordered, all materials used for temporary sheeting shall be removed when work is completed. Such removal shall be made in a manner not injurious to the structure or its appearance or to adjacent Work.
 - e. The clearances and types of the temporary sheeting, insofar as they affect the character of the finished Work, will be subject to the approval of the Engineer but the Contractor shall be responsible for the adequacy of all sheeting, shoring, bracing and other related work.
 - f. Safe and satisfactory installation of the sheeting shall be the entire responsibility of the Contractor.
2. Sheeting Left in Place:
- a. Steel sheet piling to be left in place shall be driven straight to the lines and grades shown or directed. Piles shall penetrate into firm materials with secure interlocking throughout the entire length of the pile. Damaged piling having faulty alignment shall be pulled and replaced with new piling.
 - b. The type of guide structure used and method of driving steel sheet piling to be left in place shall be subject to approval of the Engineer.
 - c. Cut off piling left in place to the grades shown or ordered by the Engineer and shall remove the cut offs from the site.
 - d. Thoroughly clean wales, braces and all other items to be embedded in the permanent structure, and make provisions that the concrete surrounding the embedded element is sound and free from air pockets or harmful inclusions. The provisions shall include the cutting of holes in the webs and flanges of wale and bracing members, and the welding of steel diaphragm waterstops perpendicular to the centerline of brace ends which are to be embedded.
 - e. Subsequent to removal of the inside face forms, and when removal of bracing is permitted, steel shall be cut back at least 2-inches inside the wall face and the opening patched with cement mortar. The concrete shall be thoroughly worked beneath wales and braces, around stiffeners and in any other place where voids may be formed.
3. Removal of Sheeting and Bracing:
- a. Unless otherwise shown on the Contract Drawings or ordered in writing by the Engineer, all sheeting and bracing shall remain in place. If removal of sheeting and/or bracing is required, removal shall be done so as to not cause damage to the Work or adjacent structures. Earth pressure shall be equal on both sides of excavation to ensure no unequal loads on pipe or structure. Use of vibratory extractors is prohibited, unless approved by the Engineer.

- b. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until wall and floor framing up to and including grade level floors are in place and concrete has attained sufficient strength to withstand the soil loads.

F. Backfill and Compaction:

1. Fill excavations as promptly as the Work permits, but not until completion of the following:
 - a. Acceptance by the Engineer of all Work within the excavation.
 - b. Inspection, testing approval, and recording of locations of underground utilities, connections, branches, structures and other facilities.
 - c. Removal of temporary shoring and bracing, and backfilling of voids with satisfactory materials.
 - d. Removal of trash and debris.
2. Excavation shall be kept dry during backfilling operations. Backfills around piping and structures shall be brought up evenly on all sides.
3. General fill and select fill materials shall be placed in layers not exceeding 8 inches in thickness, and each layer shall be compacted as specified below.
4. Backfill in pipe trenches which is below other pipes, structures, foundations, or paved areas shall be select fill and shall be placed in horizontal layers not exceeding 8-inches in depth and thoroughly compacted before the next layer is placed. Compaction layers shall be 8-inches up to the pipe spring line and 12-inches thereafter in trenches that are not below other pipes, structures, foundations, or paved areas.
5. Backfill above and adjacent to pipe, and adjacent to buildings and tank walls shall be compacted by light weight equipment, such as "walk behind" vibratory plate compactors. Heavy self-propelled compactors shall not be used until the following criteria are met:
 - a. A minimum of 18-inches of compacted backfill has been placed above the top of the pipe.
 - b. Area to be compacted is a minimum distance of three (3) pipe diameters away from the adjacent pipe.
 - c. Area to be compacted is a minimum of 10-feet from building and tank walls and riser pipes.
6. Levels of backfill against concrete walls shall not differ by more than 2-feet on either side of walls unless walls are adequately braced or all floor framing is in place up to and including grade level slabs. Particular care shall be taken to compact structural backfill that will be beneath pipes, roads, or other surface construction or structures. In addition, wherever a trench passes through structural backfill, the structural backfill shall be placed and compacted to an elevation 12-inches above the top of the pipe before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.
7. Backfill in Pipe Trenches:
 - a. Pipeline trenches may be backfilled prior to pressure testing the pipe, but no structure shall be constructed over any pipeline until it has been tested.

- b. All pipe larger than 6-inches in diameter shall be placed on existing Sand Stratum 4, Select Fill or granular embedment material. Pipe 6-inches in diameter and smaller shall be placed in granular embedment material unless the trench bottom has been graded to provide uniform and continuous support of the installed pipe.
- 8. Backfill in Electrical Ductbank Trenches:
 - a. Compacted backfill shall be required for the full depth of the trench above the electrical ductbank. Where the trench for one ductbank passes beneath the trench for another pipe or ductbank select backfill shall be placed to the level of the bottom of the upper trench.
- 9. Crushed Stone Placement:
 - a. Crushed stone shall be placed where shown on the Contract Drawings.
 - b. Crushed stone shall be placed in hand-tamped lifts not to exceed 6-inches.
- 10. Hydro hammers or "jumping jack" hammers shall not be used above pipes until a minimum of 3-feet of backfill has been placed and compacted.
- 11. Compaction Density Requirements:
 - a. Unless otherwise noted, the degree of compaction required for all types of fills shall be 95-percent in accordance with ASTM D 698. Material shall be moistened or aerated as necessary to provide the moisture content that will facilitate obtaining the specified compaction.
 - b. Drainage stone shall be compacted with a vibratory plate compactor or vibratory rolling compactor. Three complete passes shall be made on each 8-inch thick loose layer of stone. Each pass shall overlap the adjacent previously compacted area a minimum of 20-percent. Density requirement for the drainage stone will be considered satisfactory upon completion of compaction.
- 12. The Contractor shall repair any damage, at no additional cost to the County, after-settlement that occurs. He shall make all repairs and replacements necessary within thirty (30) days after notice from the Engineer.

G. Grading:

- 1. Uniformly grade areas within limits of the Work, including adjacent transition areas. Smooth subgrade surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- 2. Turfed Areas: Finish areas to receive topsoil to within not more than 1-inch above or below the required subgrade elevations.
- 3. Walks: Shape surface of areas under walks to the line, grade and cross-section shown, with finish surface not more than 1-inch above or below the required subgrade elevation.
- 4. Pavements: Shape surface of areas under pavements to the line, grade and cross-section shown, with finish surface not more than 1/2-inch above or below the required subgrade elevation.
- 5. Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/4-inch when tested with a 10-foot straightedge.

6. Compaction: After grading, compact subgrade surfaces to the depth and percentage of maximum density required.

H. Removal of Unsuitable Materials:

1. Remove and dispose off-site all unsuitable organic and/or inorganic materials. Within thirty (30) consecutive days after Notice to Proceed, submit to the County for review all required permits and a list of disposal sites for the unsuitable materials. If the disposal site is located on private property the submittal shall also include written permission from the County of record.
2. All unsuitable materials shall be disposed of in locations and under conditions that comply with Federal, State and local laws and regulations.
3. Obtain an off-site disposal area prior to beginning demolitions or excavation operations.
4. All unsuitable materials shall be hauled in trucks of sufficient capacity and tight construction to prevent spillage. Trucks shall be covered to prevent the escape of odors and the propagation of dust.
5. When all unsuitable material disposal operations are completed, leave the disposal site in a condition acceptable to the County of the disposal site.
6. Soil shall not be dumped onto those areas designated by the County as wetlands or waterways. Spoil, materials, tools or equipment shall not be stockpiled or stored on wetlands. Stockpiling of unsuitable organic material is not permitted on the Site.
7. Unsuitable material shall be as described in the Hazardous Material Report titled "Phase II Environmental Site Investigation" attached as a reference material to the Contract Documents.

I. Restoring and Resurfacing Existing Roadways and Facilities:

1. Place 1-1/2-inches of temporary bituminous pavement immediately after backfilling excavations in paved roadways. Contractor shall maintain, in good and safe condition during progress of the entire Work, the surface of the paved area over the excavation, and shall promptly fill all depressions over and adjacent to the excavation caused by settlement of backfill. Immediately prior to constructing the permanent paving and base the Contractor shall remove and dispose of temporary pavement. Permanent replacement pavement shall conform to the requirements of Section 02510 – Paving and Surfacing.
2. Pavement, gutters, curbs, walks, driveways and roadways disturbed or damaged by the operations of the Contractor shall be restored or replaced to the original condition at no additional cost to the County.
3. After all other work has been completed in each area, place and grade topsoil to a depth of not less than 6-inches.

J. Drainage and Dewatering:

1. Dewatering shall be in accordance with Section 02240.
2. Disposal of Water Removed by Dewatering System shall be in accordance with Section 02240.

3.3 – FIELD QUALITY CONTROL – (NOT USED)

++ END OF SECTION ++

SECTION 02228

CONSTRUCTION NOISE AND VIBRATION CONTROL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. The work to be done under this Section includes, but is not limited to, conducting all activities on the project in such a manner that damage is prevented to adjacent pipes, structures, property and work, and such that construction noise, ground vibrations and ground and structure displacements are consistently maintained below the maximum levels specified in this Section.
2. Notifying the Engineer prior to conducting any noise and vibration producing construction activity, and conducting appropriate monitoring at nearby structures in accordance with the plan prepared by the Contractor's independent specialist and approved by the Engineer.
3. The Contractor's independent specialist shall provide, install, and set up engineering seismographs and sound level meters adjacent to or on structures, utilities or other potentially affected areas, as appropriate.
4. Protecting vibration and sound level monitoring equipment, and other monitoring equipment that exists or is installed as required by the Contract Documents.
5. Submitting noise and vibration monitoring reports.
6. Resolution of complaints, damage and exceedances of threshold and limit value criteria.

B. Related Sections:

1. Section 02050, Demolition, Removals, and Modifications
2. Section 02200, Earthwork

1.2 REFERENCES

A. All construction noise and vibration control work shall be in accordance with:

1. FTA – Trans Noise and Vibration Impact Assessment
2. ANSI S1.4 & S1.43 Specification for Sound Level Meters
3. The State of New York

1.3 JOB CONDITIONS

- ###### A.
- The Contractor shall engage a qualified, independent specialist to install and monitor engineering seismographs adjacent to or on adjacent structures or

utilities, for the purpose of monitoring and ensuring compliance with the noise and vibration specified herein. The Contractor's independent specialist may also monitor related geotechnical instrumentation such as observation wells, piezometers and inclinometers.

- B. Vibration and sound level monitoring shall be performed by the Contractor's independent specialist using personnel experienced in the correct placement and monitoring of engineering seismographs and sound level meters.
- C. Vibration and noise monitoring shall be performed continuously during all demolition and construction activities at the site.

1.4 SUBMITTALS

- A. Submit qualifications for the independent specialist whose services have been selected by the Contractor for performing the noise and vibration monitoring work demonstrating at least 5 similar assignments completed successfully during the last 5 years.
- B. Before beginning work that may cause noise or vibrations, submit a Construction Noise and Vibration Monitoring and Control Plan including:
 - 1. Instrument specifications and calibrations.
 - 2. Table of expected noise and vibration producing activities including: description of activity, location, and anticipated dates and times of activities.
 - 3. Table of structures, utilities, levees and other noise and/or vibration sensitive receptors (including identification of historic structures and sites) that may be impacted by noise and vibration including: structure description, street address, name and address of Owner, and names of occupants.
 - 4. Proposed monitoring locations.
 - 5. A Construction Vibration Assessment performed in accordance with the guidance in Chapter 12 of the FTA Transit Noise and Vibration Impact Assessment Manual (April 1995) for construction activities.
 - 6. A Construction Noise Assessment performed in accordance with the guidance in Chapter 12 of the FTA Transit Noise and Vibration Impact Assessment Manual (April 1995) for construction activities.
 - 7. Preliminary evaluation of structure susceptibility to vibration induced damage.
 - 8. Monitoring program procedure including reporting procedures.
 - 9. Noise and Vibration Mitigation Plan (including damage prevention).
 - 10. Sample Noise and Vibration Data Report.
 - 11. Plan to deal with and resolve complaints.
- C. Before beginning work that may cause noise or vibrations, initiate a Construction Noise and Vibration Monitoring and Control Program. The Contractor shall perform the following actions:

1. Within 2 working days of receipt of each seismograph and noise meter at the site, submit copy of specifications, manual, factory calibration and manufacturer's test equipment certification.
 2. Submit background noise and vibration data reports for each building, utility, levee or other sensitive receptor in accordance with Table 2 of this Section.
 3. Submit weekly Noise and Vibration Data Reports, within 3 days of the end of each week.
 4. Submit Noise and Vibration Data Reports within 1 working day of requests by the Engineer in response to complaints by adjacent property owners.
- D. Submit pre-condition surveys of potentially impacted properties, at least two weeks before the start of vibration producing activities.
- E. Submit post-condition surveys of potentially impacted properties, no later than four weeks after the completion of vibration producing activities.
- F. All surveys shall be signed and sealed by a surveyor licensed in the state of New York.
- G. The Engineer shall be notified immediately if any noise or vibration readings exceed the threshold or limiting values specified herein.

PART 2 – PRODUCTS

2.1 EQUIPMENT

- A. Noise Meters: Provide and operate Type 1 or Type 2 sound level meters consistent with ANSI and ASTM requirements for monitoring noise levels from construction activities and equipment:
1. Noise level range: 40 to 120 db, or mid-scale.
 2. Metric: Leq, 1-hour average.
 3. A-weighted frequency response.
 4. Response time: slow setting for continuous or intermittent noise; fast setting for impulsive noise (a momentary sound such as a horn).
 5. Windscreen: place factory-supplied windscreen over microphone during all measurement periods.
 6. Position: the meter microphone should be positioned at a height of 4 feet above ground level and at least 10 feet away from a reflecting surface (such as a wall). The microphone can be handheld or tripod mounted.
 7. Data shall be collected either by manually reading and recording noise levels or by storing and downloading the data remotely depending on the capabilities of the meters used. The date, time, monitoring location and nature of construction activities shall be reported with the data.
 8. Field calibration: Noise meters shall be field calibrated before and after each

measurement, or at least once per hour, whichever is more frequent using a calibrator specified for use with the meter and the manufacturer's instructions for calibration.

- B. Seismographs: Provide portable seismographs for monitoring the velocities of ground vibrations resulting from construction activities, with the following minimum features:
1. Seismic range: 0.01 to 8 inches per second with an accuracy of 5% and no more than a 3 db roll off at the low frequency end.
 2. Flat frequency response: 2 to 200 Hertz.
 3. Three-component sensor.
 4. Fourth channel for air blast monitoring.
 5. Two power sources: Internal rechargeable battery and charger and 115 volts AC. Battery must be capable of supplying power to monitor vibrations continuously for at least 24 hours.
 6. Direct writing to printer and to either 3.5-inch magnetic disk or CD.
 7. Instruments must be capable of producing strip chart recordings of readings on site within one hour of obtaining the readings. Provide computer software to perform frequency analyses of data obtained on magnetic disks.
 8. Continuous mode and histogram mode capabilities for recording vibrations.
 9. Histogram mode must include frequencies of each peak vibration.
 9. Capability of downloading data remotely via telephone modem.
- C. Factory calibration: Provide factory calibrations for each instrument. Perform seismograph calibrations using a shake table and a reference sensor traceable to the national institute of standards and technology. Perform noise meter calibrations using a calibrator traceable to the national institute of standards and technology. Recalibrate the instruments at least once every 12 months.

PART 3 – EXECUTION

3.1 GENERAL

- A. The Contractor shall prepare a Construction Noise and Vibration Monitoring and Control Plan. Preconstruction components of the Plan shall be completed prior to construction and submitted to the Engineer for approval at least two weeks prior to the onset of construction.
1. All noise and vibration monitoring instruments shall be installed in the presence of the Engineer. The Contractor shall allow access to the work area at all times for the purpose of observing instrumentation and obtaining data. The Contractor shall determine the elevation and location of all instrumentation a minimum of one week prior to excavation or demolition.
 2. The Contractor shall be responsible for any and all damage incurred to utilities during instrumentation installation.
 3. The Contractor shall protect and maintain instrumentation until the end of

the Contract. Any instrumentation damaged or otherwise rendered non-functional shall be repaired or replaced with a new installation within five working days at no additional cost to the Owner. Repair or replacement work shall conform to the requirements specified herein for the respective type of geotechnical instrumentation.

4. The Contractor shall provide and maintain well-delineated protection devices at the surface on all instrumentation.
 5. The Contractor shall monitor construction activity noise for two one-hour periods each week when Contractor's activities are most noise intensive. The Monitoring Plan shall identify the one-hour daytime and one-hour nighttime monitoring periods to be used throughout the monitoring program.
 6. The Contractor shall monitor construction activity noise at actual or representative sensitive receptor locations. Sensitive receptor locations that are adjacent to one another and would be expected to experience equivalent exposure to construction noise may be clustered by selecting a representative monitoring location. The monitoring locations shall have an unobstructed line of sight to the construction site. The selected monitoring locations and rationale for selection shall be identified in the Monitoring Plan and shall be used throughout the monitoring program.
 7. When no construction activity occurs within 1000 feet of a monitoring location during any single week, no monitoring needs to be performed at that location during that week. The Contractor shall provide an explanation of that circumstance in the Noise and Vibration Data Report for that week.
- B. The Contractor shall execute a Construction Noise and Vibration Monitoring and Control Program. The Program shall be performed consistent with the requirements and conditions specified in the Construction Noise and Vibration Monitoring and Control Plan.
- C. The Contractor shall use every effort and every means possible to minimize noise caused by its operations. The Contractor shall provide working machinery and equipment designed to operate with the least possible noise, including the use of shields, soundproof housings, enclosures, or other physical barriers to restrict the transmission of noise. Compressors shall be equipped with silencers or mufflers on intake and exhaust lines. Wherever practicable, electricity shall be used for power to reduce noise. Where required by agencies having jurisdiction, certain noise producing work may have to be performed during other than regular working hours or at specified periods only.
- D. If the need arises, the Contractor will be required to assist the Engineer and the Owner with community coordination activities relative to public noise exposure.

3.2 GENERAL NOISE LEVEL RESTRICTIONS

- A. Contractor shall comply with local noise ordinances.

- B. As part of the Construction Noise and Vibration Monitoring and Control Plan, the Contractor shall prepare a Construction Noise Assessment in accordance with the guidance in Chapter 12 of the FTA Transit Noise and Vibration Impact Assessment Manual for construction activities. The Contractor must determine the potential for construction noise impacts on noise sensitive receptors, develop a mitigation plan to prevent impacts to the maximum extent practicable, and develop a Monitoring Plan.
- C. Contractor assumes all responsibility and liability for any noise impacts on sensitive receptors.
- D. Ambient noise measurements will be taken and mitigation measures identified and utilized to ensure compliance with local noise ordinances.
- E. Noise monitoring shall not be conducted during precipitation events or in winds greater than 12 miles per hour.
- F. If a Maximum Acceptable Construction Noise Level is reached:
 - 1. Immediately notify the Engineer.
 - 2. Meet with the Engineer to discuss response action(s).
 - 3. Submit an up-to-date report within 24 hours for all instruments for which the Maximum Level was reached, as well as on any other instruments requested by the Engineer.
- G. In addition to the above steps, if a Maximum Acceptable Construction Noise Level is reached, initiate the following response actions, as directed by the Engineer.
 - 1. Increase instrument monitoring frequencies.
 - 2. Install and monitor additional instruments.
 - 3. Modify construction procedures.
 - 4. Implement Mitigation Measures specified in Article 3.10 of this Section or as identified in the Construction Noise and Vibration Monitoring and Control Plan, so that the Maximum Level is not exceeded.
- H. If the Maximum Level is reached, the Contractor may be directed to suspend activities in the affected area with the exception of those actions necessary to avoid exceeding the Maximum Level.
- I. If complaints about noise are received, the Contractor shall promptly conduct additional monitoring at additional times, locations and frequencies, as directed by Engineer, and immediately inform Engineer of the results of such monitoring, at no additional cost to the Owner.

3.3 SPECIFIC NOISE LEVEL RESTRICTIONS

- A. Noise levels at the construction site limits shall not exceed values provided in local ordinances.
- B. The Contractor shall ensure that appropriate measures will be in place during construction to protect the sensitive receptors from noise impacts to the maximum extent practicable. These measures shall be identified within the Noise and Vibration Mitigation Plan.

3.4 GROUND VIBRATION LIMITS

- A. As part of the Construction Noise and Vibration Monitoring and Control Plan, the Contractor shall prepare a Construction Vibration Assessment in accordance with the guidance in Chapter 12 of the FTA Transit Noise and Vibration Impact Assessment Manual for construction activities. The Contractor must determine the potential for construction vibration impacts on vibration sensitive receptors, develop a mitigation plan to prevent impacts to the maximum extent practicable, and monitor construction activity vibration as needed.
- B. Contractor assumes all responsibility and liability for any vibration damage to surrounding buildings and structures as a result of the Contractor's activities if deemed the result of the fault of the Contractor.
- C. Table 02228-A, located after "End of Section" designation, indicates Threshold and Limiting Values for seismographs. These values are defined collectively as Response Values. The actions associated with these Response Values are defined. Response Values are subject to adjustment by the Engineer as indicated by prevailing conditions or circumstances.
- D. If a Threshold Value is reached:
 - 1. Immediately notify the Engineer.
 - 2. Meet with the Engineer to discuss response action(s).
 - 3. Submit an up to date report within 24 hours for all instruments for which the Threshold Value was reached, as well as on any other instruments requested by the Engineer. Continue to submit daily reports until all instrument readings fall below the specified Threshold Values, or unless otherwise directed by the Engineer.
- E. In addition to the above steps, if a Threshold Value is reached, initiate the following response actions, as directed by the Engineer.
 - 1. Increase instrument monitoring frequencies.
 - 2. Install and monitor additional instruments.
 - 3. Modify construction procedures.
 - 4. Implement Mitigation Measures as specified in Contract Documents and this Section or as identified in the approved Construction Noise and Vibration Monitoring and Control Plan, so that the Limiting Value is not exceeded.

- F. If a Limiting Value is reached:
1. If limiting values of vibration are exceeded, all work by the Contractor in the vicinity of the exceedance shall stop until a meeting takes place between the Contractor and the Engineer to assess the cause of the exceedance.
 2. Immediately notify the Engineer.
 3. Meet with the Engineer to discuss response action(s).
 4. Submit an up to date report within 24 hours for all instruments for which the Limiting Value was reached, as well as on any other instruments requested by the Engineer. Continue to submit daily reports until all instrument readings fall below the specified Threshold Values, or unless otherwise directed by the Engineer.
 5. A submittal shall be prepared and submitted to the Engineer indicating what activity caused the exceedance and what steps the Contractor will take to prevent further exceedances of the limits. No work in the vicinity of the exceedance shall be restarted until the submittal is reviewed and approved by the Engineer.
- G. Implement Mitigation Measures as specified in Contract Documents or as identified in the approved Construction Noise and Vibration Monitoring and Control Plan, so that the Limiting Value is not exceeded.
- H. If complaints about noise or vibrations are received, the Contractor shall promptly conduct additional monitoring at additional times, locations and frequencies, as directed by Engineer, and immediately inform Engineer of the results of such monitoring, at no additional cost to Owner.

3.5 GROUND BORNE NOISE AND VIBRATION LEVEL RESTRICTIONS

- A. The Contractor shall ensure that appropriate measures will be in place during construction to protect the sensitive receptors and historic structures from damage and foundation cracking to the maximum extent practicable. These measures shall be identified within the approved Construction Noise and Vibration Mitigation Plan.

3.6 SEISMOGRAPH INSTALLATION

- A. Install seismographs in accordance with Manufacturer's installation instructions.
- B. Firmly mount seismographs on the surface slab of concrete or asphalt, firmly set them in undisturbed soil, or rigidly attach them to the structure of buildings.

3.7 PROTECTION OF INSTRUMENTS

- A. Protect all instruments and appurtenant fixtures, leads, connections, and other components of instrumentation systems from damage due to construction operations, weather, traffic, and vandalism.

- B. If an instrument is damaged, repair or replace the damaged instrument at no additional cost to the Owner, including damage resulting from Contractor. Contractor's actions to instruments installed by others. The Engineer will be the sole judge of whether repair or replacement is required. The Engineer may impose a work stoppage in the vicinity of the damaged instrument until it is again operational, at no additional cost to the Owner.

3.8 DATA COLLECTION

- A. Comply with the schedule in Table 02228-2B, located after "'End of Section'" designation.

3.9 MITIGATION MEASURES

- A. As part of the Construction Noise and Vibration Monitoring and Control Plan, the Contractor shall prepare a Noise and Vibration Mitigation Plan. The Plan shall identify potential noise and vibration impacts during construction activities, and the measures the Contractor will use to minimize those impacts.
- B. Measures to minimize construction noise and vibration impacts must be evaluated for effectiveness by the Contractor. Such measures may include, but are not limited to:
 - 1. Minimize the use of other loud construction equipment during nighttime hours.
 - 2. Sequence operations, combining noisy events to occur at the same time on order to reduce the total length of the noise generating activity, and avoid nighttime construction.
 - 3. Use alternative construction methods such as: drill pile instead of impact pile driving, using quieted equipment, and alternative demolition techniques.
 - 4. Use shields, impervious fences or other physical barriers to inhibit the transmission of noise.
 - 5. Use sound retardant housings or enclosures around noise producing equipment.
 - 6. Use effective intake and exhaust mufflers on internal combustion engines and compressors.
 - 7. Use electric instead of diesel powered equipment.
 - 8. Use covered hoppers, storage bins, and chutes with sound deadening material.
 - 9. Use hydraulic tools instead of pneumatic impact tools.
 - 10. Minimize use of air or gasoline driven saws.
 - 11. Conduct truck loading, unloading, and hauling operations so that noise and vibration are minimized.
 - 12. Place operation limitations on machines and trucks.
 - 13. Site stationary equipment to minimize noise and vibration impact on the community.

14. Plan noisier operations during times of highest ambient noise levels.
15. Keep noise levels relatively uniform, avoid peaks and impulse noises.
16. Turn off idling equipment.
17. Phase in startup and shutdown of equipment.

3.10 NOISE AND VIBRATION COMPLAINT RESOLUTION

- A. As part of the Construction Noise and Vibration Monitoring and Control Plan, the Contractor shall prepare and implement a plan for responding to and resolving noise and vibration complaints that may arise during construction activities.

3.11 SCHEDULES

- A. Schedules, listed below, following the "End of Section" designation, are part of this Specification Section:
 1. Table 02228-A, Response Values
 2. Table 02228-B, Monitoring Schedule

+ + END OF SECTION + +

TABLE 02228-A, RESPONSE VALUES

INSTRUMENT	THRESHOLD VALUE	LIMITING VALUE
Seismographs at buildings: Continuous or Steady State Vibration (see Note 1)	Peak Particle Velocity: 0.3 in/sec for frequencies less than 30 Hz 0.4 in/sec for frequencies greater than 60 Hz	Peak Particle Velocity: 0.5 in/sec for frequencies less than 30 Hz 0.8 in/sec for frequencies greater than 60 Hz
Seismographs at buildings: Transient or Impact Vibration (see Note 2)	Peak Particle Velocity: 0.75 in/sec for frequencies less than 60 Hz 1 in/sec for frequencies greater than 90 Hz	Peak Particle Velocity: 1.5 in/sec for frequencies less than 60 Hz 2 in/sec for frequencies greater than 90 Hz
Special Response Values for Instruments at Historic Buildings	One-half the velocities listed above	One-half the velocities listed above
Special Response Values for Instruments at Buried Pipeline Utilities	Peak Particle Velocity = 2 in/sec	Peak Particle Velocity = 3 in/sec
Special Response Values for Instruments at Levees	Peak Particle Velocity = 1.5 in/sec	Peak Particle Velocity = 2 in/sec

Notes:

1. Response Values for Continuous or Steady State Vibrations apply to vibrations such as vibratory pile drivers, jack hammers, reciprocating pavement breakers, compactors, large pumps and compressors, bulldozers, trucks, cranes, and other large machinery. Use linear interpolation for frequencies between 30 Hz and 60 Hz.
2. Response Values for Transient or Impact Vibrations apply to vibrations such as blasting, drop chisels, clam shell buckets, impact pile drivers, wrecking balls, building demolition, gravity drop ground compactors and gravity drop pavement breakers. Use linear interpolation for frequencies between 60 Hz and 90 Hz.

TABLE 02228-B, MONITORING SCHEDULE

INSTRUMENT	SCHEDULE
Noise meters	<p>Obtain noise measurements during the designated one-hour daytime monitoring period, in the Leq metric, and the designated one-hour nighttime monitoring period one week before construction begins at the selected noise monitoring locations to establish background noise levels.</p> <p>Obtain, obtain noise measurements during the designated one-hour daytime monitoring period, in the Leq metric, and the designated one-hour nighttime monitoring period each week during construction activities at the selected noise monitoring locations.</p> <p>Submit data reports weekly.</p>
Seismographs	<p>Continuously, in histogram mode (5 minute intervals), for one week before construction begins, to obtain background vibration levels.</p> <p>At the start of vibration-inducing construction activities, determine peak particle velocity and corresponding frequencies produced by single hammer blows or blasts or other vibration-producing activities to establish the maximum energy which can be used without surpassing acceptable vibration levels in nearby structures. Perform separate tests for each building.</p> <p>Continuously in histogram mode (5 minute intervals)during vibration-producing construction activities within 300 feet of seismograph location. Submit reports weekly.</p>

SECTION 02240

DEWATERING

PART 1 – GENERAL

1.1 – DESCRIPTION

- A. This Section includes requirements for furnishing all labor, materials and equipment and to perform all work necessary to lower and control the groundwater levels and hydrostatic pressures in order to permit construction to be performed in dry conditions.
 - 1) The work shall include the testing, operation, maintenance, supervision, rewatering and final dismantling and removal from the site of the dewatering system as described herein. It shall also include the cost of any replacement or rehabilitation of the subgrade or structures damaged due to dewatering system failures or negligence on the part of the Contractor. The Contractor shall be responsible for compliance with all Federal, State and County regulations related to this work.
 - 2) Dewatering shall include the diversion, collection, and removal of all ice, snow and surface runoff from the work areas as well as removal of groundwater from any new excavations which might be required within the work areas in order to permit construction in the dry.

1.2 – RELATED SPECIFICATIONS

- A. Section 02200 – Earthwork
- B. Section 02276 – Erosion and Sediment Control
- C. Section 02500 – Surface Restoration

1.3 – PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price for bid Item 1 – General Construction Contract, as described in Section 01150 – Measurement and Payment.
- B. No additional payment will be made for additional wells or piezometer or other work required to achieve or monitor the required drawdown during construction.

1.4 – REFERENCES

A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes and standards refer to the most current issue available at the time of the Bid:

- 1) American Society for Testing and Materials (ASTM).
- 2) ASTM D1556 – Density of Soil in Place by the Sand Cone Method.
- 3) ASTM D2167 – Density of Soil in Place by the Rubber Balloon Method.
- 4) ASTM D2922 – Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- 5) Groundwater Manual, Bureau of Reclamation - 1977 U.S. Bureau of Reclamation Sediment Test by Imhoff.
- 6) Site geotechnical report.

1.5 – SUBMITTALS

A. The Contractor will be responsible for obtaining all necessary permits for dewatering operation. Approved permits shall be submitted to the County.

B. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:

- 1) Prior to Commencement of Construction:
 - a. Name and qualifications of dewatering subcontractor, if applicable, including a listing of recent dewatering installations.
 - b. Shop Drawings.
 - c. Detailed description of the sequence of both recharge and dewatering systems, including operations, estimates of drawdown and flow.
 - d. Emergency Plan.

- e. Proposed schedule and record forms for all maintenance tests for primary and standby dewatering system.
 - f. Dewatering well installation records.
 - g. Observation well installation records.
- 2) During Construction:
- a. Weekly dewatering system monitoring reports.
 - b. Records of all maintenance tests for primary and standby dewatering system.
 - c. Dewater well removal records.
 - d. Observation well removal records.
 - e. Settlement Report records.

C. The following information relates to the shop drawings to be submitted in accordance with the requirements of Division 01 of the Specifications.

- 1) Each submittal shall be complete in all respects incorporating all information and data listed herein and all additional information required for evaluation of the compliance of the proposed dewatering system with the Contract Documents.
- 2) Partial, incomplete or illegible submissions will be returned to the Contractor without review for re-submittal.
- 3) Shop drawings shall include, but not be limited to:
 - a. Plans showing the methods and location of dewatering and discharge. The drawings shall include a sufficient number of detailed sections to clearly illustrate the scope of work. The relationship of the dewatering system, observation wells, and discharge line to existing buildings, other structures, utilities, streets and new construction shall be clearly indicated. Utility locations shall be shown. The drawings showing all of the above information, including calculations, shall be prepared by a qualified

Registered Professional Engineer, licensed in the State of New York, and shall bear his or her seal and signature.

- b. Lists of materials and equipment to be used including details of installation.
- c. A sample of all well record forms, weekly reports, daily observation well reports, and settlement report forms, to be maintained during construction.
- d. The County's review of shop drawings and related submittals shall be made to verify that the general scope of work is adequate, and that the Contractor is qualified to perform the work as shown on the drawings. Approval of the Contractor's plans and methods of construction by the County shall not be construed to relieve the Contractor in any way from his responsibility for the successful performance of the dewatering work.
- e. Observation wells shall be used as the primary basis of determining compliance with the requirements for the dewatering.

4) Weekly Dewatering System Monitoring Reports:

- a. In each week, a weekly monitoring report for the dewatering system shall be submitted. No payment for dewatering expenses shall be made unless all of the weekly monitoring reports for the time period involved have been submitted.
- b. Each report shall be submitted on forms previously approved by the County; see Section 1.06 C-3. The following data shall be contained therein.
 - i. For observation wells, daily piezometric levels. Entries shall be identified by date, time, observation well number. Piezometric levels shall be noted in feet of drawdown and groundwater elevation.
 - ii. For dewatering wells, suspended material test results. Entries shall be identified by date, time, well number, well pumping rate (if monitored) and system pumping rate (subsystem if multiple pumps are used).
 - iii. Installation records for new wells or observation wells.
 - iv. Daily operating log which shall include the following data as a minimum, maintenance tests and water quality tests for suspended

matter at the discharge point including time of day and elapsed times of tests, daily discharge rates, installation and removal of wells, and general observations on the system such as equipment running times, and failures.

- v. For vertical control (settlement) points, daily readings of elevations and computed changes in elevation for each settlement point. Entries shall be identified by date, time and control point number.
- vi. For crack monitoring points, daily readings of changes in the cracks. Entries shall be identified by date, time and crack monitoring point number.

1.6 – QUALITY ASSURANCE

A. Examination of the Site:

- 1) Take all the steps that are considered necessary to become familiar with the surface and subsurface conditions at the Site. Obtain the data required to analyze the water and soil environment at the site and to assure that the materials used for the dewatering systems will not erode, deteriorate, or clog to the extent that the dewatering systems will not perform properly during the period of the dewatering. Copies of logs of soil borings are available from the County upon request. This data is furnished for information only, and it is expressly understood that the County will not be held responsible for any interpretations or conclusions drawn therefrom by the Contractor
- 2) Prior to starting dewatering operations, the Contractor and the County shall make a joint inspection of the condition of all existing structures on the site to establish their present condition. Photographs shall be taken to record any conditions that may become the subject of possible damage claims
- 3) In a recent geotechnical study, groundwater was encountered at approximately 8 feet below grade surface during drilling of all borings. Given the Site's proximity to the Reynolds Channel and the Atlantic Ocean, groundwater likely occurs at or near mean sea level and fluctuates with tidal activity.

1.7 – DELIVERY, STORAGE, AND HANDLING – (NOT USED)

1.8 – GENERAL INFORMATION

- A. Prior to any excavation, the dewatering system shall be placed in operation to lower the water level, as required. Thereafter, the system shall be operated continuously twenty-four (24) hours per day, seven (7) days per week during the work, until all Work has been satisfactorily completed, and dewatering is no longer required as noted in Section 2.12; all as determined by the County. Where excavations have been made, an adequate weight of fill material shall be in place to prevent buoyancy prior to discontinuing operation of the dewatering system.
- B. Both primary and standby power for the dewatering system shall be provided by the Contractor, including all costs for installation, energy and fuel. The primary power shall be electric service from the main onsite generated power (diesel powered engine generators) and the standby power shall be supplied by the existing onsite diesel powered emergency generators. The Contractor shall make all necessary arrangements for a temporary power service, and provide all necessary accessories required. No temporary overhead power lines will be permitted beyond the Plant's existing fence line. An alarm shall be installed at the standby power station to signal the loss of the primary power source. For any fuel powered system the Contractor shall maintain a five (5) day fuel supply on site. Storage of fuel shall include a secondary containment structure, in accordance with Nassau County Fire Marshall's Office (Article III of Nassau County Fire Prevention Ordinance).
- C. During some periods of construction, the groundwater level may be below the required drawdown level, as a result of dewatering operations by others at the Long Beach WPCP. The Contractor is required to provide a dewatering system which is based upon the normal groundwater level.

1.9 – DEWATERING SUBCONTRACTOR

- A. The dewatering subcontractor, if employed, shall perform dewatering for at least 75-percent of its total business activity. The dewatering subcontractor shall perform all of the dewatering work including supervision, installation, operation, maintenance and removal of the recharge, dewatering and discharge facilities.

PART 2 – PRODUCTS – (NOT USED)

PART 3 – EXECUTION

3.1 – INSPECTION

- A. The County will perform inspections including pertinent quality control tests and surveys during the work. The Contractor shall cooperate with the County and provide them safe access to the inspection locations in order to perform their work. Where necessary, the Contractor shall cease work while the inspections are being performed.
- B. The following are hold points requiring witnessing or approval by the County prior to further construction, at each new structure requiring dewatering, and for which prior notification is necessary:
 - 1) Testing of sand and silt content of discharge water from dewatering wells.
 - 2) Drawdown testing and performance testing of the excavation dewatering systems.
 - 3) Performance testing of standby power source, redundant dewatering components, dewatering wells and observation wells every two weeks.
 - 4) Monitoring of the long-term silt and sand content of dewatering system water at the discharge point.
 - 5) Assess the stability and integrity of subgrade, excavation, and structures in the event of failure of the dewatering system.
 - 6) Rewatering of the site and removal of the dewatering system.
- C. Written approval by the County to the Contractor, which will identify that particular item of work which is being approved, is required prior to continuing with the work.
- D. Where hold points do not meet approval or where any other inspections by the County indicate nonconformance to these requirements, both oral and written notification of such will be transmitted to the Contractor.

3.2 – INSTALLATION

A. Dewatering System Requirements:

- 1) General:

- a. The dewatering work shall be partitioned to allow the dewatering work to be performed in separate segments, at the individual locations of each new structure, as required by the Contract Documents.
- b. The dewatering system shall be installed from the existing ground surface or from the bottom of an excavation which is located above the normal groundwater level.
- c. The system design shall be based on the normal groundwater level and shall be capable of relieving all hydrostatic pressure against the height of the excavation walls and lowering the hydrostatic level below the bottom of the subgrade a minimum of two (2) feet in the work areas both prior to excavation, and during excavation and construction.

2) Responsibility:

- a. The Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the work described herein, while protecting adjacent structures and utilities from any adverse effects due to the lowering of the groundwater level
- b. The dewatering shall be accomplished in a manner that: will prevent the loss of fines, seepage, boils, quick conditions or softening of the foundation strata; will maintain stability of the sides and bottom of any excavations; and will result in all construction operations being performed in the dry, and will prevent any adverse effects on all utilities and structures within the radius of influence of the dewatering operations

3) Location:

- a. Due to the need for access by others to the existing structures, it may be necessary for the Contractor to place a portion of the header and discharge system underground and/or to provide vehicle crossings.

4) Sampling:

- a. After installation, each well shall be pumped individually, or the wellpoint system shall be pumped as a system, at its maximum or design flow and a water sample taken to determine the sand and silt content of discharge water with an Imhoff settling cone as described in "Ground Water Manual" (US Bureau of Reclamation, pages 398-400). Imhoff cones shall be furnished by

the Contractor of the type so that the volume of settled material can be estimated to 0.01-milliliters.

- b. Samples shall be obtained from stopcocks located along the discharge lines at points of high turbulence or between 4 and 8 o'clock on the perimeter of straight sections of pipe. The stopcock shall be flushed for a few seconds prior to taking a sample. The sample shall be obtained with the stopcock fully open. After the 1-liter sample has been taken, the cone and its contents shall be set aside and the volume reading taken between two (2) and three (3) minutes of elapsed time.
 - i. All wells pumping 10-parts per million (0.01 milliliters = 10 ppm) or less sand and silt as measured above shall be accepted.
 - ii. Wells pumping between 10 and 20-ppm may be accepted by the County based on the evaluation of average ppm for all wells, ppm of adjacent wells, and total quantity of water which is actually pumped to dewater the site.
 - iii. Wells pumping more than 20-ppm shall be abandoned and backfilled as described elsewhere.

5) Monitoring:

- a. The Contractor shall continue monitoring ppm of suspended material in the discharge water of each well, or for the entire system in the case of a wellpoint system, at least once every two (2) days throughout the dewatering operations. If the quantity of suspended material increases during the life of the system, the wells or wellpoints shall be replaced in accordance with the criteria stated above.

6) Materials:

- a. In developing the dewatering system, surging of the natural formation material alone to form a natural "gravel pack" is strictly prohibited. The materials used for the dewatering system and especially the well screens shall be carefully chosen to be compatible with their environment such that they will not erode, deteriorate or clog up during the required period of dewatering.

7) Records:

- a. The Contractor shall maintain a dewatering well installation record which shall include a well identification number, location, and dimensions; drilling method and materials used; well development procedures; and test results for suspended material in discharge water.

8) Segmentation:

- a. The dewatering system shall either be segmented so that the work can be performed at each location requiring dewatering, or separate systems shall be used for each location requiring dewatering, and so that if the operation of any one segment is disrupted, the remaining segment plus activated redundant components are capable of maintaining the groundwater at the stated levels.
- b. Dewatering well pumps shall be installed as necessary to drawdown the groundwater, to the stated levels, and to complete the work at each new structure location.
- c. Any dewatering wells installed but not being used during a particular phase of the work shall be properly capped. Well caps shall be secured to the top of the well casing, and shall be submitted for approval.

9) Dewatering Criteria:

- a. During some periods of construction, the groundwater level may be below the required drawdown level, as a result of dewatering operations by others at the Long Beach WPCP. At those times, the Contractor will be required to test only those components of the dewatering system which require discharge.
- b. Only after the approved dewatering system for any area requiring dewatering has been installed, the system for that area of the work tested to the County's satisfaction, and all temporary earth support systems within the affected drawdown area have been installed to their full depth will dewatering of the excavation be allowed. The Contractor shall dewater to the minimum stated requirements and meet the following performance criteria:

- i. Shut off the primary power source and demonstrate that the standby power can be activated prior to the groundwater level rising to within one (1) foot of the bottom of the lowest level of the bottom of excavation, at its lowest level, and that the standby power source is adequate to draw the groundwater level back down to the Contractor's design depth or to the minimum required depths.
- ii. Shut off portions of the system and show that redundant components can be activated prior to the groundwater level rising to within one (1) foot of the bottom of the lowest level of the bottom of excavation, and that the system is adequate to draw the groundwater level back down to the minimum required depths.
- iii. If the dewatering system fails to meet the performance requirements in either of the above, the Contractor shall add wells or wellpoints, or perform any other work or alteration to the system such that the system when re-tested will be in conformance with these requirements. This shall be done at no additional cost to the County.
- iv. The performance of the standby system and all components shall be tested at least every two weeks. Testing after performance of the system has been verified and accepted shall consist of demonstrating that the system and components are operational.

B. Standby Dewatering System Requirements:

- 1) The Contractor shall provide a complete 100 percent standby power system and power supply lines as described herein; and a 15 percent minimum increase in the number of wells, and related equipment above that required for the operating dewatering system for each area of the work, as demonstrated by computations submitted to and accepted by the County, all installed and ready to operate. The Contractor shall furnish sufficient standby power units for the standby power system. In the event individual power supply units are provided for each pump, individual power supply units shall be installed and operating, or ready to operate, for each installed pump including those provided as part of the standby system.
- 2) The unit and distribution wiring shall be installed in such a way that portions of the dewatering system and other temporary facilities requiring power may be isolated for routine maintenance or repair, in case of accidental damage, without affecting the normal operation of the system.

C. Observation Wells:

1) Number of Wells:

- a. The Contractor shall supply, install, maintain and take measurements at observation wells. The general location and minimum number of observation wells shall be as shown on the Contract Drawings or Shop Drawings, and as directed by the County. All observation wells shall be satisfactorily installed and proven to be functioning properly prior to commencement of dewatering.

2) Installation:

- a. Observation wells shall consist of a standpipe or riser of minimum 1.0-inch inside diameter and a minimum 5- feet long wellpoint screen or slotted PVC section at the bottom. Observation wells shall be installed by using cased boring techniques and the annulus between the wellpoint or riser, and the natural soil shall be backfilled completely with a free-flowing granular material similar to Ottawa Sand. Prior to installing any observation wells test pits shall be excavated to determine the location of and to clear any existing buried utilities and structures which might interfere with the observation well location. Observation wells shall be relocated to clear any buried utilities or structures. The installation of observation wells by jetting shall not be permitted.
- b. Prior to the approval of the County for the observation well, the Contractor shall, by adding or removing water from the riser, demonstrate that observation wells are functioning properly.
- c. All observation wells shall be satisfactorily installed and proved to be functioning properly prior to start of dewatering. Any observation well that becomes inactive, damaged or destroyed and, if in the opinion of the County, the observations from that observation well are critical, further work shall be suspended at the discretion of the County at no additional expense to the County. Work shall not commence until that observation well is repaired or replaced to the satisfaction of the County and reliable observations can be obtained from that well or its replacement well.

3) Records:

- a. The Contractor shall furnish an observation well installation record. This shall include date of installation, well number, location, depth, bench mark elevation, installation procedures and materials, as a minimum.

4) Maintenance:

- a. Any observation wells which become clogged, damaged or destroyed during the life of the dewatering system shall be immediately replaced by the Contractor at no additional cost to the County. To facilitate readings during construction, riser pipe of each observation well shall be removed and added as required by construction activities and processes. At any time that observation wells are required by the County to be abandoned, the Contractor shall completely fill the observation well with grout, and the riser shall be cut off at grade.
- b. The Contractor is responsible for maintaining the observation wells. This shall consist of adding and removing water from observation well risers, as required by the County, and at least every two (2) weeks from all wells, to demonstrate that they are functioning properly.

5) Piezometric Levels and Monitoring Equipment:

- a. Contractor shall provide and maintain water level monitoring equipment consisting of the following:
 - i. Two (2) self-contained water level indicators with both an audio and a visual indicator signal system; SINCO Model 51453 or equal.
 - ii. One (1) of the self-contained water level indicator shall be provided to the County for their exclusive use during the dewatering phase of the project.
 - iii. The Contractor shall be responsible for measuring the piezometric water levels to the nearest one-tenth foot, in all observation wells on a daily basis. This information shall be furnished to the County on the day readings are taken. The County reserves the right to make check measurements of the observation well readings at any time. The Contractor shall cooperate in any way which may be required to facilitate observation well measurements by the County.

6) Emergency Plan:

- a. An emergency plan to protect both the new and existing construction shall be prepared by the Contractor. This plan shall be put into operation when there is a failure of the dewatering system or any components of the system. The Contractor shall obtain the County's approval for this emergency plan and procedures, prior to construction.
- b. All additional work to restore the working area after any emergency shall be carried out by the Contractor at no additional cost to the County.

D. Special Monitoring:

1) Settlement:

- a. At a minimum, the Contractor shall establish vertical control (settlement) points for monitoring settlement due to dewatering at all existing structures adjacent to areas where dewatering will be required, and within the radius of influence of the dewatering system.
- b. At least one (1) week prior to the start of the dewatering operations, the Contractor shall take and record the elevation of each of the vertical control points. Starting at the initiation of dewatering, the Contractor shall take and record the elevation of each point on a daily basis with reports submitted to the County on a weekly basis.

2) Crack Monitoring:

- a. Any cracks observed at existing structures within the radius of influence, during either the installation of the vertical control points or the examination of the site, shall be identified and a crack monitor shall be installed. The crack monitor shall be Avongard Calibrated Crack Monitor or equal, as approved by the County.
- b. At least one (1) week prior to the start of any of the dewatering wells, the Contractor shall take and record the reading of each of the crack monitoring points. Starting at the initiation of dewatering, the Contractor shall take and record readings on a daily basis. Reports of all readings shall be submitted to the County on a weekly basis.

E. Dewatering System Failure:

- 1) If the dewatering requirements are not satisfied due to failure of the dewatering system, then loosening of the foundation strata, instability of the excavation walls, or damage to the structures may result. The Contractor shall provide in-situ density tests immediately above and at the structure founding grades. In-situ density testing will conform to ASTM D1556 or D2167. Should any failure of the dewatering systems occur, to the extent that founding soils may have been disturbed, additional in-situ tests will be required by the County, as described above.
- 2) If the additional tests show a marked decrease in density, such that the competency of the subgrade is impaired, the Contractor shall be responsible for removing all of the affected soils, as defined by density tests, and replacing them as compacted backfill as directed by the County. The Contractor shall supply all labor and materials and perform all work necessary to completely repair or replace any damaged structures or foundation soils to a condition satisfactory to the County and at no additional cost to the County. In addition, the Contractor shall carry out all soil and any other tests required by the County to demonstrate that the foundation soils and/or structures have been repaired and returned to a state measurably equal to or better than the in-situ conditions or state existing before failure occurred.

F. Coordination:

- 1) The scheduling and progress of the dewatering work shall be coordinated with all other related work such as excavation, sheeting, pouring of concrete walls and slabs, backfill and compaction, or any other operation that might be affected by this work.

G. Documentation:

- 1) The Contractor shall provide the County with a schedule of all maintenance tests for the primary and standby systems and records of all tests and monitoring activities which shall include, as a minimum: date of tests, procedures, components tested, elapsed times, resultant observations, well readings and their time relationships to the above items when applicable, suspended particles (ppm), daily discharge quantities, observation well records, and records of well installation and removal.

H. Surface Water:

- 1) The Contractor shall provide, operate and maintain all ditches, berms, site grading, sumps and pumping facilities to divert, collect and remove all surface water from work areas. All collected water shall be discharged, as indicated in the Contract Documents.

I. Flood Protection:

- 1) The Contractor shall have in-place, pipe and pumps of sufficient size and quantity to be able to simultaneously flood the structures and the excavation within twelve (12) hours in an emergency situation; as demonstrated by computations prepared by the Contractor and submitted to and approved by the County. All additional work to restore the working area shall be carried out by the Contractor at no additional cost to the County.

J. Disposal of Dewatering System Discharge:

- 1) The discharge from the dewatering system shall be treated on-site prior to discharge to surface water or conveyed to on-site tanker trucks to be stored and delivered to an off-site treatment site. The Contractor shall provide all necessary equipment, piping, or vehicles for proper disposal. The Contractor shall adhere to the applicable federal, state, and municipal regulations, including the NY State Pollutant Discharge Elimination System (SPDES) permit if discharging to surface water. Meters for measuring the discharge flow rate and the total amount of discharge shall be installed by the Contractor.
- 2) The Contractor shall provide all equipment and materials necessary to store and properly treat the discharge water prior to discharging point.

K. Rewatering and Removal of Dewatering System:

- 1) Prior to shutting down a segment of the dewatering system, at any area of the work, the Contractor shall obtain approval in writing from the County to do so.
- 2) As the dewatering system is shut down, the Contractor shall pump water into any excavations such that he always maintains the water level inside the excavation at a higher level than the rising groundwater on the outside. This shall be done until the groundwater level has reached its static level.

- 3) After completing all of the work, at each area, the Contractor shall fill with grout all dewatering wells, and fill with sand all wellpoints, and shall remove buried and surface piping, cables, pump foundations, and structural supports and all other support facilities. Trenches and excavations, below final grades or in fill areas, shall be backfilled as directed by the County.
- 4) The Contractor shall provide documentation of dewatering and observation well removal. As a minimum, this shall include date of removal, well number, location, procedures, and materials used.

3.3 – FIELD QUALITY CONTROL – (NOT USED)

++ END OF SECTION ++

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SECTION 02276

EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.1 – DESCRIPTION

- A. The Contractor is responsible for implementing Best Management Practices (BMP's) to prevent and minimize erosion and resultant sedimentation in all cleared and grubbed areas during and after construction. This item covers the work necessary for the installation of structure and measures for the prevention and control of soil erosion. The Contractor shall furnish all material, labor and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting, and removal (where applicable) of erosion prevention and control measures and to cause compliance with the New York State Pollutant Discharge Elimination System (SPDES) for Stormwater Discharges from Construction Activities (Permit No.GP 0-20-001), for any land disturbance or construction activity of one (1) acre or more, under this Section 02276, Nassau County Department of Public Works, Drainage Requirements, and City of Long Beach Stormwater Regulations.
- B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.
- C. The Contractor shall provide a Sedimentation, Stormwater, and Soil Erosion Control Plan that addresses measures to prevent migration of contaminated stormwater, sediment and to prevent erosion of features of the work.
- D. It is the intent of this Specification that the Contractor conducts the construction activities in such a manner that erosion of disturbed areas and off site sedimentation be absolutely minimized.
- E. All work under this Contract shall be done in conformance with, and subject to, the limitations of the New York State Standards and Specification for Erosion and Sediment Control (NYSSDESC) and Nassau County Department of Public Works, Drainage Requirements, and City of Long Beach Stormwater Regulations.
- F. Due to the nature of the work required by this Contract, it is anticipated that the location and nature of the erosion and sedimentation control devices will be adjusted on several occasions to reflect the current phase of construction. The construction schedule adopted by the Contractor will impact the placement and need for specific devices required for the control of erosion. The Contractor shall develop and implement such additional techniques as may be required to minimize erosion and off-site sedimentation. The

location and extent of erosion and sedimentation control devices shall be revised at each phase of construction that results in a change in either the quantity or direction of surface runoff from constructed areas. All deviations from the erosion and sedimentation control provisions shown on the Drawings shall have the prior acceptance of the Engineer.

1.2 – RELATED SPECIFICATIONS

- A. Section 02100 – Clearing, Grubbing and Site Preparation
- B. Section 02200 – Earthwork.
- C. Section 02500 – Surface Restoration.
- D. Section 02240 - Dewatering

1.3 – PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for Item 1 – General Construction Contract, as described in Section 01150 – Measurement and Payment.

1.4 – REFERENCES

- A. Without limiting the generality of other requirements of these specifications, all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.
 - 1) New York Standards and Specifications for Erosion and Sediment Controls, latest edition.
 - 2) New York State Department of Environmental Conservation (NYSDEC)
 - 3) New York State Pollutant Discharge Elimination System for Stormwater Discharges from Construction Activities (Permit No. GP-0-20-001), for any land disturbance or construction activity of one (1) acre or more.
 - 4) Stormwater Pollution Prevention Plan (SWPPP)
 - 5) Nassau County Department of Public Works, Drainage Requirements.

6) City of Long Beach Stormwater Regulations

B. See Section 01072 – Reference Standards.

1.5 – SUBMITTALS

- A. Prior to the start of the work, the Contractor shall prepare and submit a plan for applying the temporary and permanent erosion and sediment control measures as described in the NYSSSE&SC and the Stormwater Pollution Prevention Plan (SWPPP). Construction work shall not commence until the schedule of work and the methods of operations have been reviewed and approved.
- B. In accordance with the procedures and requirements set forth in the General Conditions Division 01 and Section 01300 – Submittals, submit the following:
 - 1) Name and location of all material suppliers.
 - 2) Certificate of compliance with the standards specified above for each source of each material.
 - 3) List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.

1.6 – QUALITY ASSURANCE

- A. All restoration and re-vegetation work shall be subject to the one-year guarantee period of the Contract as specified in the General Conditions.
- B. The Contractor shall hold the Owner harmless as to any violations of Federal, State, Nassau County or any local environmental regulations or codes due to untimely or faulty installation or maintenance of control measures.

1.7 – DELIVERY, STORAGE, AND HANDLING – (NOT USED)

1.8 – SEQUENCING AND SCHEDULING

- A. Construction sequence and schedule shall conform to the SWPPP.

- B. Implement soil erosion and sediment control measures, prior to disturbance of pavement and soil, within the drainage basin of the construction site.
- C. Remove temporary soil erosion and sediment control measures, except permanent vegetation measures, upon completion of work and stabilization of all areas.

1.9 – REGULATORY COMPLIANCE

- A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States and the State of New York. Contractor is the Co-Operator under the provisions of the SPDES Permit. As such, the Contractor will be required to sign certain certifications as described in the Permit. Contractor shall comply with requirements specified in the Contract Documents or by the Engineer. Contractor shall also comply with all other laws, rules, regulations, ordinances, guidelines, and requirements concerning soil erosion and sediment control established in the United States and the State of New York. The following documents and the documents referenced therein define the regulatory requirements for this Section 02276.
 - 1. SPDES PERMIT: The New York State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activities governs land disturbance or construction activities of one (1) acre or more in New York State.
 - 2. Contractor shall follow Standards and Specifications of the New York State Department of Environmental Conservation's (NYSDEC's) Standards and Specifications for Erosion and Sediment Control, latest edition.
 - 3. Storm Water Pollution Prevention Plans (SWPPP)

1.10 – EROSION AND SEDIMENTATION CONTROL DEVICES

- A. The following erosion and sedimentation control devices shall be incorporated into the work. Other devices, as necessary and acceptable to the Engineer shall be installed as required.
 - 1) Silt Fence shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Silt Fence shall not be installed across streams, ditches, or waterways. Silt Fence shall be designed, installed and maintained in accordance with the requirements of Section 5.54 of the New York State SSE&SC.

- 2) Storm drain inlet protection measures shall be constructed at the locations shown on the Drawings, and at other locations indicated by the Engineer. Storm drain Inlet protection measures shall be designed, installed and maintained in accordance with the requirements of the NYSSSE&SC.
- 3) Geotextile Filter Bags shall be installed for treatment of trench dewatering water before discharge from the construction site to a local storm sewer, upland of a stream or roadside swale or at other locations indicated by the Engineer. Filter Bag shall be installed, and maintained in accordance with the requirements of Section 5 of NYSSSE&SC.

PART 2 – PRODUCTS

2.1 – MATERIALS

A. Materials for use in erosion and sedimentation control devices shall be in accordance with New York State Standards and Specifications for Erosion and Sediment Control.

B. Silt Fence:

- 1) Silt Fence shall be a woven geotextile filter fabric made specifically for sediment control. Filter fabric shall not rot when buried and shall resist attack from soil, chemicals, alkalis and acids in the pH range from 2 to 13, and shall resist damage due to prolonged ultraviolet exposure. Filter fabric shall be listed as a woven, Silt Fence type geotextile on the NYSDOT Approved Materials List for Geosynthetics for Highway Construction. The cost of Silt Fence shall include the fabric, posts, wire fabric, and other materials, excavation, backfilling and all maintenance and restoration activities required.
- 2) Posts for silt fence shall be steel and shall have the following properties:

ASTM Designation:	ASTM A 702
Length:	5-feet long (T-type)
Weight:	1.25 pounds/foot (minimum)
Area of Anchor Plate:	14 square inches

Note: Five T-fasteners shall be furnished with each post.

2-inch square hardwood posts are acceptable as an alternative to steel.

- 3) Welded wire fabric for the silt fence shall have the following properties:

Wire Fabric Opening Size:	4-inches by 4-inches
Class 1 Designation:	ASTM A 116
Width:	32-inches
Number of Line Wires:	8
Stay Wire Spacing:	12-inches
Line and Stay Wires:	6.0 Ga.
Top and Bottom Wires:	6.0 Ga.
Wire Coating:	ASTM Class 1 Zinc Coating

- 4) Silt fence shall be installed and maintained in accordance with Part 3 of this Section, and Section 5 of the NYSSSE&SC, to the satisfaction of the Engineer throughout the duration of the contract. The cost of Silt Fence shall include the fabric, posts, wire fabric, and other materials, excavation, backfilling and all maintenance and restoration activities required.

C. Storm Drain Inlet Protection:

Storm drain inlet protection shall be constructed as shown on the Drawings and as specified herein. Inlet Protection shall be constructed at all the drop inlets and maintained in accordance with Section 5 of NYSSSE&SC.

D. Geotextile Filter Bag/Dewatering Silt Control System:

- 1) Provide a nonwoven fabric bag which is sewn with a double needle matching using a high strength thread.
- 2) Provide bag seams with an average wide width strength per ASTM D-4884 of 100 lbs. per inch.
- 3) Provide bag with fill spout large enough to accommodate a 4" discharge hose; straps to secure the hose and prevent pumped water from escaping without being filtered; and, lifting straps of strong design to lift full bag without bag rupturing.
- 4) Provide nonwoven geotextile fabric following the properties:

<u>Properties</u>	<u>Test Method</u>	<u>Units</u>	<u>Nonwoven</u>
Weight	ASTM D-3776	OZ/YD	10

<u>Properties</u>	<u>Test Method</u>	<u>Units</u>	<u>Nonwoven</u>
Grab Tensile	ASTM D-4632	LBS.	250
Puncture	ASTM D-4833	LBS.	165
Flow Rate	ASTM D-4491	GAL./MIN.FT2	70
Permittivity	ASTM D-4491	SEC.-1	1.3
Mullen Burst	ASTM D-3786	LBS. IN2	380
UV-Resistant	ASTM D-4355	%	70
AOS % Retained	ASTM D-4751	%	100
Size	-	FT.	10' x 15'
-	-	FT.	12.5' x 15'
-	-	FT.	15' x 15'
Nominal Pumping Rate	-	GAL./MIN.	1,500

- 5) Provide underlayment of gravel bed 2 inches thick, a straw mat 4 inches thick, or a vegetated filter strip to allow water to flow out of the bag to the hose to prevent back flow.

2.2 – MANUFACTURERS

A. Filter Bag/Dewatering Silt Control System:

- a. ACF Environmental, Inc., Richmond, VA, 800-644-9223; DirtBag 55
- b. Or equal as approved by the Engineer.

PART 3 – EXECUTION

3.1 - PREPARATION

- A. Erosion and sedimentation control devices shall be established prior to the clearing operations in a given area. Where such practice is not feasible, the erosion and sedimentation control device(s) shall be established immediately following completion of the clearing operation.
- B. Include proposed stockpile areas and installation of temporary erosion control devices, ditches, or other facilities in Work phasing plans.
- C. Areas designated for Contractor's use during Project may be temporarily developed as specified to provide working, staging, and administrative areas.
- D. The Contractor shall provide adequate means to prevent sediment from entering storm drains, curb inlets, ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be placed upstream of trench or other excavation to prevent sedimentation of offsite areas. In areas where a natural buffer area exists between the Work area and the closest stream or water course, this area shall not be disturbed.
- E. The Engineer may direct the Contractor to place additional sediment and erosion control devices at other locations not shown on the Drawings.
- F. The Contractor agrees to hold the Owner or any of its agents harmless from any and all liability, loss or damage that may arise out of a violation to the Erosion and Sediment Control Ordinance.
- G. The Contractor shall monitor and take precautions to control dust, including, but not limited to, use of water or chemical dust palliative, limiting the number of vehicles allowed on site, and minimizing the operating speed of all vehicles.
- H. Prior to the commencement of construction activity, the owner or operator must identify the contractor(s) and subcontractor(s) that will be responsible for installing, constructing, repairing, replacing, inspecting and maintaining the erosion and sediment control practices included in the SWPPP; and the contractor(s) and subcontractor(s) that will be responsible for constructing the post-construction stormwater management practices included in the SWPPP. The owner or operator shall have each of the contractors and subcontractors identify at least one person from their company that will be responsible for implementation of the SWPPP. This person shall be known as the trained contractor. The owner or operator shall ensure that at least one trained contractor is on site on a daily basis when soil disturbance activities are being performed.

3.2 – INSTALLATION

- A. Silt fence shall be erected as shown on the Drawings and specified herein. Silt fence shall be erected and maintained to the satisfaction of the Engineer until a vegetative

ground cover has been established. Replacement of the filter fabric, if required by the Engineer, will be at the Contractor's expense.

- 1) Silt fence construction shall be adequate to handle the stress due to sediment loading. Posts shall be installed at least 16 in. deep into the ground. When a 16 in. depth is not feasible to achieve, the posts should be adequately secured to prevent overturning of the fence due to sediment loading.
 - 2) The Contractor shall maintain the silt fence until it is removed, and shall remove and dispose of soil accumulations at the silt fence when so directed by the Owner.
 - 3) It is the Contractor's responsibility to maintain the integrity of silt fences as long as necessary to contain sediment runoff. The Contractor shall inspect all silt fences immediately after each rainfall and at least daily during prolonged rainfall. Any deficiencies shall be immediately corrected by the contractor. In addition, the Contractor shall make a daily review of the location of silt fences or posts in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, additional silt fences or posts shall be installed as directed by the Owner. The silt fence should be promptly repaired or replaced should it become damaged or otherwise ineffective.
 - 4) Sediment deposits shall either be removed when the deposit reaches approximately one-half of the height of the silt fence or a second silt fence shall be installed as directed by the Owner. Silt fence that has been removed shall become the property of the Contractor. Upon removal of the silt fence, the Contractor shall remove and dispose of excess soil accumulations, restore the area and vegetate all bare areas in accordance with the Contract Documents.
- B. Storm Inlet protection: Install inlet protection at all locations noted on the Contract Drawings. Install inlet protection prior to beginning land disturbance activities in the drainage area of the inlet.
- C. In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within fourteen (14) days from the date the current soil disturbance activity ceased.

- 1) Reseed and mulch temporary seeding areas where seedling emergence is poor, or where erosion occurs, as soon as possible. Do not mow. Protect from traffic as much as possible.
- 2) Generally, a stand of vegetation cannot be determined to be fully established until soil cover has been maintained for one full year from planting. Inspect seeded areas for failure and make necessary repairs and reseedings within the same season, if possible.
- 3) Reseeding – If a stand has inadequate cover, re-evaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand after seedbed preparation or over-seed the stand. Consider seeding temporary, annual species if the time of year is not appropriate for permanent seeding.
- 4) If vegetation fails to grow, soil must be tested to determine if acidity or nutrient imbalance is responsible.
- 5) Fertilization – On the typical disturbed site, full establishment usually requires refertilization in the second growing season. Fine turf requires annual maintenance fertilization. Use soil tests if possible or follow guidelines given for the specific seeding mixture.

D. Additional Requirements

- 1) All storm sewer piping shall be blocked at the end of every working day until the inlet is constructed above grade.
- 2) All streets around the construction area shall be scraped as necessary to prevent accumulation of dirt and debris.
- 3) The Contractor shall provide adequate means to prevent any sediment from entering any storm drains, curb inlets (curb inlet filter box), ditches, streams, or bodies of water downstream of any area disturbed by construction. These measures shall be cleaned of accumulated sediment once the sediment storage volume of the measure is half full or as otherwise directed by the Engineer. Excavation materials shall be placed upstream of any trench or other excavation to prevent sedimentation of offsite areas. In areas where a natural buffer area exists between the work area and the closest stream or water course, this area shall not be disturbed.

- 4) The Engineer may direct the Contractor to place any additional sediment and erosion control devices at other locations not shown on the Drawings.

E. General Requirements

- 1) Institute and maintain Soil Erosion and Sediment Control measures to prevent silt and fines from migrating from the area of construction.
- 2) Install silt fencing in the locations shown on the Contract Documents.
- 3) Clean and maintain silt fences after each and every rainfall.
- 4) Repair of any soil erosion and sediment control measured damaged during the life of the project.
- 5) Stockpile topsoil.
- 6) Provide temporary vegetative cover and mulch by the end of next business day of construction or disturbance.
- 7) Provide permanent vegetative cover, mulch, and mulch netting on the disturbed areas.
- 8) Removal of soil erosion and sediment control measures (i.e. silt fence).
- 9) The Contractor shall hold the Owner harmless as to any violations of Federal, State, Nassau County or any local environmental regulations or codes due to untimely or faulty installation or maintenance of control measures.

F. Removal

- 1) Upon the establishment of permanent asphaltic pavement, and final vegetative cover and landscaping, the Contractor shall carefully, without injury to new established growths of vegetation, remove all Soil Erosion and Sediment Control structures, measures and devices. This shall mean to also include all silt and mulch netting.
- 2) At such time that temporary erosion and control structures are no longer required under this item, the Contractor shall notify the Engineer of its intent and schedule for the removal of the temporary structures, and obtain the Engineer's approval in

writing prior to removal. Once the Contractor has received such written approval from the Engineer, the Contractor shall remove, as approved, the temporary structures and all sediments accumulated at the removed structure shall be returned upgrade. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage. Such areas shall be evenly graded and seeded as specified in Section 02500 Surface Restoration and - Section 02485 – Grassing and Plantings.

3.2 – INSPECTION

- A. For construction sites where soil disturbance activities are on-going, the *qualified inspector shall conduct a site inspection at least once every seven (7) calendar days. The following areas are to be inspected:
 - 1) Disturbed areas of the Site that have not undergone final stabilization.
 - 2) Erosion and sediment control structures.
 - 3) All locations where vehicles enter or exit the Site.
 - 4) Material storage and construction laydown areas that are exposed to precipitation and have not been finally stabilized.
- B. Within one business day of the completion of an inspection, the qualified inspector shall notify the owner or operator and appropriate contractor or subcontractor of any corrective actions that need to be taken. The contractor or subcontractor shall begin implementing the corrective actions within one business day of this notification and shall complete the corrective actions in a reasonable time frame.
- C. The Qualified Person shall follow the practices of inspection and maintenance requirements described in the SWPPP. All appropriate records required by the SWPPP shall be maintained on site.
- D. Immediate action will be taken to correct deficiencies to BMP's. The State reserves the right to stop all construction activities not related to maintaining BMP's until such deficiencies are repaired.
- E. For construction sites where soil disturbance activities have been temporarily suspended (e.g. winter shutdown) and temporary stabilization measures have been applied to all disturbed areas, the qualified inspector shall conduct a site inspection at least once every thirty (30) calendar days.

F. During inspections the following will be observed, and appropriate maintenance procedures taken:

- 1) The conformance to specifications and current condition of all erosion and sediment control structures.
- 2) The effectiveness and operational success of all erosion and sediment control measures.
- 3) The presence of sediments or other pollutants in storm water runoff at all runoff discharge points.
- 4) If reasonably accessible, the presence of sediments or other pollutants in receiving waters.
- 5) Evidence of off-site tracking at all locations where vehicles enter or exit the site.

G. Inspect silt fence once every 14 days and within 48 hours after each runoff producing rainfall event. Check for any bulges in the silt fence.

H. Inspect temporary storm drain inlet protection following each period of significant rainfall. Remove sediment and restore it to its original dimensions when the sediment has accumulated to one-half the design depth of the trap or basin. Place the sediment that is removed in a designated disposal area and replace the contaminated part of the gravel facing.

I. Filtering device shall be inspected frequently and repaired or replaced once the sediment build-up prevents the structure from functioning as designed.

*Qualified Inspector - means a person that is knowledgeable in the principles and practices of erosion and sediment control, such as a licensed Professional Engineer, Certified Professional in Erosion and Sediment Control (CPESC), Registered Landscape Architect, New York State Erosion and Sediment Control Certificate Program holder.

3.3 – MAINTENANCE AND REPAIRS

A. The Contractor shall furnish the labor, materials and equipment required for routine maintenance of all erosion and sedimentation control devices. Maintenance shall be

scheduled as required for a particular device to maintain the removal efficiency and intent of the device. Maintenance shall include but not be limited to

1. The removal and satisfactory disposal of trapped sediments from traps or silt barriers and
 2. Replacement of filter fabrics used for silt fences. Sediment removed from erosion and sedimentation control devices shall be disposed of in locations that will not result in off-site sedimentation as acceptable to the Engineer, at no additional cost to the Owner.
 3. The erosion and sediment control measures described in this specification are minimum requirements for anticipated Site conditions. During the construction period, upgrade these measures as needed to comply with all applicable local, state, and federal erosion and sediment control regulations.
- B. Silt Fence shall be maintained to the satisfaction of the Engineer until a vegetative cover is established. Replacement of the filter fabric, if required by the Engineer, will be at the Contractor's expense.
1. Should the fabric of a silt fence collapse, tear, decompose or become ineffective, replace it promptly.
 2. When sediment deposits reach approximately one-half the height of the silt fence, remove and stabilize deposits.
 3. Remove sediment deposits as necessary to provide adequate storage volume for the next rain and to reduce pressure on the fence. Take care to avoid undermining the fence during cleanout.
- C. Street Cleaning:
1. Use self-propelled pickup street sweepers whenever required by Engineer to prevent transport of sediment and other debris off Project Site. Provide street sweepers designed and operated to meet air quality standards. Street washing with water shall require approval by Engineer. Intentional washing of sediment into storm sewers or drainage ways must not occur. Vacuuming or dry sweeping and material pickup must be used to cleanup released sediments.
 2. Provide and maintain inlet protection where pavement milling and inlay work is planned. Remove milling debris and dust prior to removing inlet protection.
 3. All streets around the construction area shall be scraped as necessary to prevent accumulation of dirt and debris.
- D. Inlet Protection:

1. Geotextile: When depth of accumulated sediment and debris reaches approximately one-half the height of an internal device or one-third the height of external device (or less when so specified by the manufacturers) or as designated by Engineer, remove deposits and stabilize onsite.
 2. Remove sediment and restore the inlet protection to its original dimensions when the sediment has accumulated to one half the design depth. Place the sediment that is removed in a designated disposal area and replace the contaminated part of the gravel facing.
 3. Check the structure for damage from erosion or piping. Stone or riprap displaced from the berm must be replaced immediately.
 4. All storm sewer piping shall be blocked at the end of every Working day until the inlet is constructed above grade.
- E. At end of each work day, stabilize or cover soil stockpiles or implement other BMPs to prevent discharges to surface waters or conveyance systems leading to surface waters.
- F. Temporarily stabilize soils at end of shift before holidays and weekends, if needed. Ensure soils are stable during rain events at all times of year.

3.4 – FIELD QUALITY CONTROL

A. Monitoring and Reporting

1. Monitoring: The qualified inspector shall inspect all erosion and sediment control practices and pollution prevention measures to ensure integrity and effectiveness, all post-construction stormwater management practices under construction to ensure that they are constructed in conformance with the SWPPP, all areas of disturbance that have not achieved final stabilization, all points of discharge to natural surface waterbodies located within, or immediately adjacent to, the property boundaries of the construction site, and all points of discharge from the construction site. .
2. Reporting: The qualified inspector shall prepare an inspection report subsequent to each and every inspection as per the NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activities (Permit No. GP-0-20-001). The inspection reports shall be maintained on site with the SWPPP..

++ END OF SECTION ++

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SECTION 02430

MANHOLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: The Contractor shall furnish all labor, materials, equipment and incidentals necessary to provide all manholes shown, specified and otherwise required to complete the Work.
- B. General:
 - 1. Structures shall conform in shape, size, dimensions, material, and other respects to the details shown or as ordered by the Engineer.
 - 2. Concrete shall conform to the requirements specified under Section 03300, Cast-In-Place Concrete.
 - 3. Inverts shall conform accurately to the size and elevation of the adjoining pipes. Side inverts shall be curved and main inverts, where direction changes, shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipelines.
 - 4. Frames and covers shall conform in shape, size, dimensions, materials and other respects to the details on the Drawings and the Specifications.
- C. Related Sections:
 - 1. Section 02200, Earthwork.
 - 2. Section 03200, Concrete Reinforcing.
 - 3. Section 03300, Cast-In-Place Concrete.
 - 4. Section 05501, Miscellaneous Metal Fabrications.
 - 5. Division 15, Sections on Piping.

1.2 QUALITY ASSURANCE

- A. General:
 - 1. The Contractor must give the Engineer twenty-four (24) hours written notice plus travel time prior to the commencement of any manufacturing process or testing sequence for manhole components made of precast concrete.
 - 2. At the place of manufacture of precast concrete components the Engineer reserves the right at all times:
 - a. To inspect the materials, the processes of manufacture, and the records of analysis and tests.
 - b. To select test specimens.
 - c. To inspect and test manhole components, accessories and joint material.
 - d. To inspect and test cast-in-place concrete.
 - 3. Upon delivery to the site the Engineer reserves the right to inspect and test:

- a. Manhole components, accessories and joint material.
 - b. Cast-in-place concrete.
 4. All manhole components made of precast concrete delivered to the site shall be clearly marked at the factory with the date of manufacture and the manufacturer's identification. Omission of this information may be cause for rejection of the manhole components.
- B. Design Calculations: The Contractor shall submit in the Shop Drawings the following design calculations conforming to the applicable requirements of the American Concrete Institute Standard - ACI 318 (design calculations shall be signed and sealed by a New York State Professional Engineer) :
 1. Load Calculations: The calculations shall verify that all manhole components will have the required strength to withstand the following loadings:
 - a. Equivalent fluid pressure of 90 pounds per cubic foot.
 - b. The maximum live load produced by H-20 loading as stipulated in the American Association of State Highway Transportation Officials (AASHTO).
 2. Uplift Calculations: The calculations shall verify that all manhole components shall be designed with a factor of safety of 1.25 against uplift with the maximum groundwater level as shown in the geotechnical report and/or as shown in the drawings).
- C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 1. ASTM C 32, Sewer and Manhole Brick (made from Clay or Shale).
 2. ASTM C 139, Concrete Masonry Units for Construction of Catch Basins and Manholes.
 3. ASTM C 140, Sampling and Testing Concrete Masonry Units.
 4. ASTM C 207, Hydrated Lime for Masonry Purposes.
 5. ASTM C 478, Precast Reinforced Concrete Manhole Sections.
 6. ASTM C 923, Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
 7. ASTM C913, Precast Concrete Water and Wastewater Structures
- D. Manufacturer's Testing:
 1. Tests on reinforced concrete manhole components shall be in accordance with the "Physical Requirements" section of ASTM C 478.
 2. The Contractor shall ensure that the manufacturer furnishing manholes under these Specifications shall be fully equipped with testing facilities of the approved type and capacity. The Contractor shall furnish the required number of specimens of manhole components at no additional cost to the Owner.
 3. Absorption Test:
 - a. For every 100 manhole bases and manhole riser sections manufactured, one specimen shall be selected for an absorption test. As a minimum, one specimen representing a manhole base and manhole riser section shall be

tested. The absorption test shall be performed in accordance with the requirements of ASTM C 478.

- b. In the event any specimen fails to meet any of the requirements of the absorption test, then two additional test specimens shall be selected for each specimen that failed, from the lot represented by the specimen that failed. The additional specimens shall be tested; and should any one of these fail to meet the requirements specified, the entire lot represented by these tests shall be rejected.

4. Compression Test:

- a. For each of the four manhole components made of precast and cast-in-place concrete (manhole base, manhole riser section, transition slab and top slab) compression tests shall be made on standard rodded concrete cylinders. A minimum of four concrete cylinders shall be molded for each day's production of a particular manhole component. Each cylinder representing a particular manhole component shall be molded from the same concrete batch utilized for the manufacture of the component. The concrete cylinders shall be tested in accordance with the specifications of ASTM C 478 except for the required strengths of the cylinders, which shall be as follows:

The strength of precast concrete shall be considered satisfactory if both of the following requirements are met:

- 1) The average at 28 days of three consecutive strength tests equals or exceeds 4000 psi.
 - 2) No individual strength test falls below required strength by more than five hundred psi.
- b. In the event a concrete cylinder's compressive strength is unsatisfactory the manufacture shall select one of the following two options:
 - 1) The entire day's production of the manhole component represented by the test cylinder shall be rejected.
 - 2) The manufacturer shall have the option to drill two cores from manhole components represented by the unsatisfactory test cylinder and perform compression tests on the cores. The manhole component sampled shall be selected by the Engineer. Should the compression tests on these core samples meet the strength requirements as specified in this Section, the Engineer shall determine the acceptability of all manhole components represented by the test, considering the results of the tests on the concrete cylinders as well. Based on the Engineer's evaluation, if the compression test for the cores is determined to be unacceptable the entire day's production of the manhole component represented by the core sample shall be rejected. The Engineer's decision shall be considered final.

5. Top and Transition Slabs:

- a. In lieu of a proof of design test for the top and transition slabs the Contractor shall submit in the Shop Drawings top slab and transition slab design calculations and Drawings for approval by the Engineer.

- b. The design calculations shall be in accordance with requirements specified in this Section.

1.3 SUBMITTALS

- A. Submit for approval samples of brick, block, gaskets and all accessories required for the manholes.
- B. For all manholes submit Shop Drawings for approval. Shop Drawings shall include, but not be limited to, the following information:
 - 1. Size and spacing of steel reinforcement.
 - 2. Wall and slab thicknesses.
 - 3. Concrete cover over steel reinforcement.
 - 4. Joint design between component manhole sections, show all dimensions.
 - 5. Concrete mix design including design compressive strength.
 - 6. Design of flexible manhole seal assemblies.
 - 7. Final grade elevation at manhole.
 - 8. All pipe penetrations into manhole.
 - 9. Plan of manhole base invert.
 - 10. NYSPE Signed and sealed design calculations and drawings.
 - 11. Certificates of compliance with referenced standards.
 - 12. Certified test results.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Manhole components shall not be shipped until the 28-day strength is reached.
- B. Handle all manhole components carefully with approved handling devices. Manhole components shall be kept completely free from dirt and foreign matter.
- C. Manhole components with damaged O-ring grooves will not be approved.
- D. The Contractor shall clearly mark and immediately remove all damaged manhole components.
- E. Certified copies of all test results shall accompany each manhole component shipment and shall be furnished to the Engineer with each shipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manholes shall conform to the details shown on the Contract Drawings. All concrete manhole bases, transition slabs, riser sections and top slabs shall be precast.

- B. Except where otherwise specified manhole components shall conform to ASTM C 478.
- C. Precast manhole bases shall be of approved design and of sufficient strength to withstand the loads to be imposed upon them. An approved joint shall be provided to receive the pipe sections forming the barrel.
- D. Mark date of manufacture and name or trademark of manufacturer on all precast concrete items.
- E. Unless a larger size is required by the Drawings, the barrel of precast manholes shall be constructed of 48-inch diameter standard reinforced concrete manhole sections. the barrel shall be constructed of various lengths of pipe in combination to provide the correct height with the fewest joints. Wall sections shall not be less than 5 inches thick.
- F. Unless shown otherwise on the Drawings, joints for all precast concrete manhole components shall be of the bell and spigot type with a round "O" ring rubber gasket or a preformed plastic sealing compound as specified in the Federal Specifications SS-S-210A. Joints shall be formed so that adjacent manhole sections will fit and seal properly.
- G. A precast or cast-in-place slab or precast eccentric cone, as shown or approved, shall be provided at the top of the manhole barrel to receive the access hatches or cast iron frame and cover. The slab or cone shall be of acceptable design and of sufficient strength to safely support an H-20 loading. Concrete slabs shall be not less than 6 inches thick.
- H. Manhole sections shall contain manhole steps, 12 inches on centers, accurately positioned and embedded in the concrete. Steps are specified under Section 05501, Miscellaneous Metal Fabrications.
- I. All lifting holes shall be sealed tight with a solid rubber plug driven into the holes and the remaining void filled with 1 to 2 cement-sand mortar.

2.2 CASTINGS

- A. General: All manhole frames and covers (standard and oversize) shall conform to the following requirements. All manhole frames shall be the adjustable types.
- B. Standards referenced in this Section are listed below:
 - 1. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 48/A 48M, Specification for Gray Iron Castings.
 - b. ASTM B 26/B 26M, Specification for Aluminum-Alloy Sand Castings.

- C. Gray Iron Castings: ASTM A 48/A 48M, Class 35B.
- D. Round Manhole Frame with Solid Lid: Provide one of the following:
 - 1. R-1530, as manufactured by Neenah Foundry Company.
 - 2. E-1920, as manufactured by East Jordan Iron Works, Inc.
 - 3. Or equal.
- E. Valve Box Frame and Lid: Provide one of the following:
 - 1. R-7506-F, as manufactured by Neenah Foundry Company.
 - 2. V-8450, as manufactured by East Jordan Iron Works, Inc.
 - 3. Or equal.
- F. Coatings: Iron - Coat with asphaltic paint standard with the manufacturer.

2.3 BRICK MASONRY

- A. General:
 - 1. Brick masonry shall be installed between the manhole top slab and the manhole casting, in order to set the manhole casting at the proper grade. Brick masonry shall also be utilized to close up both openings in manhole walls where future pipe connections are proposed and openings where existing pipes have been removed. The elevation and location of such bricked up openings shall be as shown on the Drawings or as directed by the Engineer.
- B. Brick: All brick used as specified under this Section shall meet the requirements stated in ASTM C32.
- C. Mortar and Plaster: All mortar and plaster required to complete brick masonry as shown on the Drawings or as specified herein shall be in conformance with the requirements stated in Section 04100, Mortar, except cement shall conform to ASTM C 150 Type II.

2.4 STEEL REINFORCEMENT

- A. Steel reinforcement shall be placed in all concrete manhole components as shown on the Drawings and as specified herein. The reinforcing shown on the Drawings is the minimum amount required. Design calculations shall be submitted in accordance with requirements specified in this Section. All steel reinforcement shall meet the requirements specified in Section 03200, Concrete Reinforcing.

2.5 TOP SLABS AND TRANSITION SLABS

- A. Each top slab placed on the top of the manhole riser sections shall be manufactured in accordance with the Drawings and as specified herein.

- B. Concrete slab thicknesses shall not be less than the dimensions shown on the Drawings.
- C. Each top slab and transition slab shall be of acceptable design and of sufficient strength to safely support an AASHTO H-20 loading.

2.6 MANHOLE BASES AND MANHOLE RISER SECTIONS

- A. The minimum diameter for each manhole base shall be as shown.
- B. Manhole base sections minimum slab and wall thicknesses shall be as shown on the Drawings
- C. Manhole riser sections shall have the following minimum diameter and minimum wall thickness as shown on the drawings.
- D. Manhole riser sections shall be constructed of various lengths to provide the correct height with the fewest joints. No pipe penetrations shall be located at a joint.

2.7 PIPE CONNECTIONS

- A. Each manhole base shall be provided with circular openings at the required locations and elevations for the proper connection of all pipes. Prior to manufacturing manhole, Contractor shall verify all elevations (grade elevations and pipe elevations) to ensure proper coordination with existing conditions.
- B. Mortar shall be used to seal opening around the pipes entering the manholes. The diameter of the pipe opening shall be as shown on the Drawings.

2.8 MANHOLE RUNGS

- A. The rung shall be of corrosion-resistant fiberglass construction.
- B. Material of construction shall be protruded structural fiberglass utilizing a synthetic surfacing veil for chemical and ultraviolet resistance and special high modulus pultrusion process for strength. Minimum glass content shall be sixty (60%) percent, comprising both longitudinal strands and continuous strand mat so aligned as to prevent splitting due to laminar shear. The FRP shapes shall possess Class I fire retardance, with an ASTM E 84 flame-spread rating of twenty-five (25) maximum.
- C. Each rung installed shall be subjected to a loading test of 300 lbs. and a pulling test of 300 lbs. Should any test fail, then the Contractor shall make repairs as approved by the Engineer.

- D. Rungs shall be spaced at a maximum of 16-inch spacing and no less than 12-inch spacing.
- E. Hardware (brackets, nuts, bolts, fasteners, etc.) shall be made of 316 stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Excavation:
 - 1. All excavation required for the construction of manholes shall be performed as specified in Section 02200, Earthwork.
- B. Shoring:
 - 1. Shoring of all excavations shall be provided as specified in Section 02200, Earthwork.

3.2 INSTALLATION

- A. No manhole components shall be installed prior to the acceptance of all test results by the Engineer.
- B. Manhole Bases:
 - 1. During excavation the soil below each base shall not be disturbed. Overexcavated areas shall be backfilled with select fill and compacted as specified in Section 02200, Earthwork. Manhole bases shall be checked for proper bearing on the subgrade and proper elevation and orientation to receive the incoming and outgoing pipes at the designated invert elevations. Special care shall be taken in placing the concrete around the bottom of the pipes to obtain a waterproof structure.
 - 2. Manhole Base Inverts:
 - a. The concrete invert fill shall be installed following the connection of all sewer pipes to the manhole. The invert fill shall be true to the pipe invert elevations, with smooth channels of uniform section and slope, either straight or with continuous curve being provided between inlets and outlets of all manholes.
 - b. The concrete invert fill shall also be placed in accordance with dimensions and details shown on the Drawings.
 - c. To eliminate free fall conditions in a manhole resulting from grade differentials between incoming and outgoing pipes, the Contractor shall form and construct suitable channels in the bottom of the manhole of such configuration as approved by the Engineer in order to provide a smooth and even transition of flow through the manhole.
- C. Manhole Riser Sections:

1. Set sections vertical with sections in true alignment.
2. Install sections, joints and gaskets in accordance with manufacturer recommendations.

D. Joints:

1. Joints between manhole components shall be made with the materials specified in Paragraph 2.1.F of this Section.
2. Gaps between sections shall not exceed 3/8-inch.

E. Manhole Watertightness:

1. All manholes shall be free of visible leakage. Each manhole shall be periodically inspected for leaks, and all leaks shall be repaired in a manner subject to the Engineer's approval.

F. Brick Masonry:

1. The brick masonry shall be constructed as required to bring the manhole frame and cover to the proper grade in accordance with the Drawings.
2. Brick shall be satisfactorily wet when being laid and each brick shall be laid in mortar so as to form full bed, end and side joints in one operation. The joints shall not be wider than 3/8-inch, except when the bricks are laid radially, in which case the narrowest part of the joint shall not exceed 1/4-inch.
3. Following the placement of the brickwork, a one half-inch layer of cement mortar shall be applied to the exterior surface of the brick and troweled to a smooth finish.
4. If concrete grading rings are installed in lieu of brick masonry the combined height of the brick masonry and grading rings shall not exceed 12 inches.

G. Castings:

1. Each casting shall be installed to the proper grade. Feathering of pavement around the casting is not permitted.

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SECTION 02455

MICROPILES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall furnish all materials for installation and testing for Micropiles for permanent structures as shown on the Drawings in accordance with the requirements of the Contract Documents, and industry standard drilling and installation practices. This shall include all drilling, material requirements and other appurtenances necessary to make a complete installation..
- B. Load Carrying Capacity: Refer to drawings for gravity and lateral load requirements. The Micropiles shall be drilled pipes with reinforced grout as indicated on drawings. The CONTRACTOR shall determine the length required for specified load capacity and site conditions. The CONTRACTOR shall be responsible for installing Micropiles in accordance with the testing subsection of this specification. CONTRACTOR's proposal for said work shall explain in detail the materials and methods, he will employ.
- C. Related Sections:
 - 1. Section 03200 , Concrete Reinforcing.
 - 2. Section 03300 , Cast-In-Place Concrete.
 - 3. Section 02200 , Earthwork .

1.2 REFERENCES

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. ASTM C1077-06, Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
 - 2. ASTM D1143, Standard Test Method for Piles Under Static Axial Compressive Load.
 - 4. ASTM E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
 - 5. AWS D1.1, Structural Welding Code.
 - 6. AWS Standard Qualification Procedure.
 - 7. ASTM A519, Standard Test Method for Seamless Carbon and Alloy Steel Mechanical Tubing.
 - 8. FHWA Design Manual: Micropile Design and Construction. FHWA-NHI-05-039, published by Federal Highway Administration, December, 2005.

1.3 QUALITY ASSURANCE

A. CONTRACTOR/Installer Qualifications:

1. The CONTRACTOR performing the work described in the specification shall have installed Micropiles for a minimum of five years. At the time of bid, the CONTRACTOR shall submit a list containing at least five projects of similar complexity and scope on which the CONTRACTOR has installed Micropiles. A brief description of each project and a reference shall be included for each project listed. As a minimum, the reference shall include an individual's name and current phone number.
2. Prior to the start of work, the CONTRACTOR shall submit a list identifying the ENGINEER, drill operators and on-site supervisors who will be assigned to the project. The list shall contain a summary of each individual's experience and it shall be complete enough for the ENGINEER to determine whether or not each individual has satisfied the following qualification.
3. The CONTRACTOR shall assign an ENGINEER to supervise the work with at least five years of experience in the design and construction of Micropiles. The use of consultants or manufacturer's representatives does not satisfy the requirements of this section. Drill operators and on-site supervisors shall have a minimum of three year experience installing Micropiles with the CONTRACTOR's organization.
4. The ENGINEER shall approve or reject the CONTRACTOR's qualifications and staff within 15 working days after receipt of the submission. Work shall not be started on any piling nor any materials ordered until approval of the CONTRACTOR's qualifications are given. The ENGINEER may suspend the Micropile work if the CONTRACTOR substitutes unqualified personnel for approved personnel; the CONTRACTOR shall be fully liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of work will be allowed.
5. Also, the CONTRACTOR shall submit a detailed narrative within his proposal describing the construction method he intends to employ and encompassing all aspects, peripheral or otherwise, of his site operation.
6. Installer's responsibility includes providing a qualified professional ENGINEER to prepare pile-driving installation records.
7. Please note the OWNER (and his contracts manager as appropriated) reserves the right to reject any or all bids on the basis of price or in the belief that the narrative content does not reveal that the CONTRACTOR has given due thought to the construction process.

- #### B. Survey Work: Engage a registered surveyor to perform surveys, layouts, and measurements for Micropile work. Conduct layout work for each Micropile to lines and levels required before excavation, and actual measurements of each Micropile location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other data as required.

- C. All drilling and load test operations must be performed in the presence of the GEOTECHNICAL ENGINEER.
- D. Concrete/Grout tests shall be performed in accordance with Section 03300 , Cast-In-Place Concrete.
- E. The OWNER shall engage the services of a qualified geotechnical and materials testing agency to perform inspections and testing. The Agency shall meet the requirements of ASTM C1077 and ASTM E 329 and documented according to ASTM E548.
- F. The OWNER's geotechnical and materials testing agency shall inspect Micropiles at the time of construction and before placement of pile cap. The agency shall verify bottom elevations, bearing capacities, and length of Micropiles installed compared to estimates of each based on the geotechnical studies. Reports of such should be completed and distributed with two days of completion of each Micropile.
- G. Materials and installed Work may require testing and retesting, as directed by GEOTECHNICAL ENGINEER, at any time during the progress of the Work. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be done at OWNER'S expense, including the retesting of rejected materials and installed Work, shall be done at CONTRACTOR'S expense.

1.4 SUBMITTALS

- A. The CONTRACTOR shall prepare and submit to the ENGINEER for review and approval, working drawings , describing the Micropile system. The working drawings shall be submitted atleast 30 calendar days prior to the commencement of the Micropile work. The working drawing shall include the following:
 - 1. CONTRACTOR shall submit a detailed description of the construction procedures proposed for use to the ENGINEER for review. This shall include a schedule of major equipment resources.
 - 2. The CONTRACTOR shall submit certified mill test reports, properly marked for the reinforcing steel, as the materials are delivered to the ENGINEER for record purposes. The ultimate strength, yield strength, elongation, and composition shall be included. For steel pipe used as permanent casing, or core steel, the CONTRACTOR shall submit a minimum of two representative coupon tests or mill certifications on each load delivered to the project.
 - 3. The CONTRACTOR shall submit the grout mix designs, including details of all materials to be incorporated, and the procedure for mixing and placing the grout to the ENGINEER for Approval.
 - 4. The CONTRACTOR shall submit detailed plans for the method proposed for testing the micropiles to the ENGINEER for review and acceptance prior to beginning load tests.

5. The contractor shall submit the ENGINEER calibration reports for each test jack, pressure gauge and master pressure gauge to be used. The calibration tests shall have been performed within 1 year of the date submitted.
6. The Contractor shall submit rate of driving of each pile, pile location plumbness and pile test reports.

PART 2 - PRODUCTS

2.1 PILES MATERIALS

- A. General: Piles shall be either end bearing or combined end-bearing and friction piles with required capacity for the loading as shown on the drawings. Submit details of type proposed for installation, showing cross-sections, end closures, and details of connections for approval by ENGINEER before delivery of any material to project site.
- B. Structural steel plates and shapes: Structural steel plates and shapes for pile shall conform to ASTM A36 or ASTM A572 Grade 50.
- C. Concrete and Grout: Concrete, Grout and all related materials shall be as specified in Section 03300 , Cast-In-Place Concrete. Concrete shall be Class A with a minimum compressive strength of 5,000 psi at 28 days.
- D. Reinforcement Steel: All reinforcement steel shall be as specified in Section 03200 , Concrete Reinforcing.
- E. Structural Steel Casing: Structural steel casing shall be a minimum of 3/16-inch thick, ASTM A 252, Grade 3, or A36 steel or American Petroleum Institute (API) 5CT or 5L (N-80) casing may be used, or stronger. The minimum elongation shall be 15%. Casings shall be smooth.
- F. Water: Water for mixing grout shall be potable, clean and free from substances which may be in any way deleterious to grout or steel.
- G. Fillers: Insert fillers such as sand may be used in the grout in special situation as approved by the Geotechnical ENGINEER.
- H. Admixtures which control bleed, improve flowability, reduce water content and retard set may be used in the grout, subject to approval by the Geotechnical ENGINEER.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the ground surface and conditions under which micropiles is to be accomplished. Do not proceed with the Work until unsatisfactory conditions have been appropriately corrected.

3.2 GENERAL

- A. The term "final grade" shall be defined as the subgrade elevation adjacent to the micropile in question.

3.3 INSTALLATION

- A. The micropile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project. The micropile CONTRACTOR shall select the drilling method and the grouting procedures used for the installation of the micropiles, subject to the approval of the Geotechnical ENGINEER.
- B. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, with minimal disturbance to these conditions or any overlying or adjacent structure or service. The borehole must be open to the defined nominal diameter, full length, prior to placing grout and reinforcement.
- C. All installation techniques shall be determined and scheduled such that there will be no interconnection or damage to piles in which grout has not achieved final set.
- D. Centralizers shall be provided at 10-ft center maximum spacing on central reinforcement. The uppermost centralizer shall be located a maximum of 5 ft from the top of the micropile. Centralizers shall permit the free flow of grout without misalignment of the reinforcement.
- E. The central reinforcement steel with centralizers shall be lowered into the stabilized drill holes to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole in order to eliminate interconnection or damage to piles in which the grout has not achieved final set.
- F. The drilling equipment shall be configured to collect all cuttings returned to surface into containers for disposal of cuttings offsite to designated landfill.

3.4 GROUTING

- A. The CONTRACTOR shall provide systems and equipment to measure the grout quality, quantity, and pumping pressure during the grouting operations. This information is to be measured and recorded by the CONTRACTOR.

- B. After drilling, the hole shall be flushed with water and/or air to remove drill cuttings and/or other loose debris. The CONTRACTOR shall provide a stable, homogenous neat cement grout or a sand cement grout with a minimum 28-day unconfined compressive strength of 5000 psi. The grout shall not contain lumps or any other evidence of poor or incomplete mixing. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The pump shall be equipped with a pressure gauge to monitor grout pressures. The pressure gauge shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used by the CONTRACTOR, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The grout should be kept in constant agitation prior to pumping.
- C. The grout shall be injected from the lowest point of the drill hole (by tremie methods) until clean, pure grout flows from the top of the micropile. The tremie grout may be pumped through grout tubes, hollow stem augers, or drill rods. Subsequent to tremie grouting, all grouting operations associated with, for example, extraction of drill casing and pressure grouting, must ensure complete continuity of the grout column. The use of compressed air to directly pressurize the fluid grout is not permissible. The grout pressures and grout takes shall be controlled to prevent excessive heave in cohesive soils or fracturing of soil or rock formations. The entire pile shall be grouted to the design cut-off level.
- D. Upon completion of grouting, the grout tube may remain in the hole, but it shall be filled with grout. Grout tubes shall be installed prior to the tremie grouting.
- E. Grout within the micropiles shall be allowed to attain the minimum design strength prior to being loaded.
- G. If the CONTRACTOR uses a post-grouting system, all relevant details including grouting pressure, volume, location and mix design, shall be submitted.
- H. Grout shall have bleed less than or equal to 1%, Initial set time of 3 to 6 hours and pressure filtration coefficient of 0.05 to 0.5.

3.5 PILE SPLICES

- A. Casing and reinforcing steel shall not be spliced.

3.6 TOLERANCE

- A. Centerline of piling shall not be more than 3 in. from indicated plan location.
- B. Piles shall not be out of plumb of more than 2%
- C. Top elevation of pile shall be within +1 in. of the design vertical elevation

D. Centerline of core reinforcement shall not be more than $\frac{3}{4}$ in. from centerline of piling.

3.7 PILE LOAD TESTING

- A. Perform a verification pile load test on one non-production pile to demonstrate that the design bond length and proposed construction procedures will provide a pile meeting the design load requirement, prior to installation of production piles. Acceptance and approval of GEOTECHNICAL ENGINEER is required prior to production of piles. Perform proof tests on one micropile at the proposed Electrical building. The proof load tests shall be performed at locations determined by the GEOTECHNICAL ENGINEER.
- B. Lateral load testing shall be conducted – prior to axial testing – in accordance with ASTM 3966. During both pre-production verification- and proof- test phases, care must be exercised to not cause permanent structural damage to the pile which will subsequently reduce its axial load capacity.
- C. The CONTRACTOR shall submit for review and acceptance the proposed micropile load testing procedure. The testing program shall be provided 2 weeks prior to starting the load testing. This micropile verification load testing proposal shall be in general conformance with ASTM D-1143 +/- D-3689, and shall indicate the minimum following information.
 - 1. Type and accuracy of apparatus for measuring load.
 - 2. Type and accuracy of apparatus for applying load.
 - 3. Type and accuracy of apparatus for measuring the pile deformation.
 - 4. Type and capacity of reaction load system, including sealed design drawings.
 - 5. Hydraulic jack calibration report.
- D. The drilling and grouting methods, casing and other reinforcement details, and depth of embedment for the test pile shall be identical to the production piles, except where approved otherwise by the Geotechnical ENGINEER.
- E. The tested micropiles shall be loaded to 200% of the compression and/or tension design load (DL) (i.e., 2.0 DL). The load tested piles must be of the same design as the production piles to ensure meaningful results. The jack shall be positioned at the beginning of the test such that the unloading and repositioning of the jack during the test will not be required. Piles shall be tested under compression loads prior to testing under tension loads. An Alignment Load (AL if required) shall be applied the pile prior to setting the movement recording devices. This Alignment Load shall be no more than 10% on Design Load (i.e., 0.1 DL); dial gauges shall be zeroed at the first setting of AL. Verification load tests shall be made by loading the micropile in the following load increments:

LOAD	HOLD TIME (MINUTES)
AL	-
0.15 DL	2.5
0.30 DL	2.5
0.45 DL	2.5
AL	1
0.15 DL	1
0.45 DL	1
0.60 DL	2.5
0.75 DL	2.5
0.90 DL	2.5
1.00 DL	2.5
AL	1
0.15 DL	1
1.00 DL	1
1.15 DL	2.5
1.30 DL	10 *
1.45 DL	2.5
AL	1
0.15 DL	1
1.45 DL	1
1.60 DL	1
1.75 DL	2.5
1.90 DL	2.5
2.00 DL	10
1.50 DL	5
1.00 DL	5
0.50 DL	5
AL	5

* Hold until meet acceptance criterion 2 above

AL = Alignment Load; DL – Design Load

F. Measurement of pile movement shall be obtained at each increment. The load hold period shall start as soon as the test load is applied and the pile movement, with respect to a fixed reference, shall be measured and recorded at 1 minute, 2, 3, 4, and 5, and 10 minutes (load cycle maxima only).

G. Proof Load Tests.

1. Proof load tests shall be completed for Minimum 10 % of the total pile installation. Follow the same procedure as that described for the verification load test.

2. Additional proof load tests shall be required if modifications are made in the micropile installation methods subsequent to the installation of the first production micropile.
3. Micropile designated proof load testing shall be tested to a Proof Test Load of 1.3 times the design load (1.3 DL). Proof tests shall be made by incrementally loading the micropile in accordance with the following schedule

LOAD	HOLD TIME (MINUTES)
AL	-
0.15 DL	2.5
0.30 DL	2.5
0.45 DL	2.5
0.60 DL	2.5
0.75 DL	2.5
0.90 DL	2.5
1.00 DL	2.5
1.15 DL	2.5
1.30 DL	10*
1.00 DL	4
0.75 DL	4
0.50 DL	4
0.25 DL	4
AL	4

AL = Alignment Load

DL = Design Load

* Hold until meet acceptance criterion

3.7 PILE LOAD TEST ACCEPTANCE

A. Acceptance Criteria.

1. The pile shall sustain the compression and tension design capacities (1.0 DL) with no more than 0.5 in. total vertical movement at the top of the pile as measured relative to the pile prior to the start of testing. If an Alignment Load is used, then the allowable movement will be reduced by multiplying by a factor of (DL-AL)/DL.
2. Test piles shall have a creep rate at the end of the 1.3 DL increment which is not greater than 0.040 inch per log cycle time from 1 to 10 minutes or 0.080 inch per log cycle time from 6 to 60 minutes and has a linear or decreasing creep rate.
3. For verification tests, the slope of the micropile head settlement versus load curve shall be less than or equal to 0.025 inch per kip at the 2.0 DL maximum load. Failure is defined as a slope of the load versus deflection (at end of

increment) curve exceeding 0.025 inches per kip and shall not occur at loads less than 2.0DL.

- B. When a micropile fails to meet the acceptance criteria, CONTRACTOR shall modify the design, the construction procedures, or both. These modifications include, but are not limited to, installing replacement micropiles, modifying the installation methods, increasing the bond length, regrouting via pre-placed re-grout tubes, or changing the micropile type. Any modification which requires changes to the structure shall have prior review and acceptance of the OWNER. The cause for any modifications of design or construction procedures shall be decided in order to appropriately determine any additional cost implications.
- C. If a micropile that is proof tested fails to meet the acceptance criteria, the CONTRACTOR shall be directed to proof test another micropile within the structure at a location chosen by the Geotechnical ENGINEER. For failed piles and further construction of other piles, the CONTRACTOR shall modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement micropiles, incorporating piles of reduced load capacities, modifying the installation methods, increasing the bond length, or changing the micropile type and/or diameter. Any modification which requires changes to the structure shall have prior review and acceptance of the ENGINEER. Any modifications of design or construction procedures shall be at the CONTRACTOR's expense. Any additional time required to remedy failing proof load test shall not be cause for delay or impact claims.

3.8 PILE LOAD TEST REPORTING

- A. The CONTRACTOR will provide the OWNER a written report confirming micropile geometry and construction details within 7 working days after the completion of the pre-production tests. This written confirmation will either confirm the bond lengths as shown in the drawings for micropiles or propose modifications based upon the results of the verification tests.

+ + END OF SECTION + +

SECTION 02485

GRASSING AND PLANTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to do landscape work on all areas used by the Contractor for the Work, and on all areas disturbed by the Contractor's construction activities. This includes seeding/sodding around the new facility and manholes.
2. Types of work required include, but are not limited to, the following:
 - a. Provide topsoil from off-site sources. On-site topsoil shall not be re-used and shall be disposed of in accordance with 02200 Earthwork and Attachment B Environmental Site Investigation Report.
 - b. Provide new turf areas and recondition existing turf areas.
 - c. Provide mulches and all other material necessary to complete the seeding job as specified.
 - d. Maintenance work as specified.
 - e. Provide soil amendments, fertilizers, wood pine chunk bark and miscellaneous materials.
 - f. Provide sod (an alternate to seeding).
 - g. Remove existing shrubs and trees from areas of new construction, store and re-plant on-site where directed by Engineer.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that shall be installed with the landscaping.
2. Obstructions Below Ground and Utilities: Exercise extreme caution in all operations, as there are underground electric and telephone cables, sewer lines and water lines throughout the entire area. Study and be familiar with the location of these obstructions and underground utilities. Repair all damage to obstructions and underground utilities at no expense to the Owner.

C. Related Sections:

1. Section 02110, Clearing, Grubbing and Site Preparation.
2. Section 02200, Earthwork.

1.2 QUALITY ASSURANCE

A. Subcontractor Qualifications:

1. Subcontract the Work to a single firm specializing in landscape work. Provide the services of an experienced foreman, who will personally supervise all Work.

- B. Source Quality Control:
1. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Analytical Chemists, wherever applicable or as further specified.
 2. Topsoil stockpiled for reuse: Topsoil will be inspected by the Engineer before reuse. At the time of inspection, the Engineer may require representative soil samples to be tested for physical properties, hydrogen-ion value, organic matter, and available phosphoric acid and potassium. Supply twenty-pound samples to the Owner for testing. If deficiencies in the topsoil are found, as a result of this analysis, they shall be corrected at no additional expense to the Owner.
 3. Provide sod procured from areas having growing conditions similar to those areas on which the sod is to be used.
 4. Machine-cut sod into rectangular sections, exercising care to retain the native soil on the roots of the sod, during stripping, transportation and planting.
 5. Cut and move sod only when soil moisture conditions are such that favorable results can be expected.
 6. Rectangular sections of sod may vary in length but shall be equal in width and of a size that permits the sod to be lifted and rolled without breaking.
- C. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
1. ASTM C 602, Agricultural Liming Materials.
 2. ASTM D 2487, Classification of Soils for Engineering.
 3. Association of Official Analytical Chemists, Official Methods of Analysis.
 4. Official Seed Analysts of North America, Standards of Quality.
 5. FSO-F-241D, Fertilizer, Mixed, Commercial.
 6. FSO-P-166E, Peat Moss; Peat, Humus; and Peat, Reed-sedge.

1.3 SUBMITTALS

- A. Samples: Submit for approval the following:
 - 1. Wood pine chunk bark: One pound bag.
- B. Shop Drawings: Submit for approval the following:
 - 1. Planting schedule showing scheduled dates for each type of planting in each area of Site.
 - 2. Before delivery of off-site topsoil, written statement giving the location of the properties from which the topsoil is to be obtained, the names and addresses of the suppliers, the depth to be stripped and the crops grown during the past 2 years.
 - 3. Manufacturer's specifications and installation instructions for all materials required.
- C. Tests by the Owner: Submit topsoil, seed, soil amendments and fertilizer to the Owner's testing facility for testing:
 - 1. Before delivery of off-site topsoil, a soil analysis will be made by the Owner's testing laboratory for porosity, the percentages of silt, clay, sand and organic matter and the pH and the mineral and plant nutrient content of the topsoil. Supply topsoil with 5 percent organic matter minimum.
 - 2. Before delivery of seed, soil amendments and fertilizer an analysis will be made by the Owner's testing laboratory stating the mechanical and chemical analysis of the materials proposed for use.
- D. Certificates: Submit for approval the following:
 - 1. Certificates of inspection as may be required by governmental authorities to accompany shipments, and manufacturer's or vendors certified analysis for soil amendments and fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.
 - 2. Certificates from seed vendors certified statement for each seed mixture required, stating botanical and common name, percentage by weight and percentages of purity, germination, and weed seed for each species.
 - 3. Before delivery of sod, submit written statement giving the locations of the property from which the sod is to be obtained and the names and addresses of the suppliers.
 - 4. Certificates of inspection substantiating that sod contains no noxious weeds or other material that might be detrimental to the proposed planting.

1.4 JOB CONDITIONS

- A. Environmental Requirements:
 - 1. Proceed with and complete the Work as rapidly as portions of the Site become available, working within the seasonal limitations for each kind of landscape work required.
 - 2. Do not spread seed when wind velocity exceeds 5 miles per hour.

3. Do not seed when drought, or excessive moisture, or other unsatisfactory conditions prevail.

B. Scheduling:

1. Seed or install materials only during normal planting seasons for each type of work required. Correlate seeding with specified maintenance periods to provide maintenance until completion of Work.
2. Sod: Time delivery so that sod will be placed within 24 hours after stripping.
3. Protect sod against drying and breaking of rolled strips.
4. If sod is stacked place roots to roots or grass to grass.
5. Protect sod from exposure to wind and sun and from freezing.

1.5 GUARANTEE

- A. Guarantee turf through the specified maintenance period.

1.6 ALTERNATES

- A. The Contractor, with the approval of the Engineer, may substitute sod as specified herein for the seeding specified. Submit a request to the Engineer in writing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Topsoil that is removed shall be disposed of off-site and shall be re-used. Disposal shall meet the requirements of Section 02200 Earthwork and Attachment B Environmental Site Investigation Report.
2. Provide off-site topsoil as required, which is fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth, free of any admixture of subsoil, clods of hard earth, plants or roots, sticks or other extraneous material harmful to plant growth. Supply topsoil with the following analysis:
 - a. 3/4-inch: 100 percent passing
1/4-inch: 97-100 percent passing
No. 100: 40 to 70 percent passing
No. 200: 20 percent minimum
 - b. pH 5.0 to pH 7. If approved by the Engineer, natural topsoil not having the hydrogen-ion value specified may be amended by the Contractor at his own expense.
 - c. Organic content not less than 5 percent, not more than 20 percent.
 - d. Free of pests and pest larvae.

B. Soil Amendments:

1. Lime: Natural limestone containing not less than 80 percent of total carbonates, ground so that not less than 100 percent passes a 10-mesh sieve, not less than 70 percent passes a 100-mesh sieve and not less than 50 percent passes a 200-mesh sieve.
2. Superphosphate: Soluble mixture of treated minerals; approximate 0-20-0 formulation, 18 percent available phosphoric acid.
3. Commercial Fertilizer: Complete fertilizer of neutral character, with a minimum of 50 percent nitrogen derived from natural organic sources or urea form; 50 percent of the nitrogen shall be inorganic. Available phosphoric acid derived from superphosphate, bone, or tankage. Potash derived from muriate of potash, containing 60 percent potash. Uniform in composition, freeflowing and suitable for application with approved equipment. Provide fertilizer with the following percentages of available plant nutrients:
 - a. For turf, provide fertilizer with not less than 6 percent phosphoric acid and not less than 4 percent potassium, and nitrogen not less than 10 percent. Provide nitrogen in a form that will be available to the turf during the initial period of growth.
4. Sand: Washed of fine to medium texture.

C. Turf Materials:

1. Lawn: Seed shall be state-certified seed of the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Seed shall be labeled in conformance with U.S. Department of Agriculture rules and regulations under the Federal Seed Act. Seed that has become wet, moldy, or otherwise damaged will not be acceptable. On-site seed mixing shall be done only in the presence of the Owner. The seed mixture shall be proportioned as follows:
2. Mixtures:
 - a. Mixture A to be seeded, in general, on areas not regularly mowed.

MIXTURE A	Mixture		Germination	
	Tolerance Tolerance			
Proportions of Mixture	<u>Minus</u>	<u>Plus</u>	<u>Germination</u>	<u>Minus</u>
25% Lynn Rye	3%	5%	90%	6%
25% Baron Blue	3%	5%	85%	7%
25% Penn Fine Rye	3%	5%	90%	6%
25% Mustang Fescue	3%	5%	90%	6%

- a. Mixture B to be seeded, in general, on areas regularly mowed and well-maintained.

MIXTURE B	Mixture		Germination	
	Tolerance Tolerance			

<u>Proportions of Mixture</u>	<u>Minus</u>	<u>Plus</u>	<u>Germination</u>	<u>Minus</u>
50% Merion Blue Grass	3%	5%	80%	7%
30% Penn Lawn Fescue	3%	5%	90%	6%
20% NK106 Hybrid Rye	3%	5%	85%	7%

D. Miscellaneous Landscape Materials:

1. Mulch:
 - a. Anti-Erosion Mulch: Provide clean, seed-free wood fiber.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Superior Fiber as manufactured by Wolbert Master and Associates, Inc.
 - 2) Silva Fiber as manufactured by Weyerhaeuser Corporation.
 - 3) Or equal.
2. Water: Potable.
3. Steel Edging: Commercial steel edging fabricated in sections with loops pressed from or welded to face of sections to receive stakes. Provide tapered steel stakes 16 inches long. Finish edging sections and stakes with manufacturer's standard black paint. Provide edging of the following cross-section size:
 - a. 4 inches by 1/8 inch.
4. Gravel: Hard, durable, well graded stone washed free of loam, sand, clay and other foreign substances, and of the following size, range, and color:
 - a. Size Range: 1-1/2 inch maximum, 3/4-inch minimum.
 - b. Color: Uniform tan beige color range.
 - c. Product and Manufacturer: Provide one of the following:
 - 1) No. 245 Camel Brown as manufactured by George Scholfield Company, Incorporated.
 - 2) Or equal.
5. Base Film: Provide 10 mil thick black polypropylene film in 10-foot widths.
6. Chunk Bark Mulch: Provide chunks of pine wood mulch with a nominal face dimension of 2 to 4 inches to a minimum finished depth of 5 inches.
7. Wrapping: Provide a standard manufactured tree wrapping paper, brown in color, two layers cemented together by asphaltum, crepe surface. Provide twine for tying, lightly tarred, medium coarse sisal (lath) yarn.

- E. Sod: Provide strongly rooted machine-cut sod, not less than 2 years old and free of seeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant) and in strips not more than 18-inches wide by 14 feet-0 inches long by 1-1/2 inches thick (excluding top growth and thatch). Provide sod composed of mixture B above.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Contractor and his installer shall examine the subgrade, verify the elevations, observe the conditions under which the grassing and gravel work is to be performed, and notify the Engineer of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
- B. Inspect existing trees and shrubs to be relocated for injury and insect infestation. Prune as required before moving. Discard damaged trees and shrubs as directed by the Engineer.
- C. Do not begin moving or storing of trees until deficiencies are corrected.

3.2 PREPARATION

- A. Layout individual tree and shrub locations and areas for multiple plantings as directed by the Engineer. Stake locations and outline areas and secure the Engineer's acceptance before start of planting work. Make minor adjustments as may be requested. Refer to paragraph 1.1.B. herein for the requirements of coordination by others.
- B. Move existing trees with full ball of earth. Take all measures necessary to avoid breaking earth ball. Dig earth ball same diameter as drip line of tree and to a depth 1/2 the diameter of earth ball minimum. Do not cut roots over 1/2-inch in diameter. Alter earth ball shape as required to avoid cutting roots. If trees cannot be planted immediately, cover earth ball with planting soil and maintain in moist condition. Keep plants out of full sun. Support plants with stakes to maintain upright and stable position. Plant as specified herein. Apply anti-desiccant as specified herein. Trees lost due to improper moving techniques shall be replaced in kind and size at no additional expense to the Owner.
- C. Seedbed Preparation:
 - 1. Loosen subgrade of seedbed areas to a minimum depth of 4 inches. Remove stones over 1-1/2 inches in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas that will be planted promptly after preparation.
 - 2. Spread topsoil to minimum depth of 6 inches after natural settlement and light rolling.
 - a. Do not spread topsoil while in a frozen or muddy condition.
 - 3. Apply ground limestone, by machine, at a rate of 2,000 pounds per acre over all areas to receive turf, as required, to bring the soil to a neutral pH. Work lightly into the top 3 inches of topsoil at least five days before applying the commercial fertilizers.

4. Apply commercial fertilizers at a rate of 1500 pounds per acre within 10 days of seeding.
 5. Thoroughly and evenly incorporate commercial fertilizers with the soil to depth of 3 inches by dicing, or other approved method.
 - a. In areas inaccessible to power equipment, use hand tools.
 6. Apply superphosphate at the rate of 20 pounds per 1000 square feet and incorporate into the top 3 inches of topsoil.
 7. Grade seedbed areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous foreign material in excess of 1 inch in diameter. Roll and rake and remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
 8. Moisten prepared seedbed areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy soil condition.
 9. Restore turfed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
- D. Preparation of Planting Beds:
1. Remove all existing soil from planting beds to the depth required so that finished plantings are level with adjacent final lines, grades and elevations after addition of planting soil to the depth shown on the Drawings and after light rolling and natural settlement.
 2. Loosen subgrade of planting bed areas to a minimum depth of 6-inches using a culti-mulcher or similar equipment. Remove stones over 1-1/2-inches in any dimension, and sticks, stones, rubbish and other extraneous matter.
 3. Place approximately 1/2 of total amount of planting soil required. Apply 10 pounds of superphosphate per 1000 square feet of bed. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.
- E. Excavation for Trees and Shrubs:
1. Excavate pits with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
 - a. For existing trees and shrubs to be replanted, make excavations at least twice as wide as the ball diameter and equal to the ball depth, plus the following allowance for setting of ball on a layer of compacted backfill:
 - 1) Allow for 6-inches setting layer of planting soil mixture.
 2. Dispose of subsoil removed from landscape excavation. Do not mix with planting soil or use as backfill.

3.3 INSTALLATION

- A. Determine location of underground utilities and perform Work in a manner which will avoid possible damage. Hand excavate, as required, to minimize possibility

of damage to underground utilities. Maintain grade stakes until removal is mutually agreed upon by all parties concerned.

B. Planting Trees and Shrubs:

1. Set existing trees to be replanted on layer of compacted planting soil mixture, plumb, and hold rigidly in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Maintain previous relationship that plant had to existing soil line at trunk or main leader. Do not set plants in depressions or on mounds. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3-full, water thoroughly before placing remainder of backfill. Water again after placing final layer of backfill. Remove burlap from sides of balls; retain on bottoms.
2. Dish top of backfill to allow for mulching. Provide dish 4 feet in diameter approximately 4-inches deep around each tree.
 - a. For spring planting, provide additional backfill berm around edge of excavations to form shallow saucer to collect water.
3. Place water permeable base film over finished planting beds prior to placing planting bed mulch.
 - a. Lap joints 4-inches minimum.
 - b. Use one hold down pin per 4 square feet of film.
 - c. Take precaution not to tear or puncture base film further when placing planting bed mulch.
4. Mulch pits, trenches and planted areas. Provide not less than 5-inches of planting bed mulch and finish level with adjacent finish grades.

C. Seeding:

1. Seed only between April 15 and May 30 and between August 15 and October 1.
2. Sow seed at a rate of 150 pounds per acre using a spreader or seeding machine.
3. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
4. Sow not less than the quantity of seed specified.
5. Cultivator-packer, or approved similar equipment, may be used to cover the seed and to firm the seedbed in one operation. In areas inaccessible to cultivator-packer:
 - a. Rake the seeded ground and roll in two directions with a water ballast roller, weighing not less than 100 pounds per linear foot.
 - b. Take care during raking that seed is not raked from one spot to another.
6. Protect seeded areas against erosion by spreading specified lawn mulch after completion of seeding operations.
 - a. Protect seeded areas against hot, dry weather or drying winds by applying straw mulch not more than 24 hours after completion of seeding operations.

7. Do not leave seeded areas unmulched for longer than 3 days. Reseed areas which remain without mulch for longer than 3 days.
8. Mulch shall be spread uniformly over the seeded area at the rate. Recommended by the manufacturer in writing.
9. Prevent foot or vehicular traffic, or the movement of equipment, over the mulched area. Reseed areas damaged as a result of such activity.
10. Water seeded areas thoroughly with a fine spray.

D. Hydro-Seeding:

1. Hydro seeding may be substituted for mechanical seeding with the approval of the Owner.
2. All requirements of "Seeding" hereinbefore specified shall apply except as modified herein.
3. Areas to be hydro-seeded shall be scarified sufficiently to break up the surface crust immediately before seeding as approved by the Owner except where the ground is loose and friable as immediately following grading or as otherwise approved.
4. Hydro-seeder slurry shall be a homogeneous mixture of seed, mulch, limestone and fertilizer that shall remain in suspension in water under agitation. The slurry shall be evenly distributed over the area to be seeded and shall be applied in accordance with the following application rates per acre of surface seeded.
5. 6,000 gallons of water, 2,000 pounds of wood fiber mulch, 200 pounds of grass seed mixture, 1,200 pounds of ground limestone, 90 pounds of 10-6-4 fertilizer.
6. Grass seed mixture used for Hydro-Seeding shall conform to "Mixture A" as specified in this Section.

E. Miscellaneous Landscape Work:

1. Install steel edging between all grassed and graveled areas. Anchor with steel stakes spaced not more than 3 feet on center and driven at least 1 foot below bottom elevation of edging.
2. Place water permeable base film over compacted subgrade prior to placing gravel.
 - a. Lap joints 4 inches minimum.
 - b. Use one hold-down pin per 4 square feet of film.
 - c. Take precautions not to tear or puncture base film when placing gravel.
3. Place gravel beds 6 inches deep. Compact soil subgrades before placing gravel.

F. Reconditioning Existing Turf:

1. Recondition areas outside of the clearing line damaged by the Contractor's operations including storage of materials and equipment and movement of vehicles. Also recondition existing turf areas where minor regrading is required.

2. Provide fertilizer, seed or sod and soil amendments as specified for new turf and as required to provide a satisfactory reconditioned turf. Provide new topsoil as required to fill low spots and meet new finish grades.
3. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
4. Remove diseased and unsatisfactory turf areas; do not bury into soil. Remove topsoil containing foreign materials resulting from the Contractor's operations including oil drippings, stone, gravel and other loose building materials.
5. In areas approved by the Engineer, where substantial turf remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
6. Water newly planted areas and keep moist until new turf is established.

G. Sodding Lawns:

1. Do not lay sod on ground that is frozen, dust dry or that has not been uniformly prepared as specified.
2. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod.
3. Place sod strips in straight lines parallel to one another.
4. Immediately upon completion of a section of sodding, tamp, roll lightly and water, to ensure contact with subgrade and elimination of air pockets.
5. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.
6. Peg sod on slopes as required to prevent slippage. Use 1-inch by 1-inch by 6-inch wooden pegs with one end sharpened.
7. Water sod thoroughly with a fine spray immediately after planting. Water sufficiently to insure penetration of moisture to bottom of prepared topsoil layer not just to bottom of sod blanket.

3.4 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain turf for 60 days minimum, and longer as required to establish an acceptable stand, as determined by the Engineer.
- C. The Contractor shall supply required irrigation materials, equipment, and water.
- D. Maintain lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.
 1. Cutting Height: Mow lawns as soon as there is enough top growth to cut with mower set at the specified height for the principal species planted.

Repeat mowing as required to maintain specified height. Do not remove more than 1/3 of grass height. Do not mow when grass is wet. Time initial and subsequent mowings as required to maintain the following grass height:

- a. Mow grass at 2-1/2-inch height. Do not mow lower than 1-1/2 inches.
2. Apply fertilizer after first mowing and when the grass is dry. Use fertilizer that will provide not less than 1.0 pound of actual nitrogen per 1000 square foot of lawn area.
3. Maintain grass for at least one mowing or for specified period whichever is first.
4. After grass has started, reseed repeatedly all areas greater than 8 inches square which fail to show a uniform stand of grass for any reason whatsoever until all areas are covered with a satisfactory stand of grass, as determined by the Engineer, is achieved.

3.5 CLEANUP AND PROTECTION

- A. During landscape work, store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods.
- C. Remove all rubbish, equipment and rejected materials from the Site.
- D. Protection includes all temporary fences, barriers and signs and other work incidental to proper maintenance.

3.6 INSPECTION AND ACCEPTANCE

- A. When the Work is completed, including maintenance, the Engineer will make an inspection to determine acceptability.
- B. Where inspected Work does not comply with the requirements, replace rejected Work and continue specified maintenance until reinspected by the Engineer and found to be acceptable.

+ + END OF SECTION + +

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SECTION 02500

SURFACE RESTORATION

PART 1 – GENERAL

1.1 – DESCRIPTION

- A. This Section includes requirements for providing all labor, equipment and materials necessary for final grading, topsoil placement and miscellaneous site work not included under other Sections but required to complete the Work as shown on the Contract Drawings and specified herein.

1.2 – RELATED SPECIFICATIONS

- A. Section 02200 – Earthwork.

1.3 – PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for Item 1 – General Construction Contract, as described in Section 01150 – Measurement and Payment.

1.4 – REFERENCES – (NOT USED)

1.5 – SUBMITTALS – (NOT USED)

1.6 – QUALITY ASSURANCE – (NOT USED)

1.7 – DELIVERY, STORAGE, AND HANDLING – (NOT USED)

PART 2 – PRODUCTS

2.1 – DESCRIPTION

- A. Topsoil shall meet the requirements of Section 02200 – Earthwork.

2.2 – MANUFACTURERS – (NOT USED)

PART 3 – EXECUTION

3.1 – INSPECTION – (NOT USED)

3.2 – INSTALLATION

A. Final Grading: Following approval of rough grading, the subgrade shall be prepared as follows:

- 1) For topsoil, scarify 2-inches deep at 4-inches below finished grade.

B. Topsoil Placement:

- 1) Topsoil shall be placed over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped.
- 2) Topsoil shall be spread in place for lawn and road shoulder seed areas at a 4-inch consolidated depth and at a sufficient quantity for plant beds and backfill for shrubs and trees.
- 3) Topsoil shall not be placed in a frozen or muddy condition.
- 4) Final surface shall be hand or mechanically raked to an even finished surface to finish grade as shown on Drawings.
- 5) All stones and roots over 2-inches and rubbish and other deleterious materials shall be removed and disposed of.

3.3 – FIELD QUALITY CONTROL – (NOT USED)

++ END OF SECTION ++

SECTION 02529

CONCRETE CURBS, GUTTERS AND SIDEWALKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install concrete curbs, gutters and sidewalks.
2. Types of Work covered by these Specifications are conventionally formed or machine formed curbs, gutters and sidewalks.
3. Thickness and extent of curbs, gutters and sidewalks are shown on the Drawings.

B. Related Sections:

1. Section 02200, Earthwork.
2. Section 02576, Pavement.
3. Section 03200, Concrete Reinforcing.
4. Section 03251, Concrete Accessories.
5. Section 03300, Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. ASTM D 1190, Concrete Joint Sealer, Hot Poured Elastic type.

B. Applicator Qualifications: Minimum of two years installing curbs, gutters and sidewalks.

1.3 SUBMITTALS

A. Samples: Submit for approval the following:

1. Samples, manufacturer's product data, test reports and material certifications as required in referenced Sections for concrete work.

B. Certificates: Submit for approval the following:

1. Manufacturer's certification that sealer meets Specification requirements.

C. Shop Drawings: Submit for approval the following:

1. Copies of dimensioned layout of the Work, showing pattern, expansion joints and reinforcing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing Bars and Welded Wire Fabric: Deformed steel bars and smooth wire fabric shall comply with requirements of Section 03200, Concrete Reinforcing.
 - 1. Furnish wire fabric in flat sheets, not rolls.
- B. Concrete Materials: Comply with requirements of applicable Division 3 - Concrete Work Sections for formwork, concrete materials, admixtures, bonding materials, curing materials and others as required.
- C. Expansion Joint Material: Comply with requirements of Section 03251, Concrete Accessories, for preformed expansion joint fillers.

2.2 CONCRETE MIX, DESIGN AND TESTING

- A. Comply with requirements of applicable provisions of Section 03300, Cast-In-Place Concrete, for concrete mix designs, sampling and testing, and quality control.
- B. Design the mix to produce concrete having properties of compressive strength, slump range and air content as specified in Section 03300.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Preparation of the subgrade including compaction shall be completed for the full width of the Work:
 - 1. The Contractor and his installer shall examine the substrate and the conditions under which Work is to be performed and notify the Engineer of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
 - 2. Verify that earthwork is completed to correct line and grade.
 - 3. Do not commence Work until conditions are satisfactory, and approved by the Engineer.
 - 4. Where the subgrade is constructed by excavation of existing grade, the top 6-inches of the subgrade shall be compacted to at least 90 percent of maximum density at optimum moisture content.
 - 5. Where the subgrade is constructed on fill:
 - a. The existing grade shall be made smooth and compacted per Section 3.1.A.
 - b. The subgrade shall be brought to the final lines and grades utilizing select fill as specified in Section 02200, Earthwork. The compaction requirements of Section 02200 apply.
 - 6. Base: Base shall be provided as shown on the Drawings. The material shall be select fill as specified in Section 02200, Earthwork, and compacted as specified.

3.2 FORM CONSTRUCTION

- A. Set forms to line and grade. Install forms over full length of curbs, gutters and sidewalks.

3.3 REINFORCEMENT

- A. Locate, place, and support reinforcement as specified in Section 03200, unless otherwise shown. Size of reinforcement shall be as shown.

3.4 CONCRETE PLACEMENT

- A. General: Comply with the requirements of Section 03300 for mixing and placing concrete, and as specified.
- B. Place concrete for curbs and gutters using methods which prevent segregation of the mix. Consolidate concrete along the face of forms with an internal vibrator.
- C. Machine Formed: Automatic curb, gutter and sidewalk machine may be used for forming, at the Contractor's option. Concrete shall have properties as specified in Section 03300, except that maximum slump shall be 2-1/2 inches and air content

shall be 2 percent of design. Machine forming shall produce curbs, gutters and sidewalks to the required cross-section, lines, grades, finish, and jointing, as specified for conventionally formed concrete. If results are not acceptable, remove and replace at the Contractor's expense.

3.5 JOINTS

- A. General: Construct expansion, contraction, and construction joints with faces perpendicular to surface of the curb, gutter and sidewalk. Construct transverse joints at right angles to the Work centerline and as shown.
- B. Contraction Joints: Provide these joints at 10 feet on centers for curbs and gutters and 5 feet on centers for sidewalks.
- C. Construction Joints: Place joints at locations where placement operations are stopped for a period of more than 1/2-hour, except where such pours terminate at expansion joints.
- D. Expansion Joints: Provide 1/2-inch expansion joint filler where Work abuts structures; at returns; and at 30 foot spacing for straight runs. If curb, gutter, and sidewalk are not poured monolithically, provide expansion joints where each abuts the other.
 - 1. Place top of expansion joint material not less than 1/2 inch or more than 1 inch below concrete surface. Apply joint sealer on top of expansion joint material flush with concrete surface, and in accordance with manufacturer's instructions.

3.6 CONCRETE FINISHING

- A. Smooth the exposed surface by screeding and floating.
- B. Work edges of gutter and sidewalks, back top edge of curb, and transverse joints; and round to 1/4-inch radius.
- C. Complete surface finishing by drawing a fine-hair broom across surface, perpendicular to line of traffic.

3.7 CURING

- A. Protect and cure finished concrete curbs, gutters and sidewalks, complying with applicable requirements of Section 03300.

3.8 REPAIR AND CLEANING

- A. Repair or replace broken or defective curbs, gutters and sidewalk as directed by the Engineer.

B. Sweep Work and wash free of stains, discolorations, dirt or other foreign material.

+ + END OF SECTION + +

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SECTION 02576

PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install hot mix-hot laid bituminous paving. In addition, any existing pavement damaged by the Contractor outside the removal limits shown on the Drawings shall be removed and replaced, as directed by the Engineer.
2. The Work includes permanent and temporary pavements comprised of one or more of the following:
 - a. Aggregate base course.
 - b. Tack coats.
 - c. Binder course.
 - d. Top course.
 - e. Pavement marking.
3. Temporary pavement shall be placed as necessary.
4. In order to prevent damage to the permanent pavement by the Contractor's operations, all permanent pavement materials, including the aggregate base course, shall not be installed until approved in writing by the Engineer. The finished course of paving shall not be installed until all buildings, structures, equipment, piping and outside facilities are substantially completed and at a time approved by the Engineer.

B. Related Sections:

1. Section 02050, Demolition, Removals and Modifications.
2. Section 02200, Earthwork.
3. Section 02529, Concrete Curbs, Gutters and Sidewalks.

1.2 QUALITY ASSURANCE

A. Plant Inspection: All bituminous mixes will be subject to inspection, testing and approval by the Owner. The Contractor and plant personnel shall furnish all necessary assistance and cooperation.

B. Laboratory Approval: Laboratory approval of the sources of supply of the fine aggregates, coarse aggregates, mineral filler, bituminous materials, liquefiers and any other materials used in the mix shall be obtained and submitted by the Contractor. No delivery or mixed materials shall be made from any bituminous mixing plant until the source of supply are approved.

C. Testing Services:

1. General: Testing of materials and of compaction requirements for compliance with technical requirements of the Specifications shall be the duty of the testing laboratory provided by the Owner.
2. Testing Services: The testing laboratory will:
 - a. Test the Contractor's proposed materials in the laboratory and field for compliance with the Specifications.
 - b. Perform field density tests to assure that the specified compaction of surface and base course materials has been obtained.
 - c. Report all test results to the Engineer and the Contractor.
3. Authority and Duties of Testing Laboratory: Technicians representing the testing laboratory will inspect the materials in the field and perform compaction tests, and will report their findings to the Engineer and the Contractor. When the materials furnished or work performed by the Contractor fails to fulfill Specifications requirements, the technician will direct the attention of the Engineer and the Contractor to such failure.
 - a. The technician will not act as foreman or perform other duties for the Contractor. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor will it obligate the Engineer for final acceptance. Technicians are not authorized to revoke alter, relax, enlarge, or release any requirements of the Specifications, nor to approve or accept any portion of the Work.
4. Responsibilities and Duties of the Contractor: The use of testing services shall in no way relieve the Contractor of his responsibility to furnish materials and construction in full compliance with the Drawings and Specifications. To facilitate testing services, the Contractor shall:
 - a. Secure and deliver to the Engineer and the testing laboratory representative samples of the materials he proposes to use and which are required to be tested.
 - b. Furnish such casual labor as is necessary to obtain and handle samples at the project or at other sources of material.
 - c. Advise the testing laboratory and the Engineer sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.

D. Reference Standards: Comply with the applicable provisions and recommendations of the following, unless otherwise shown or specified.

1. Standard Specifications and Drawings (including addenda) of the County of Nassau Department of Public Works for Construction of Highway and Bridges, herein referred to as the County Standard Specification.
 - a. Bituminous concrete shall conform to the County Standard Specification, Part Three, Section B.

1.3 SUBMITTALS

- A. Samples: Submit for approval the following:
 - 1. At least two weeks prior to the date of anticipated use, the Contractor shall submit to the Owner for approval, a representative sample of materials for the following:
 - a. Aggregate base course.
 - b. Binder course.
 - c. Top course.
 - d. Other materials as requested by the Engineer.
 - 2. The Contractor shall notify the Owner in writing of the location and source of each sample.
- B. Shop Drawings: Submit for approval the following:
 - 1. Job mix formula proposed, giving complete data on materials, including source, location, percentages, temperatures, date of last testing, and all other pertinent data.

1.4 JOB CONDITIONS

- A. Weather Limitations:
 - 1. Permanent paving materials, including the aggregate base course, shall be placed only when the air temperature is 40 degrees Fahrenheit and rising or warmer and the surface on which the paving is to be laid is 40 degrees Fahrenheit or higher. All temperatures are to be measured in the shade.
 - 2. Bituminous pavement for temporary uses, that are not and will not become part of a permanent pavement, will not be subject to the above regulations in regard to weather limitations. No pavement, however, shall be laid on a frozen subgrade.
- B. Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope for each course during construction operations.

PART 2 – PRODUCTS

2.1 PAVEMENT THICKNESS

- A. In-place compacted material thickness shall not be less than shown on the Drawings.

2.2 MATERIALS

- A. Materials shall conform to the following:
 - 1. Subgrade shall be virgin material or select fill conforming to the requirements of Section 02200, Earthwork.

2. Base Courses:

- a. Aggregate for permanent pavement base course shall consist of crushed stone conforming to the requirements of the County Standard Specification and the following gradation:

<u>Screen Size</u>	<u>% Passing</u>
1-1/2-in	100
1-in	90-100
1/2-in	65-85
3/8-in	55-75
#4	40-55
#8	30-45
#16	22-36
#30	16-27
#50	12-19
#100	7-13
#200	3-8

- b. Aggregate for temporary access road base course shall consist of limestone screenings. Stone screenings shall be limestone and may be crusher run provided 100 percent passes a 1/2-inch screen, 15 percent to 35 percent passes a #20 screen and 5 percent passes a #200 screen. Screenings need not be washed provided they contain no clay, loam or other deleterious material. Screenings shall be from stone that passes the abrasion and soundness tests described under the County Standard Material Specification M4 Coarse Aggregate.

3. Pavement:

- a. Permanent: Provide a two course wearing surface for permanent pavement, consisting of a binder course and a top course. Binder course shall conform to the County Standard for Bituminous Concrete Binder Course. Top course shall conform to the County Standard for Bituminous Concrete Type 1A (Flat Process) Top Courses.
- b. Temporary: Provide a one course-wearing surface for temporary pavement, consisting of a top course as specified above.
4. Tack Coat: Tack coat shall be an asphalt emulsion conforming to the County Standard Material Specification M5 Bituminous Materials, Material Designation RS-1.
5. Pavement Markings: Pavement markings shall be installed at locations shown on the Drawings. Pavement markings shall be white, thermoplastic reflectorized type conforming to Section 727-01 of the New York State Department of Transportation, Design and Construction Division, Standard Specifications, Construction and Materials, latest revision.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation of all pavement materials and pavement markings shall be performed by experienced personnel.
- B. Preparing the mixtures, paving equipment, placing the mixes, and compacting the mixes shall be in accordance with the County Standard Specification.
 - 1. Preparing the mixtures includes the plant equipment, stockpiling, heating, aggregate processing, mixing of aggregate and bituminous material, and transportation to job site.
 - 2. Paving equipment includes bituminous pavers, rolling equipment and hand tools.
 - 3. Placing the mixes includes paver-placing, hand placing, spreading, tamping and jointing.
 - 4. Compacting the mixes includes breakdown rolling, second rolling and finish rolling.
- C. Regardless of the type of temporary or permanent restoration involved, the Contractor shall insure that all castings are set flush with the road surface. The Contractor is advised that there shall be no placement of bituminous concrete top course until:
 - 1. Curbs, gutter aprons, driveway aprons, surface inlets, catch basins, and manholes have been constructed to their final elevation.
 - 2. Defective areas of the binder course have been repaired.
- D. Provide final surfaces of uniform texture, conforming to required grades and cross sections.
- E. Repair holes from test specimens as specified for patching defective work.
- F. The Contractor shall provide all labor, equipment and materials required to provide a drainage system for temporary access roads to facilities under construction.

3.2 SUBGRADE PREPARATION

- A. Permanent Pavement: Preparation of the permanent pavement subgrade including compaction shall be completed for the full width of the roadway.
 - 1. Fine grade earth subgrade and compact with self-powered rollers of sufficient size to provide a firm, unyielding surface to receive the aggregate base course. Remove and replace all unsuitable subgrade material as directed by the Engineer.
 - 2. Where the subgrade is constructed by excavation of the existing grade, the top 6-inches of the subgrade shall be compacted to at least 95 percent of

maximum density at optimum moisture content as determined in ASTM D 698.

3. When the subgrade is constructed on fill:
 - a. Existing grade shall be made smooth and compacted per Section 3.2.A.2.
 - b. Subgrade shall be brought to the appropriate lines and grades utilizing select backfill placed in accordance with the applicable requirements of Section 02200, Earthwork.
4. Existing grades prior to placement of subbase or backfill shall be established such that when materials for construction are placed no rutting or displacement will occur.

B. Temporary Pavement: Subgrade shall be compacted with a ten-ton roller or other approved method.

C. No materials, temporary or permanent, shall be placed on subgrades which are muddy or have water thereon.

3.3 PERMANENT PAVEMENT BASE COURSE INSTALLATION

- A. Construct base course to thickness shown on Drawings in equal layers not more than three inches (compacted) thick. If subgrade material is worked into the base material during compaction or finishing operations, remove the aggregate over this area and replace with new aggregate.
- B. Compact each layer with a power driven roller weighing not less than ten tons in an approved manner with the aid of water. Before mixing and spreading the base material, the moisture content shall be both sufficient to prevent segregation into pockets of fine and coarse material, and to permit satisfactory compaction. Add water as required.
- C. After compaction, the top surface of this course shall not extend above, nor more than 1/2-inch below true grade and surface at any location. Depressions shall be filled with additional aggregate material and the surface rerolled. Base course shall be maintained by the Contractor within the 1/2-inch tolerance until the pavement course is installed.

3.4 LIMESTONE SCREENINGS INSTALLATION

- A. Construct limestone screenings course to not less than 4-inch thickness.
- B. Screenings shall be spread evenly and thoroughly rolled with an approved three-wheel roller, weighing not less than 10 tons, until thorough consolidation is obtained. Depressions shall be filled with screenings, and the process of rolling and filling shall continue until a thoroughly compacted uniform surface, satisfactory to the Engineer, is produced. No segregation of large or fine materials will be permitted, but the screenings shall be sprinkled with water at times and in the amounts necessary to provide consolidation.

3.5 PAVEMENT INSTALLATION

- A. Contact surfaces of all curbs, gutters, castings and adjacent pavement edges shall be painted with a layer of tack coat before placing or repairing the pavement course.
- B. Bituminous concrete shall be constructed to thicknesses as shown on the Drawings and rolled with 12 ton self powered two axle or three-axle tandem or three-wheel roller to a density of 94 percent of maximum.
- C. Pavement shall be uniform in appearance, free of bumps and hollows, worked to drain, and free of bleeding.
- D. Trim the existing pavement with pneumatic chisels of all loose edges and broom and tack coat all edges prior to placing the transition pavement.
- E. In placing and compacting abutting courses of bituminous concrete pavements, joint heating devices shall be used on all joints (transverse, longitudinal and existing). See the County Standard Specification for additional information.
- F. Bituminous pavement shall match in thickness the existing pavement and shall butt with the pavement in a smooth, even transition.
- G. Test bituminous pavement for conformity with the specified crown and grade immediately after initial compression. Correct variations by the removal or additional of materials and by continuous rolling.
- H. The finished surface shall not vary more than 1/4-inch when tested with a 16-ft straightedge applied parallel with, or at right angles to, the centerline.
- I. After final rolling, again test the smoothness of the course. Correct humps or depressions exceeding the specified tolerances or that retain water on the surface by removing the defective work and replacing with new material.

3.6 TEMPORARY PAVEMENT OVER TRENCHES

- A. Bituminous concrete plant mix to be utilized for temporary pavement over trenches, as required, shall conform to the requirements for the top course Type 1A plant mix conforming to the Referenced Specifications.
- B. Trenches for utility work within existing paved areas shall receive temporary pavement. Temporary pavement shall be furnished, installed and maintained by Contractor. The Owner shall determine the limits of temporary pavement to be installed over these trenches.

- C. After the trench has been properly backfilled, excavation shall be made over the trench area and the sub-grade compacted by rolling with a ten ton roller or other approved methods, so as to permit the placing of a one and one-half inch (1-1/2") compacted thickness of bituminous concrete. The sub-grade shall not be in a muddy or frozen condition and shall be smooth and parallel to the desired surface of the finished pavement. Compaction of this 1-1/2" minimum thickness bituminous concrete shall be as specified herein.

3.7 PATCHING

- A. Remove and replace all defective areas in temporary and permanent pavements. Cutout such areas and fill with fresh Type 1A bituminous concrete top course as specified in the County Standard Specification. Compact to the required density.

3.8 CLEANING AND PROTECTION

- A. After completion of paving operations, clean surfaces of excess or spilled bituminous materials and all foreign matter.
- B. Protect newly finished pavement until it has become properly hardened by cooling.
- C. During the paving operation cover openings of drainage structures in the area of paving.

3.9 MAINTENANCE AND ACCEPTANCE

- A. The Contractor shall maintain all paved surfaces until the roads and parking areas have been accepted. Paved areas will not be accepted until after the Contractor has completed all phases of the work, including all necessary transportation, hauling and severe usage of the paved areas. The Engineer shall be the sole judge in this matter.

+ + END OF SECTION + +

SECTION 03100

CONCRETE FORMING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete forming. The Work also includes:
 - a. Designing forming systems in accordance with requirements of ACI 347, ACI 301, and ACI 350.5 and the Contract Documents.
 - b. Providing forming to accommodate the Work under this and other Sections and building into forming items such as sleeves, anchorage devices, inserts, pipe embedments, reinforcing, and all other items to be embedded in concrete for which placement is not specifically provided under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before concrete forming Work.
2. Coordinate forming Specifications with requirements for finished surfaces specified in Section 03300, Cast-In-Place Concrete.

C. Related Sections:

1. Section 03251, Concrete Accessories.
2. Section 03300, Cast-In-Place Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary.
2. ACI 301, Specifications for Structural Concrete.
3. ACI 347, Guide to Formwork for Concrete.
4. ACI 350.5, Specifications for Environmental Concrete Structures
5. ASTM C805/C805M, Test Method for Rebound Number of Hardened Concrete.
6. ASTM C1074, Practice for Estimating Concrete Strength by the Maturity Method.
7. NIST PS 1, Structural Plywood.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Professional Engineer:

- a. CONTRACTOR or formwork Supplier shall retain a registered professional engineer legally qualified to practice in same state as the Site. Professional engineer shall have at least five years experience designing formwork and falsework of the type required.
- b. Responsibilities include:
 - 1) Reviewing formwork and falsework performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.
 - 3) Preparing or supervising preparation of design calculations verifying compliance of formwork and falsework with requirements of the Contract Documents.
 - 4) Signing and sealing all calculations.
 - 5) Certifying that:
 - a) Design of formwork and falsework was performed in accordance with performance and design criteria stated in the Contract Documents, and
 - b) Design conforms to all Laws and Regulations, and to prevailing standards of practice.
 - c) In place falsework, prior to concrete placement, complies with the intent of the forming design and complies with the Contract Documents.

- B. Mock-Ups for Concrete Finishes: Provide forming for mock-ups as required for finish work shown and specified for the Work. Place embedded materials in mock-up. Construct forms using facing materials such as form liners, where required, to provide specified finishes and to the requirements specified in Section 03 30 00, Cast-In-Place Concrete. Obtain ENGINEER'S acceptance of each mock-up prior to starting forming for the Work. Do not remove mock-up(s) until directed by ENGINEER.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Samples:

- a. Plywood form material used for smooth form finish, four inches square minimum.
- b. Form liner section sufficiently large to show two full repeating patterns, at least 12 inches square.
- c. Controlled permeability forming liner material, eight inches square, minimum.
- d. Form Liner Sample Panel:

- 1) Sample shall show texture and surface pattern, required backing, form tie treatment, and treatment at liner panel joints. Use form material to be used in the Work.
- 2) Minimum Size: Three feet by four feet.

B. Informational Submittals: Submit the following:

1. Shop Drawings: When requested by ENGINEER, submit Shop Drawings showing and indicating general construction of individual forms, including:
 - a. Jointing.
 - b. Special formed joints or reveals.
 - c. Location, pattern, and details of form tie placement, removal, and repair procedures.
 - d. Location and details for temporary openings.
 - e. Void-form layout drawings and details of installation.
 - f. Other items that would visually affect the finished concrete.
2. Design of Temporary Measures: Design of formwork and falsework is CONTRACTOR's responsibility. Submit the following:
 - a. Falsework layout drawings with the seal and signature of CONTRACTOR's or Supplier's professional engineer. Layout drawings shall show bracing details, waler arrangements, location of shores, joint forming details, and details at connections to previously placed concrete. ENGINEER's review will be for general conformance to the requirements of the Contract Documents and ACI 347, ACI 301 and ACI 350.5, as indicated for delegated design in the General Conditions.
 - b. Design calculations for formwork and falsework, when requested by ENGINEER.
 - c. Certification letter from CONTRACTOR's or Supplier's professional engineer stating that in-place falsework was inspected and complies with the intent of the falsework design.
3. Product Data: Manufacturer's data for proprietary materials, including form coatings, manufactured form systems, ties and accessories.
4. Manufacturer's Instructions: Installation instructions for proprietary materials, including form coatings, manufactured form systems, ties and accessories.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage:

1. Upon delivery to the Site, place materials in area protected from weather.
2. Store materials in accordance with manufacturer's recommendations.
3. Store materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.

B. Handle materials in accordance with the manufacturers' recommendations. Do not damage materials during handling.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:

1. Design, erect, support, brace and maintain forming in accordance with ACI 347, ACI 301 and ACI 350.5 so that forming safely supports vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by forming system or in-place construction that has attained adequate strength for the purpose. Construct forming so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
2. Design forms and falsework to include values of live load, dead load, weight of moving equipment operated on forming, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
3. Provide shores and struts with positive means of adjustment capable of taking up forming settlement during concrete placing operations, using wedges or jacks, or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.
4. Support form facing materials by structural members spaced sufficiently close to prevent beyond tolerance deflection, in accordance with ACI 117. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. For long-span members without intermediate supports, provide camber in forming as required for anticipated deflections resulting from weight and pressure of fresh concrete and construction loads.
5. Design and construct forming to be readily removable without impact, shock or damage to concrete surfaces and adjacent materials.
6. Provide forming sufficiently tight to prevent leakage of cement paste during concrete placing. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

2.2 FORM MATERIALS

A. Forms for Smooth Finish Concrete:

1. Unless otherwise shown or indicated in the Contract Documents, construct forming for smooth concrete surfaces with plywood, metal, metal-framed plywood-faced, or other panel type materials acceptable to ENGINEER. Forming shall provide continuous, straight, smooth as-cast surfaces with no wood grain or other surface texture imparted by forming. Provide in largest practical sizes to minimize number of joints and to conform to joint system shown or specified in the Contract Documents. Provide form material with

sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

B. Forms for Standard Finish Concrete:

1. Form concrete surfaces designated to have standard formed finish with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least two edges and one side.

C. Forms for Architecturally Finished Concrete:

1. Form finish concrete surfaces with units of face design, size, arrangement, and configuration as shown or as required to comply with approved Project job mock-up. Provide solid backing and form supports to ensure stability of form liners.
2. Form Material: Overlaid plywood in accordance with NIST PS 1. Provide B-B high density overlaid concrete form, Class I.
3. Form Liners: Rigid PVC or fiberglass in pattern shown or indicated.
4. Form Reuse: To be determined by ENGINEER at time of installation.
5. Rustication Joints: Rigid PVC in profile shown or indicated.
6. Panel Joints: Conceal joints behind rustication joints, unless approved by ENGINEER in writing.

D. Form Ties:

1. Provide factory-fabricated metal form ties, designed to prevent form deflection, and to prevent spalling of concrete surfaces upon removal.
2. Unless otherwise shown or indicated in the Contract Documents, provide ties so that portion of tie remaining within concrete after removal of exterior parts of tie is at least 1.5 inches from the outer concrete surface. Unless otherwise shown or indicated in the Contract Documents, provide form ties that will leave a hole no larger than one-inch diameter in concrete surface.
3. Ties shall have waterstops on all exterior, below-grade walls, and walls subject to hydrostatic pressure.
4. Ties shall leave a uniform, circular hole when forms are removed.
5. Do not use removable ties unless accepted by ENGINEER. Removable ties are not allowed on exterior below-grade walls or walls subject to hydrostatic pressure. If removable ties are accepted, CONTRACTOR shall submit hole repair details for ENGINEER approval.
6. Wire ties are not allowed.
7. Do not use reinforcing bars shown by the Drawings as part of the form tie system unless approved by ENGINEER.
8. Provide stainless steel form ties for areas with architectural finish. When used, tiebreak back point shall be at least one inch from outer concrete surface.

E. Form Coatings:

1. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor

impede wetting of surfaces to be cured with water or curing compounds. For concrete surfaces that will be in contact with potable water or water that will be treated to become potable, form coating shall be a mineral oil base coating.

F. Void-Forms:

1. Void (carton) forms shall be corrugated fiberboard used for creating a void space beneath grade beams and slabs on grade.
2. Manufacturer: Provide void-forms by one of the following:
 - a. Savway Carton Forms
 - c. SureVoid Products
 - d. Or equal
3. Void-forms shall have moisture-resistant treated paper faces, be laminated with waterproof adhesive, and be biodegradable. Void-forms shall have interior fabrication of uniform braced cellular configuration and shall be capable of sustaining minimum working load of 1,000 psf for minimum of ten days after concrete placement.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine substrate and conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORM CONSTRUCTION

- A. Construct forms in accordance with ACI 347, ACI 301 and ACI 350.5; to the exact sizes, shapes, lines, and dimensions shown; as required to obtain accurate alignment, location, and grades; to tolerances specified; and to obtain level and plumb work in finish structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes. Finish shall be in accordance with approved mock-up or sample panel, when specified.
- B. Allowable Tolerances:
1. Construct forming to provide completed concrete surfaces complying with tolerances specified in ACI 117, ACI 301, and ACI 347.
 - a. Architectural finish forming, and where shown or indicated on the Drawings, shall be Class A surface, 1/8-inch offset.
 - b. Other surfaces exposed to view shall be Class B surface, 1/4-inch offset. Exposed to view shall include surfaces of liquid containing structures when liquid and media, if present, are removed.
 - c. Other surfaces shall be Class C surface, 1/2-inch offset.

2. Tolerances apply to form offsets and to irregularities within the formed surface when measured with a straightedge over a five-foot distance.
- C. Install forming and accessories for facilities in accordance with manufacturer's instructions, Laws and Regulations, and the Contract Documents.
- D. Fabricate forms for easy removal without damaging concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.
- E. Provide temporary openings where interior area of forming is inaccessible for cleanout, for inspection before concrete placement, and for placing concrete. Brace temporary closures and set tightly to forms to prevent loss of cement paste. Locate temporary openings on forms in locations as inconspicuous as possible, consistent with requirements of the Work. Form intersecting planes of openings to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.
- F. Falsework:
1. Erect falsework and support, brace, and maintain falsework to safely support vertical, lateral, and asymmetrical loads applied until such loads can be supported by in-place concrete structures. Construct falsework so that adjustments can be made for take-up and settlement.
 2. Provide wedges, jacks or camber strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce finished Work of required dimensions.
- G. Forms for Smooth Finish Concrete:
1. Do not use metal cover plates for patching holes or defects in forms.
 2. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
 3. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material that will produce bow.
 4. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
 5. Form molding shapes, recesses, rustication joints and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.
- H. Corner Treatment:

1. Form exposed corners of beams, walls, foundations, bases and columns to produce smooth, solid, unbroken lines, except as otherwise shown or indicated in the Contract Documents. Chamfer exposed corners.
 2. Form chamfers with 3/4-inch by 3/4-inch strips, unless otherwise shown or indicated in the Contract Documents, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. Use rigid PVC chamfers for architecturally formed concrete. Extend terminal edges to required limit and miter chamfer strips at changes in direction.
 3. Reentrant or internal and unexposed corners may be formed either square or chamfered.
- I. Joints:
1. For joint treatment, comply with Section 03251, Concrete Accessories. Locate joints as shown and specified.
- J. Openings and Built-In Work:
1. Provide openings in concrete forming shown or required under other Sections. Refer to Paragraph 1.1.B of this Section for coordination requirements.
 2. Accurately place and securely support items to be built into forms.
- K. Sealing Forming:
1. Forming joints shall be tight-fitting or otherwise sealed to prevent loss of cement paste.
 2. Provide forming resting against concrete surfaces with compressible gasket material between the concrete and edge of form, to fill irregularities and create tight seal.
- L. Cleaning and Tightening:
1. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before concrete is placed. Retighten forms immediately after placing concrete, as required to eliminate cement paste leaks.
- M. Tie Hole Repair:
1. Repair tie holes in accordance with Section 03 30 00, Cast-In-Place Concrete.

3.3 FORM COATINGS

- A. Coat form contact surfaces with non-staining form-coating compound before installing reinforcing materials. Do not allow excess form coating material to accumulate in forms or come into contact with surfaces that will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.
- B. Coat steel forms with non-staining, rust-preventative form oil, or otherwise protect against rusting. Do not use rust-stained steel forming.

- C. For concrete surfaces that will be in contact with potable water or water that will be treated to become potable, form coating shall be mineral-oil base coating.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into forming anchorage devices and other embedded items, shown, specified, or required under other Sections. Refer to Paragraph 1.1.B of this Section for coordination requirements. Use necessary setting drawings, diagrams, instructions, and directions.
- B. Edge Forms and Screeds Strips for Slabs:
 - 1. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units to support screeds.

3.5 VOID-FORMS

- A. Install void-forms where shown or indicated in the Contract Documents, to the thickness indicated, in accordance with manufacturer's recommendations.
- B. Where void-form is shown or indicated in the Contract Documents, place void-form to grades and elevations shown over an even, well-compacted subgrade to form continuous void space under entire extent of slab, mat, or grade beam.
- C. For structural slab applications, place 1/8-inch thick masonite or plywood sheet over void-form. Place void-forms in largest pieces practical and secure in place.
- D. Properly surround and void around upper portion of drilled piers at intersection of slab, grade beam or pier cap using premanufactured, non-field cut sealed void-form with curved, radial, vertical edge adjacent to drilled pier.
- E. Void-forms shall remain dry and undamaged prior to concrete placement. Replace damaged pieces prior to placing concrete. Seal all joints and exposed ends to prevent concrete leakage into void space.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Before placing concrete, check ties, tie cones, tie waterstops, embedded items, form coatings, forming stability, alignment, and tolerances. Make corrections and adjustments to ensure forming complies with intent of the forming design, proper stability of forming systems, and accurate size and location of concrete members.
 - 2. During concrete placing, check forming and related supports to ensure that forms are not displaced and that completed Work will be within specified tolerances.

3. If forms are unsatisfactory in any way, either before or during concrete placing, stop or postpone placing of concrete until defects are corrected as required by CONTRACTOR's or Supplier's professional engineer and accepted by ENGINEER.

3.7 REMOVAL OF FORMS

- A. Determination of time between placing concrete and removing forms is CONTRACTOR's responsibility. Requirements specified in this Section are minimum times and requirements intended to ensure that concrete will support its own weight, and do not consider additional effects of the construction. Additional effects of the construction shall be accounted for by CONTRACTOR when determining time for removing forming. Time for removing of forms is subject to ENGINEER's acceptance.
- B. Comply with requirements of ACI 301 and ACI 347, and ACI 350.5, except as indicated in the Contract Documents.
- C. Removal of Forms for Walls, Columns, Sides of Beams and Girders, and Slab and Foundation Edges:
 1. Comply with requirements of Table 03 10 00-A of this Section:

TABLE 03 10 00-A, REMOVAL OF FORMS

Component	Average Daily Ambient Air Temperature (deg F)				Min. Concrete Compressive Strength for Form Removal
	Over 70 F	60 F to 70 F	50 F to 60 F	Below 50 F	
Walls	One day	Two days	Three days	See Paragraph 3.8.C.2 of this Section	750 psi
Columns	Two days	Three days	Four days		1000 psi
Side of beams and girders	One day	One day	Two days		500 psi
Slab and foundation edges	One day	One day	Two days		500 psi

2. When average daily ambient air temperature is below 50 degrees F, do not remove forms until concrete attains minimum compressive strength indicated in Table 03 10 00-A for form removal, and comply with Paragraph 3.8.C.3.b of this Section.
3. Concrete Strength Requirements for Form Removal:
 - a. For other than beams and elevated slabs, do not remove forms until concrete attains minimum concrete compressive strength indicated in Table 03 10 00-A for form removal.
 - b. For beams and elevated slabs, do not remove supporting forms or shoring until concrete attains minimum of 90 percent of its specified compressive strength.

- D. Alternative Criteria for Removing Forms for Walls, Columns, Sides of Beams and Girders, and Slab and Foundation Edges: CONTRACTOR has the option of

submitting an alternative removal of forms table, together with supporting data, for ENGINEER's acceptance. Supporting data shall include representative field data for each different placement ambient temperature condition and minimum of three tests per temperature condition to ensure that accurate correlation between concrete strength and placement temperature is obtained.

- E. Determination of In-place Concrete Strength:
 - 1. Determine compressive strength of in-place concrete by compression test specimens cured at the Site under the same conditions of temperature and moisture as the concrete member under consideration.
 - 2. Alternately, determine compressive strength of in-place concrete by maturity factor procedure in accordance with ASTM C1074 and approved by ENGINEER. Location of embedded thermistors or thermocouples shall be as approved by ENGINEER.
- F. When high-early strength concrete is used, time for removing the forms will be developed at the Site from the age/strength relationships established for the materials and proportions used by tests in accordance with ACI 301.
- G. Leave form facing material in place for minimum of four days after concrete placement, unless otherwise approved by ENGINEER.
- H. Continue curing, including bottom surfaces of slabs and beams, after form removal in accordance with Section 03 30 00, Cast-In-Place Concrete.

3.8 PERMANENT SHORES

- A. Provide permanent shores in accordance with ACI 347.
- B. Reshores are not allowed.

3.9 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in the construction. Do not use split, frayed, delaminated, or otherwise damaged form facing material. Apply form coating compound material to concrete contact surfaces as specified for forming.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces. Form surfaces are subject to ENGINEER's approval.

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SECTION 03200

CONCRETE REINFORCING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete reinforcing.
2. Extent of concrete reinforcing is shown and indicated in the Contract Documents.
3. Work includes fabrication and placement of reinforcing including bars, ties, and supports, and welded wire fabric for concrete, encasements, and fireproofing.

B. Related Sections:

1. Section 03251, Concrete Accessories.
2. Section 04201, Unit Masonry Construction.
3. Section 05051, Anchor Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 301, Specifications for Structural Concrete.
2. ACI 315, Details and Detailing of Concrete Reinforcement.
3. ACI 318, Building Code Requirements for Structural Concrete.
4. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
5. ACI 350.5, Specifications for Environmental Concrete Structures.
6. ANSI/AWS D1.4, Structural Welding Code - Reinforcing Steel.
7. ASTM A82, Specification for Steel Wire, Plain, for Concrete Reinforcement.
8. ASTM A185, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
9. ASTM A615, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
10. ASTM A706, Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
11. ASTM A767, Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
12. ASTM A775, Specification for Epoxy-Coated Steel Reinforcing Bars.
13. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.

14. Concrete Reinforcing Steel Institute (CRSI), CRSI 1MSP, Manual of Standard Practice.
15. ICC Evaluation Service (ES) AC 308, Acceptance Criteria for Post-Installed Anchors in Concrete Elements.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall meet requirements of ASTM E329 and shall have experience in the testing welded splices of reinforcing steel and tension testing of reinforcing bars set in adhesive in hardened concrete.
2. Installer of Adhesive Dowels: Shall be experienced and certified by manufacturer of adhesive as possessing necessary training for installing manufacturer's products. Distributors or manufacturer's representatives shall not provide product training unless qualified as certified trainers by anchor manufacturer.

B. Certifications:

1. Weld Procedures: For types of splices and grades of reinforcing used in the Work, weld procedures for welded reinforcing steel splices shall be certified in accordance with ANSI/AWS D1.4.
2. Welders: For types of splices and grades of reinforcing used in the Work, welders shall be certified for welding reinforcing steel splices in accordance with ANSI/AWS D1.4.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI 315, Parts A and B, ACI 301 and ACI 350.5.
 - b. For walls, show elevations at minimum scale of 1/4-inch to one foot.
 - 1) Elevations shall show all openings and reference details that identify additional reinforcing required around each opening.
 - 2) Elevations shall denote each wall intersection and reference a detail that identifies additional reinforcing required at wall intersection. As an alternate to providing separate details for each wall intersection, provide overall plan detailing only the additional wall intersection reinforcing for each wall intersection.
 - c. For slabs and mats, show top and bottom reinforcing on separate plan views.
 - 1) Plans shall show all openings and shall reference details that identify additional reinforcing around each opening.
 - d. Show bar schedules, stirrup spacing, diagrams of bent bars, location of bar splices, length of lap splices, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing unless otherwise noted.

- e. Provide plans and elevations detailing location, spacing, and lengths of masonry wall dowels, where masonry is required. Coordinate location of dowels with masonry openings and with standard modular spacing. Submit masonry wall dowels with reinforcing submittal for element into which masonry dowel will be embedded. Coordinate with Section 04201, Unit Masonry Construction.
 - f. Splices shall be kept to a minimum. For slabs and beams, when splices are required, locate splices in bottom bars within 1/3 span from supports and for top bars locate splices in the middle 1/3 of the span.
 - g. Drawings detailing location of all construction and expansion joints, as required under Section 03251, Concrete Accessories, shall be submitted and approved before Shop Drawings for reinforcing are submitted.
 - h. Drawings detailing location, spacing, edge distance, and embedment depth of adhesive dowels. Adhesive system shall be submitted and approved before Shop Drawings with adhesive dowels are submitted.
2. Product Data:
- a. Manufacturer's product data for adhesive, if not submitted under other Sections.
 - b. Adhesive manufacturer's test data and ICC ES report to verify specified capacity of adhesive dowels.
- B. Informational Submittals: Submit the following:
- 1. Certificates:
 - a. Steel manufacturer's certificates of mill analysis, tensile, and bend tests for reinforcing steel.
 - b. Certification of welders and weld procedures for splices.
 - c. Adhesive manufacturer's certification verifying that installer is qualified and using proper installation procedures.
 - 2. Manufacturer's Instructions:
 - a. Installation instructions for adhesive systems.
 - 3. Field Quality Control Submittals:
 - a. Reports of all field quality control testing, where applicable.
 - b. Results of required inspection of welded splices of reinforcing bars.
 - c. Results of required tensile testing of adhesive dowels. Include size and location of bars tested.
 - 4. Special Procedure Submittals; Description of reinforcing weld locations and weld procedures.

1.5 DELIVERY, HANDLING, AND STORAGE

- A. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
- B. Store concrete reinforcing products to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Reinforcing Bars: Shall be deformed in accordance with ASTM A615, and as follows:
 - 1. Provide Grade 60 for all bars, unless indicated otherwise.
 - 2. At beams and columns forming frames and wall boundary elements, where shown on the Drawings, provide ASTM A706 or ASTM A615, Grade 60, with tested actual maximum yield stress of 78,000 psi and ratio of actual tested tensile strength to tested yield strength not less than 1.25.
 - 3. Epoxy-coated reinforcing bars shall be in accordance with ASTM A775.
 - 4. Galvanized reinforcing bars shall be in accordance with ASTM A767, ACI 318, and ACI 350.
- B. Mechanical Couplers: Reinforcement bars may be spliced with mechanical connection. Connection shall be full mechanical connection that shall develop in tension or compression, as required, at least 125 percent of specified yield strength (fy) of bar in accordance with ACI 318 and ACI 350. Where splices at the face of wall are shown or approved by ENGINEER, form saver-type mechanical couplers may be used. Form-saver couplers shall have integral plates designed to positively connect coupler to formwork.
- C. Steel Wire: Shall be in accordance with ASTM A82.
- D. Welded Smooth Wire Fabric: Shall be in accordance with ASTM A185.
 - 1. Furnish in flat sheets, not rolls.
- E. Column Spirals: Hot-rolled rods for spirals, conforming to ASTM A615.
- F. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing in place.
 - 1. Use wire bar type supports complying with CRSI 1 MSP recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
 - 2. For slabs on grade, use precast concrete blocks, four inches square in plan, with embedded tie wire as specified by CRSI 1 MSP. Precast concrete blocks shall have same or higher compressive strength as specified for concrete in which they are located.
 - 3. For concrete surfaces where legs of supports are in contact with forms, provide supports complying with CRSI 1 MSP as follows:
 - a. At formed surfaces in contact with soil, weather, or liquid, or located above liquid, supports shall be CRSI Class 1 for maximum protection. Plastic coating on legs shall extend at least 0.5-inch upward from form surface.

- b. At interior dry surfaces (not located above liquid), supports shall be either Class 1 or Class 2 for moderate protection.
 - c. At formed surfaces with an architectural finish, use stainless steel protected legs (Type B).
 - 4. Over waterproof membranes, use precast concrete chairs.
 - 5. For epoxy-coated reinforcing, use wire reinforcing supports coated with dielectric material including epoxy or another polymer for minimum distance of two inches from point of contact with epoxy-coated reinforcement.
- G. Adhesive Dowels:
 - 1. Dowels:
 - a. Dowel reinforcing bars shall be deformed in accordance with ASTM A615, Grade 60.
 - 2. Adhesive:
 - a. Requirements for adhesive are specified under requirements for concrete adhesive anchors in Section 05051, Anchor Systems.

2.2 FABRICATION

- A. General: Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI 301 and ACI 350.5 and CRSI 1 MSP. In case of fabricating errors, do not re-bend or straighten reinforcing in manner that injures or weakens material.
- B. Unacceptable Materials: Reinforcing with one or more of the following defects is not allowed:
 - 1. Bar lengths, bends, and other dimensions exceeding specified fabrication tolerances.
 - 2. Bends or kinks not shown on approved Shop Drawings.
 - 3. Bars that do not meet or exceed their ASTM specification requirements when hand-wire-brushed, with respect to cross section, nominal weight, or average height of deformations.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the substrate and conditions under which concrete reinforcing is to be placed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable recommendations of Laws and Regulations, applicable standards, CRSI 1 MSP, ACI 301, and ACI 350.5 for details and methods of reinforcing placement and supports.
- B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
 - 1. Place reinforcing to obtain minimum concrete coverages specified in ACI 318, ACI 350, and the Contract Documents. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
 - 2. Prior to placing concrete, using surveyor's level or string line, demonstrate to ENGINEER that specified cover of reinforcing has been attained.
 - 3. Do not secure reinforcing steel to forms with wire, nails, or other ferrous metal. Metal supports subject to corrosion shall not touch formed or exposed concrete surfaces.
- D. Allowable Placing Tolerances: Comply with ACI 318, Chapter 25 - Reinforcement Details, and ACI 350, Chapter 7 - Details of Reinforcement, except as specified in this Section:
 - 1. Concrete surfaces in contact with liquid shall have minimum of two inches of concrete over reinforcing steel.
- E. Provide supports with adequate spacing and strength required to carry reinforcing. Do not place reinforcing bars more than two inches beyond last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- F. Lap Splices:
 - 1. Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown for minimum lap of spliced bars as shown on the Drawings.
- G. Install welded wire fabric in lengths as long as practical. Lap adjoining pieces at least one full mesh and lace splices with 16-gage wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.
- H. Mechanical Couplers:
 - 1. Mechanical butt splices shall be in accordance with recommendations of mechanical splicing device manufacturer. Butt splices shall develop 125 percent of specified minimum yield tensile strength of spliced bars or of smaller bar in transition splices. Bars shall be flame-dried before butt splicing.

Provide adequate jigs and clamps or other devices to support, align, and hold longitudinal centerline of bars being butt spliced in straight line.

I. Welded Splices:

1. When field welding of reinforcing is required on the Drawings or allowed by ENGINEER in writing, welding of reinforcing bars shall conform to ANSI/AWS D1.4. Preheating and rate of cooling requirements shall be based on bar steel chemistry and ANSI/AWS D1.4. Welded splices shall be sized and constructed to transfer minimum of 125 percent of specified minimum yield tensile strength of spliced bars or of smaller bar in transition splices. Unless otherwise allowed by ENGINEER in writing, welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.
2. Welding of wire to wire, and of wire or welded wire fabric to reinforcing bars or structural steels, shall conform to applicable provisions of ANSI/AWS D1.4 and ENGINEER's requirements for the particular application.
3. After completing welding on coated reinforcing bars, repair coating damage as specified in this Section. Welds and steel splice members, when used to splice bars, shall be coated with same material used for repair of coating damage.

J. Adhesive Dowels:

1. Comply with manufacturer's written installation instructions and requirements of this Section.
2. Drill holes to adhesive system manufacturer's recommended drill bit diameter and to specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances indicated in ANSI B212.15. Core-drilled holes shall not be permitted.
3. Before setting adhesive dowel, hole shall be made free of dust and debris by method recommended by adhesive system manufacturer. Brush the hole with adhesive system manufacturer-approved brush and blow hole clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
5. Prior to injecting adhesive into the drilled hole, dispense to an appropriate location for waste an initial amount of adhesive from the mixing nozzle until adhesive is a uniform color, indicating that product is properly mixed.
6. Inject adhesive into hole through injection system-mixing nozzle and extension tubes (as required) placed to bottom of hole. Withdraw nozzle's discharge end as adhesive is placed while keeping nozzle immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placing.
7. Twist dowel during insertion into partially-filled hole to ensure full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining or adjacent Work that could impose or impart load on the dowels. Do not begin adjoining or adjacent Work until dowels are successfully tested or when approved by ENGINEER.

9. Limitations:
 - a. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with requirements of adhesive systems manufacturer during installation and adhesive system curing.
 - b. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by adhesive system manufacturer. Cost of corrective measures, including but not limited to redesign of dowels due to decreased capacities, shall be paid by CONTRACTOR.

3.3 FIELD QUALITY CONTROL

A. Site Inspections and Tests:

1. General:
 - a. Do not place concrete until reinforcing is inspected, and permission for placing concrete is granted by ENGINEER. Concrete placed in violation of this provision will be rejected.
 - b. Do not close up formwork for walls and other vertical members until reinforcing is inspected, and permission for placing concrete is granted by ENGINEER. Concrete placed in violation of this provision will be rejected.
 - c. Correct defective Work by removing and replacing or correcting, as required by ENGINEER.
 - d. CONTRACTOR shall pay cost of corrections and subsequent testing required to confirm integrity of post-installed anchors.
 - e. Testing laboratory shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.
2. Site Tests:
 - a. OWNER will employ testing laboratory to perform field quality testing of adhesive dowels at the Site.
 - 1) Testing shall comply with ASTM E488.
 - 2) Test at least ten percent of each type of adhesive dowel. If one or more dowels fail the test, CONTRACTOR shall pay cost to test all dowels of same diameter and type installed on the same day as the failed dowel.
 - 3) Test dowels to 60 percent of specified yield strength. ENGINEER will direct which dowels are to be tested.
 - 4) Apply test loads with hydraulic ram.
 - 5) Displacement of dowels shall not exceed $D/10$, where D is nominal diameter of dowel.
3. Inspection of Welded Splices: OWNER will employ testing laboratory to perform field quality control testing of welded splices. All welded splices shall be visually inspected. Radiographically test minimum of five percent of butt splice welds. Repair defective welds so that welds are completely sound.

B. Manufacturer's Services:

1. Provide qualified adhesive manufacturer's representative at the Site during initial installation of adhesive dowel systems to train installing personnel in proper selection and installation procedures. Manufacturer's representative shall observe to verify that installer demonstrates proper installation procedures for adhesive dowels and adhesive material. Each installer shall be certified in writing by manufacturer as qualified to install adhesive anchors.

+ + END OF SECTION + +

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SECTION 03251

CONCRETE ACCESSORIES

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete accessories.
- B. Related Sections:
 - 1. Section 03100, Concrete Forming.
 - 2. Section 03600, Grouting.
 - 3. Section 07920, Joint Sealants.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ACI 301, Standard Specifications for Structural Concrete.
 - 2. ACI 350.5, Specifications for Environmental Concrete Structures.
 - 3. ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - 4. CRD-C572, U.S. Army Corps of Engineers Specifications for Polyvinyl-Chloride Waterstop.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Layout of construction and expansion joint locations. Submit and obtain approval prior to submitting concrete reinforcement Shop Drawings.
 - b. For construction and expansion joints that require waterstops, submit layout of locations showing waterstop details. Indicate waterstop type, waterstop joint conditions, and details on how joint conditions will be handled.
 - c. Detail for joining PVC to steel waterstops.
 - d. Layout of all control joint locations.
 - 2. Samples:
 - a. Submit Sample, at least six inches long each, of each type of waterstop proposed for use.
 - b. Submit Sample of foam rubber and cork expansion joint fillers.
 - c. Submit Sample of each type of prefabricated PVC waterstop joint.

- B. Informational Submittals: Submit the following:
 - 1. Manufacturer's Instructions: Manufacturer's specifications and installation instructions for all materials required.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Transportation and Handling of Products:
 - 1. Deliver materials to Site to ensure uninterrupted progress of the Work.
 - 2. Comply with Section 01610, Transportation and Handling of Materials and Equipment.
- B. Storage and Protection:
 - 1. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight. Comply with manufacturer's storage and protection requirements.
 - 2. Comply with Section 01610, Transportation and Handling of Materials and Equipment.

PART 2 – PRODUCTS

2.1 WATERSTOPS

- A. Polyvinyl Chloride (PVC):
 - 1. Material Requirements:
 - a. Waterstops shall be extruded from elastomeric PVC compound containing plasticizers, resins, stabilizers, and other materials necessary to meet requirements of the Contract Documents and requirements of CRD-C572. Do not use reclaimed or scrap material.
 - b. Tensile strength of finished waterstop: 1,400 psi, minimum.
 - c. Ultimate elongation of finished waterstop: 280 percent, minimum.
 - d. Minimum thickness shall be 3/8-inch over entire width of waterstop.
 - e. Provide waterstops with minimum of seven ribs equally spaced at each end on each side. First rib shall be at the edge. Ribs shall be a minimum of 1/8-inch in height.
 - f. Provide waterstops with hog rings or factory-installed grommets anchored to exterior ribs to facilitate tying waterstop in position.
 - 2. Split waterstops are not allowed.
 - 3. Construction Joints: Waterstops shall be flatstrip ribbed type, six-inch minimum width, unless otherwise shown or indicated in the Contract Documents.
 - 4. Expansion Joints: Waterstops shall be centerbulb ribbed type, nine-inch minimum width, unless otherwise shown or indicated in the Contract Documents. Centerbulb shall have minimum outside diameter of 7/8-inch.
 - 5. Product and Manufacturer: Provide one of the following:
 - a. W.R. Meadows, Inc.

- b. Durajoint Concrete Accessories.
- c. Greenstreak Plastic Products Company.
- d. Paul Murphy Plastics Company.
- e. Vinylex Corporation.
- f. Or equal.

B. Hydrophilic Waterstop Materials:

- 1. General Material Properties:
 - a. Bentonite-free, and expandable by minimum of 80 percent of dry volume in presence of water to form watertight joint seal without damaging concrete in which material is cast. Provide only where shown or indicated in the Contract Documents.
 - b. Material shall be composed of resins and polymers that absorb water and cause an increase in volume in completely reversible and repeatable process. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
 - c. Select materials that are recommended by manufacturer for type of liquid to be contained.
- 2. Hydrophilic Rubber Waterstop:
 - a. Minimum cross sectional dimensions shall be 3/16-inch by 3/4-inch.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Duroseal Gasket, by BBZ USA, Inc.
 - 2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
 - 3) Hydrotite, by Greenstreak Plastic Products Company.
 - 4) Or equal.
- 3. Hydrophilic Sealant:
 - a. Hydrophilic sealant shall adhere firmly to concrete, metal, and PVC in dry or damp condition. When cured sealant shall be elastic indefinitely.
 - b. Product and Manufacturer: Provide one of the following:
 - 1) Duroseal Paste, by BBZ USA, Inc.
 - 2) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
 - 3) Hydrotite, by Greenstreak Plastic Products Company.
 - 4) SikaSwell S, by Sika Corporation.
 - 5) Or equal.

2.2 PREFORMED EXPANSION JOINT FILLER

- A. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

2.3 CONCRETE CONSTRUCTION JOINT ROUGHENER

- A. Provide water-soluble non-flammable, surface-retardant roughener.

- B. Product and Manufacturer: Provide one of the following for the types of joints specified:
1. Rugasol-S, by Sika Corporation for horizontal joints only.
 2. Concrete Surface Retarder-Formula S, by Euclid Chemical Company, for horizontal joints only.
 3. Concrete Surface Retarder-Formula F, by Euclid Chemical Company, for vertical joints only.
 4. TK-6100 Concrete Form Surface Retarder, by TK Products.
 5. Or equal.

2.4 EPOXY BONDING AGENT

- A. Provide a two-component epoxy-resin bonding agent.
- B. Product and Manufacturer: Provide one of the following:
1. Sikadur 32 Hi-Mod LPL, by Sika Corporation.
 2. Eucopoxy LPL, by the Euclid Chemical Company.
 3. Resi-Bond J-58, by Dayton Superior.
 4. Or equal.

2.5 EPOXY-CEMENT BONDING AGENT

- A. Provide three component epoxy resin-cement blended formulated as bonding agent.
- B. Product and Manufacturer: Provide one of the following:
1. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation.
 2. Duralprep A.C., as manufactured by the Euclid Chemical Company.
 3. MasterEmaco P124, as manufactured by BASF.
 4. Or equal.

2.6 JOINT SEALANT AND ACCESSORIES

- A. For joint sealants and accessories used on isolation joints, control joints, and expansion joints, refer to Section 07 92 00, Joint Sealants.

2.7 CONCRETE BOND BREAKERS

- A. Provide asphalt-saturated rag felt building paper, not less in weight than commercially known as 15 pound felt building paper, which weighs 15 pounds per 100 square feet.
- B. Chemical Bond Breaker:
1. Provide medium solids resin solution chemical concrete bond breaker complying with ASTM C309, Type I, Class B.

PART 3 – EXECUTION

3.1 INSPECTION

- A. CONTRACTOR and installing Subcontractor, if any, shall examine substrate and conditions under which the Work is to be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 CONSTRUCTION JOINTS

- A. Comply with requirements of ACI 301, ACI 350.5, and the Contract Documents.
- B. Locate and install construction joints as shown or indicated on the Drawings. Where not shown or indicated, locate joints to not impair strength of the structure; position joints at points of minimum shear. Location of joints shall be approved by ENGINEER. In addition to joints shown or indicated on the Drawings, locate construction joints as follows:
 - 1. In foundation mats, locate joints at spacing of approximately 40 feet. Joints shall be located within middle third of element span, unless otherwise shown or indicated on the Drawings. Element span shall be considered distance between piles or, as determined by ENGINEER, distance between bearing elements, such as columns, exterior walls and interior walls. Place concrete in strip pattern, unless otherwise shown or indicated on the Drawings.
 - 2. In walls, locate joints at a maximum spacing of 40 feet. Locate joints away from wall intersections a minimum of one-quarter of the clear span distance between wall intersections measured horizontally.
 - 3. In structural slabs and beams, joints shall be located within middle third of element span and shall be located in compliance with ACI 301 and ACI 350.5, unless otherwise shown or indicated on the Drawings.
 - 4. In slabs on grade, locate joints at spacing of approximately 40 feet. Place concrete in strip pattern, unless otherwise shown or indicated on the Drawings.
- C. Horizontal Joints:
 - 1. Roughen concrete at interface of construction joints by abrasive blasting, hydroblasting, or using surface retardants and water jets to expose aggregate and remove accumulated concrete on projecting rebar immediately subsequent to form stripping, unless otherwise approved by ENGINEER. Do not allow surface retardants to contact waterstop. Protect waterstop from blasting. Immediately before placing fresh concrete, thoroughly clean existing contact surface using stiff brush or other tools and stream of pressurized water. Surface shall be clean and wet, and free from pools of water at time of placing fresh concrete.
 - 2. Remove laitance, waste mortar, and other substances that may prevent complete adhesion. Where joint roughening was performed more than seven days prior to concrete placing or where dirt or other bond reducing contaminants are on surface, perform additional light abrasive blasting or

hydroblasting to remove laitance and all bond-reducing materials just prior to concrete placement.

3. Provide over contact surface of concrete a six-inch layer of Construction Joint Grout as specified in Section 03 60 00, Grouting. Place fresh concrete before grout has attained its initial set. Placement of grout may be omitted if concrete mix has slump increased to at least six inches by addition of high range water reducer.

D. Vertical Joints:

1. Apply roughener to the form in thin, even film by brush, spray, or roller in accordance with manufacturer's instructions. Do not allow roughener onto waterstop. Clean off any roughener that contacts the waterstop. After roughener is dry, concrete may be placed.
2. When concrete has been placed, remove joint surface forms as early as necessary to allow for removal of surface retarded concrete. Forms covering member surfaces shall remain in place as required under Section 03 11 00, Concrete Forming. Wash loosened material off with high-pressure water spray to obtain roughened surface subject to approval by ENGINEER. Alternately, surface shall be roughened by abrasive blasting or hydroblasting to expose aggregate. Outer one-inch of each side of joint face shall be masked and protected from blasting to avoid damaging member surface. Protect waterstop from blasting.

3.3 EXPANSION JOINTS

- A. Comply with requirements of ACI 301, ACI 350.5 and this Section.
- B. Locate and install expansion joints as shown and indicated in the Contract Documents. Install joint filler in accordance with manufacturer's instructions. Install sealants as specified in this Section.

3.4 CONTROL JOINTS

- A. Provide control joints in non-water bearing slabs on grade as shown or indicated on the Drawings. Where control joints are not shown or indicated on the Drawings, space control joints at 24 to 36 times thickness of slab in both directions. Locate control joints only at places approved by ENGINEER.
- B. A groove, with depth of at least 25 percent of the member thickness, shall be tooled, formed, or saw-cut in concrete. Groove shall be filled with joint sealant material in accordance with Section 07 92 00, Joint Sealants.
- C. Where control joint is formed by sawcutting, make sawcut in presence of ENGINEER immediately after concrete has set sufficiently to support the saw and be cut without damage to concrete. Keep concrete continually moist during cutting. Joints shall be approximately 1/8-inch wide.

- D. Control joints may be formed with tool or by inserting joint forming strip. After concrete has achieved design strength, remove upper portion of joint forming strip and fill void with sealant.

3.5 ISOLATION JOINTS

- A. Provide isolation joint where sidewalk or other slab on grade abuts a concrete structure and slab on grade is not shown doweled into that structure. Form isolation joint by 1/2-inch joint filler with upper 1/2-inch of joint filled with sealant.

3.6 WATERSTOPS

A. General:

- 1. Comply with ACI 301, ACI 350.5, and this Section. Make joints in accordance with manufacturer's instructions.
- 2. Provide PVC waterstops, except where otherwise shown or indicated on the Drawings.
- 3. Provide waterstops in all joints where concrete construction is below grade or intended to retain liquid. Install waterstop to the higher of: at least 12 inches above grade, or 12 inches above overflow liquid level in tanks.
- 4. Waterstops shall be fully continuous for extent of joint and with waterstops in intersecting joints. Maintain waterstop continuity at transitions between waterstops in joints at different levels and orientations.
- 5. In vertical joints in walls that are free at the top, waterstops shall extend no closer than six inches from top of wall.
- 6. In placing concrete around horizontal waterstops, with waterstop flat face in horizontal plane, work the concrete under waterstops by hand to avoid forming air and rock pockets.

B. Polyvinyl Chloride Waterstop:

- 1. Waterstops shall be positively held from displacement during concrete placing. Tie waterstops to reinforcement or other rigid supports at maximum spacing of 18 inches so that waterstop is securely and rigidly supported in proper position during concrete placing. Continuously inspect waterstops during concrete placing to ensure proper positioning.
- 2. Perform splicing in waterstops by heat sealing adjacent waterstop sections in accordance with manufacturer's printed recommendations. The following is required:
 - a. Material shall not be damaged by heat sealing.
 - b. Splices shall have tensile strength of not less than 60 percent of unspliced material's tensile strength.
 - c. Maintain the continuity of waterstop ribs and of its tubular center axis.
- 3. Only butt-type joints of ends of two identical waterstop sections shall be made while material is in forms.
- 4. Prefabricated PVC Waterstop Joint:
 - a. Joints with waterstops involving more than two ends to be jointed together, and joints that involve an angle cut, alignment change, or

- joining of two dissimilar waterstop sections, shall be prefabricated by CONTRACTOR or manufacturer prior to placing in the forms.
- b. Prefabricated joints shall have minimum of 2.0 feet of waterstop material beyond joint in each direction.
 - c. Install prefabricated joint assembly in the forms and butt-weld each two-foot end to a straight-run portion of waterstop in place in the forms.
5. Where centerbulb waterstop intersects and is jointed with non-centerbulb waterstop, seal end of centerbulb using additional PVC material as required.
 6. Symmetrical halves of waterstops shall be equally divided between concrete placements at joints and centered within joint width, unless shown or indicated otherwise in the Contract Documents. Place centerbulb waterstops in expansion joints so that centerbulb is centered on joint filler material.
 7. When waterstop is installed in the forms or embedded in first concrete placement and waterstop remains exposed to atmosphere for more than four days, implement suitable precautions to shade and protect exposed waterstop from direct rays of sun during entire exposure, until exposed portion of waterstop is embedded in concrete.
 8. Protect waterstop placed in joints intended for future concrete placement from direct rays of the sun by temporary means until permanent cover is installed, so that waterstop is not exposed to direct rays of the sun for more than four days total.

D. Hydrophilic Rubber Waterstop and Sealant:

1. Where a hydrophilic rubber waterstop or sealant is required in accordance with the Contract Documents, or where approved by ENGINEER, install waterstop or sealant in accordance with manufacturer's instructions and recommendations; except, as modified in the Contract Documents.
2. When requested by ENGINEER, provide manufacturer's technical assistance at the Site.
3. Locate waterstop or sealant as near as possible to center of joint. Waterstop or sealant shall be continuous around entire joint. Minimum distance from edge of waterstop to face of the member shall be three inches.
4. Where hydrophilic rubber waterstop is used in combination with PVC waterstop, hydrophilic rubber waterstop shall overlap PVC waterstop for minimum of six inches. Fill contact surface between hydrophilic rubber waterstop and PVC waterstop with hydrophilic sealant.
5. Where wet curing methods are used, apply hydrophilic rubber waterstop and sealant after curing water is removed and just prior to closing up of the forms for concrete placement. Protect hydrophilic rubber waterstop and sealant from direct rays of sun and from becoming wet prior to concrete placement. If material becomes wet and expands, allow material to dry until material has returned to original cross sectional dimensions before placing concrete.
6. Install hydrophilic rubber waterstop in bed of hydrophilic sealant, before skinning and curing begins, so that irregularities in concrete surface are completely filled and waterstop is bonded to sealant. After sealant has cured, install concrete nails, with washers of a diameter equal to waterstop width, to secure waterstop to concrete at maximum spacing of 1.5 feet.

7. Prior to installing hydrophilic sealant, wire brush or sandblast the concrete surface to remove laitance and other materials that may interfere with bonding. Metal and PVC surfaces to receive sealant shall be cleaned of paint and any material that may interfere with bond. When sealant alone is shown or indicated in the Contract Documents, place sealant placed in built-up bead which has a triangular cross section with each side of triangle at least 3/4-inch long, unless otherwise indicated in the Contract Documents. Do not place concrete until sealant has cured as recommended by sealant manufacturer.

3.7 BONDING AGENT

- A. Use epoxy bonding agent for bonding of fresh concrete to concrete that has been in place for at least 60 days, and for bonding to existing concrete.
- B. Use epoxy-cement bonding agent for the following:
 1. Bonding toppings and concrete fill to concrete that has been in place for at least 60 days, and for bonding to existing concrete.
 2. For locations where bonding agent is required and concrete cannot be placed within open time period of epoxy bonding agent.
- C. Use cement-water slurry as bonding agent for toppings and concrete fill to concrete that has been in place for less than 60 days. Cement water slurry shall be worked into surface with stiff bristle broom and place the concrete before cement-water slurry dries.
- D. Handle and store bonding agent in accordance with manufacturer's printed instructions and safety precautions.
- E. Mix bonding agent in accordance with manufacturer's instructions.
- F. Before placing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with bonding agent not less than 1/16-inch thick. Place fresh concrete while bonding agent is still tacky (within its open time), without removing in-place bonding agent coat, and as directed by manufacturer.

3.8 BEARING PAD INSTALLATION

- A. Neoprene Bearing Pad: Install with water insensitive adhesive in accordance with manufacturer's instructions.

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install cast-in-place concrete.
2. Concrete shall be in accordance with requirements of ACI 301 and ACI 350.5 unless otherwise specified.
3. The Work includes providing concrete consisting of portland cement, fine and coarse aggregate, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured. The Work also includes:
 - a. Providing openings in concrete to accommodate the Work under this and other Sections, and building into the concrete all items such as sleeves, frames, anchorage devices, inserts, and all other items to be embedded in concrete Work.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:

1. Class “A” concrete shall be steel-reinforced and includes the following:
 - a. All concrete, unless otherwise shown or indicated.
2. Class “AF” concrete shall be steel-reinforced and may be used in lieu of Class “A” concrete for the following:
 - a. Walls and foundations thicker than 16 inches.
3. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing, and includes the following, unless otherwise shown or indicated:
 - a. Concrete fill within structures.
 - b. Duct banks.
 - c. Unreinforced encasements.
 - d. Curbs and gutters.
 - e. Sidewalks.
 - f. Thrust blocks.
5. Class “D” concrete shall be unreinforced and used where required as concrete fill under foundations, filling abandoned piping, and where “lean concrete” or “mudmat” is shown or indicated in the Contract Documents.

D. Related Sections:

1. Section 03251, Concrete Accessories.
2. Section 03600, Grouting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO M 182, Specification for Burlap Cloth Made From Jute or Kenaf and Cotton Materials.
2. AASHTO TP23, Test Method for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.
3. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary.
4. ACI 214R, Evaluation of Strength Test Results of Concrete.
5. ACI 301, Specifications for Structural Concrete.
6. ACI 302.1R, Guide for Concrete Floor and Slab Construction.
7. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
8. ACI 305.1, Specification for Hot Weather Concreting.
9. ACI 306.1, Standard Specification for Cold Weather Concreting.
10. ACI 308.1, Specification for Curing Concrete.
11. ACI 309R, Guide for Consolidation of Concrete.
12. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
13. ACI 350/350R, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
14. ACI 350.5, Specifications for Environmental Concrete Structures.
15. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
16. ASTM C33, Specification for Concrete Aggregates.
17. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
18. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
19. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
20. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
21. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
22. ASTM C143/C143M, Test Method for Slump of Hydraulic- Cement Concrete.
23. ASTM C150, Specification for Portland Cement.
24. ASTM C157/C157M, Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
25. ASTM C171, Specification for Sheet Materials for Curing Concrete.
26. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
27. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
28. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
29. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

30. ASTM C330, Specification for Lightweight Aggregates for Structural Concrete.
31. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
32. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
33. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
34. ASTM C989, Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
35. ASTM C1017, Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
36. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.
37. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
38. ASTM C1077, Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
39. ASTM C1240, Specification for Silica Fume Used in Cementitious Mixtures.
40. ASTM C1260, Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
41. ASTM C1293, Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
42. ASTM C1567, Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate
43. ASTM D3574, Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams.
44. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials
45. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
46. ASTM E1643, Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
47. ASTM E1745, Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
48. NSF/ANSI 61, Drinking Water System Components - Health Effects.
49. NRMCA, National Ready Mixed Concrete Association.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Concrete Testing Laboratory:
 - a. Employ independent testing laboratory experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes. Employ different laboratories for design of concrete mixes and field testing.
 - 1) Testing agency shall be in accordance with ASTM E329 and ASTM C1077.

- 2) Testing laboratory shall have been inspected and passed within previous two years by Cement and Concrete Reference Laboratory (CCRL) of NIST for: testing concrete aggregates, and for preparing and testing concrete trial batches with or without admixtures. Testing laboratory shall provide documentation indicating how deficiencies, if any, in most recent CCRL inspection report were corrected.
 - 3) Selection of testing laboratory is subject to OWNER's acceptance.
 - 4) Submit written description of proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities, and equipment, and other information requested by ENGINEER.
2. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
 3. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
 4. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
 5. Water Reducing Admixture Manufacturer:
 - a. Water-reducing admixtures shall be manufactured under strict quality control in facilities operated under a quality assurance program. Submit copy of manufacturer's quality assurance handbook to document program existence.
 - b. Manufacturer shall maintain a concrete testing laboratory approved by CCRL at NIST.
 - c. Manufacturer shall be capable of providing services of qualified field service representatives at the Site.
- B. Laboratory Trial Batch:
1. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
 2. For classes of concrete that require air-entrainment, test the trial batch at highest percentage of air allowed for that class of concrete.
 3. Perform the following testing on each trial batch:
 - a. Aggregate gradation for fine and coarse aggregates.
 - b. Fly ash testing to verify meeting specified properties, unless fly ash Supplier submits certification by an independent testing laboratory.
 - c. Slump.
 - d. Air content.
 - e. Compressive strength based on three cylinders each tested at seven days and at 28 days.
 - f. Shrinkage test in accordance with this Section, for Class "A" concrete and Class "AF" concrete.
 4. Submit for each trial batch the following information:
 - a. Project identification name and number (if applicable).
 - b. Date of test report.
 - c. Complete identification of aggregate source of supply.

- d. Tests of aggregates for compliance with the Contract Documents.
- e. Scale weight of each aggregate.
- f. Absorbed water in each aggregate.
- g. Brand, type, and composition of cementitious materials.
- h. Brand, type, and amount of each admixture.
- i. Amounts of water used in trial mixes.
- j. Proportions of each material per cubic yard.
- k. Gross weight and yield per cubic yard of trial mixtures.
- l. Measured slump.
- m. Measured air content.
- n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28 day test, and for each design mix.
- o. Shrinkage test results where required and as specified in this Section. Report results and averages for original length and at zero, seven, 14, 21, and 28 days of drying.

C. Shrinkage Test:

- 1. Perform drying shrinkage tests for trial batch as specified in this Section.
- 2. Drying shrinkage specimens shall be four-inch by four-inch by 11-inch prisms with effective gage length of ten inches; fabricated, cured, dried, and measured in accordance with ASTM C157 modified as follows: remove specimens from molds at an age of 23 hours, plus-or-minus one hour, after trial batching; shall be placed immediately in water at 70 degrees F plus-or-minus three degrees F for at least 30 minutes; and shall be measured within 30 minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F plus-or-minus three degrees F. Measurement to determine expansion expressed as percentage of original length shall be made at age of seven days. Length at age of seven days shall be base length for drying shrinkage calculations (zero days drying age). Immediately afterward store specimens in humidity-controlled room maintained at 73 degrees F plus-or-minus three degrees F, and 50 percent (plus-or-minus four percent) relative humidity for remainder of test. Obtain measurements to determine shrinkage expressed as percentage of base length and report measurements separately for seven, 14, 21, and 28 days of drying after seven days of moist curing.
- 3. Determine drying shrinkage deformation of each specimen as the difference between base length (at zero days drying age) and length after drying at each test age. Determine average drying shrinkage deformation of specimens to nearest 0.0001-inch at each test age. If drying shrinkage of a specimen departs from average of that test age by more than 0.0004-inch, results obtained from that specimen shall be disregarded. Report results of shrinkage test to nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from same concrete used for preparing drying shrinkage specimens. Tests shall be considered part of normal compression tests for the Work. Allowable shrinkage limitations shall be as specified in Part 2 of this Section.

D. Component Supply and Compatibility:

1. Provide all admixture materials from a single manufacturer. If all products cannot be provided by a single manufacturer, Provide a certificate of compatibility for all admixture materials.

E. Sample Panels:

1. Provide Sample panels of wall finishes, each at least 12 inches by 12 inches by three inches thick. Revise Sample panels to produce acceptable finished concrete surfaces.
 - a. Provide additional Sample panels as required if original results are unsatisfactory as determined by ENGINEER.
2. Continuity of color and texture for exposed concrete surfaces is important. Maintain such controls and procedures, in addition to those specified, as necessary to provide continuous match of concrete Work with approved Samples.

F. Mock-up Panels:

1. Provide mock-up panels representative of specified finished surfaces after Sample form panels are approved, at locations on the Site directed by ENGINEER. Form, reinforce, mix, cast, cure, and finish mock-up panels using selected materials and construction methods proposed for the Work. Provide mock-up panels as follows:
 - a. Wall section of L-shaped panels, approximately four feet high by three feet each side by eight inches thick and set on an 18-inch wide by eight-inch thick base, unless otherwise shown or indicated. Form faces to represent each specified formed surface finish. Include not less than two form ties, two form panel intersections, one vertical construction joint, and one horizontal construction joint. Construction joints are in Section 03 15 00, Concrete Accessories.
 - b. Column section, approximately four feet high and not less than 12-inch diameter for round sections, and not less than 12 inches in the least dimension for rectangular sections, for each specified formed finish, unless otherwise shown or indicated. Set column sections on a six-inch thick concrete base extending eight inches beyond column. Chamfer exposed edges of rectangular Sample columns.
 - c. Slab-on-grade section, approximately four feet square and minimum of four inches thick for each applied finish, with at least one construction joint and one expansion joint, if used.
 - d. Pan-formed section using at least two pan form units. Set units to illustrate method of blending exposed pan joints.
2. Reinforce mock-up panels as required to prevent cracking and to be structurally stable or as shown or indicated; reinforcing steel shall not be less than 0.25 percent of the gross concrete cross section in each direction.
3. Protect mock-up panels from damage and do not remove approved mock-up panels without written ENGINEER's permission. When directed by ENGINEER, demolish mock-up panels and remove from the Site.

G. Existing Example Panels:

1. ENGINEER will identify sections of existing concrete that will serve as reference examples of acceptable concrete finishes.
 2. If appropriate existing concrete members that adequately define required finishes do not exist, provide Sample panels as specified in this Article.
- H. Designated Finish Sample Areas:
1. ENGINEER will identify areas of concrete members, to serve as reference examples of acceptable concrete finishes, from first members constructed for each finish.
 2. At each area so designated, complete the finish as specified.
 3. Where specified concrete finish is not obtained, repair the member to provide an acceptable finish. Adjust construction techniques to produce the required finish.
 4. Clearly mark each Sample area with name of specified finish to cause no damage to finish.
 5. Protect Sample areas from damage and maintain access to view Sample areas.
- I. Concrete Coordination Conference:
1. Conduct concrete coordination conference to review detailed requirements of CONTRACTOR's proposed concrete design mixes, to discuss procedures for producing proper concrete construction, and to clarify roles of the parties involved. CONTRACTOR shall organize and schedule the conference, and prepare and distribute to all parties attending conference minutes of the conference.
 2. Conduct concrete coordination conference no later than 14 days after the date the Contract Times commence running. Conference shall be held at mutually agreed upon date and time; conference shall be held at the Site unless otherwise mutually agreed upon. Notify all parties to attend concrete coordination conference not less than five days prior to scheduled date of conference.
 3. All parties involved in the concrete Work shall attend concrete coordination conference including, but not limited to, the following:
 - a. CONTRACTOR.
 - b. Field testing services representative.
 - c. Concrete Subcontractor (if any).
 - d. Reinforcing steel Subcontractor (if any) and reinforcing steel Supplier and detailer.
 - e. Concrete Supplier.
 - f. Admixture manufacturer's representative.
 - g. ENGINEER.
 - h. Resident Project Representative (if any).

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Mix Design:
 - a. List of concrete materials and proportions for the proposed concrete mix designs. Include data sheets, test results, certifications, and mill reports

to qualify the materials proposed for use in the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.

- b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
 - c. Test results per ASTM C33 confirming meets limit on deleterious material in fine aggregate.
 - d. Test results per ASTM C1260, ASTM C1293, and ASTM C1567 to determine potential for alkali-silica reactivity.
 - e. Certificate of compatibility of combined admixtures.
 - f. Certification of mix designer.
2. Concrete Supply:
 - a. Ready-mixed Concrete: Submit the following information.
 - 1) NRMCA plant certification.
 - 2) Physical capacity of mixing plant.
 - 3) Trucking facilities available.
 - 4) Estimated average amount of the specified concrete that can be produced and delivered to the Site during a normal, eight-hour day, excluding output to other customers.
 3. Product Data:
 - a. Manufacturers' specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
 4. Samples:
 - a. Submit Samples of materials as specified and as requested by ENGINEER. Include with each Sample names of product and Supplier, and description.
 - b. Colored Cement Pigment Color Samples: Submit complete selection of manufacturer's standard and custom colors for final selection by ENGINEER.
 5. Thermal Control Plan:
 - a. Submit plan for controlling internal temperature and temperature gradients within specified limits.
 6. Curing and Protection Plans:
 - a. Submit detailed plan for curing and protection of concrete placed and cured in cold weather.
 - b. Submit detailed plan for curing and protection of concrete placed and cured in ambient temperatures over 80 degrees F.

B. Informational Submittals: Submit the following:

1. Certifications:
 - a. Notarized certification of conformance to reference standards used in this Section, when required by ENGINEER.
 - b. Flatwork finisher certification.
2. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94 along with project identification

name and number (if any), date, mix type, mix time, quantity and amount of water introduced.

3. Minutes of the Concrete Coordination Conference and other subsequent structure specific concrete construction conferences.
4. Field Quality Control Submittals:
 - a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Transportation, Delivery, and Handling:
 1. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
 2. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
- B. Storage:
 1. For storage, provide bins or platforms with hard, clean surfaces.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All cementitious materials, admixtures, curing compounds, and other industrial-produced materials used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

2.2 CEMENTITIOUS MATERIALS

- A. Cement:
 1. Portland cement shall be Type II(MH) ASTM C150. Type I or Type II may be used in lieu of Type II(MH) when approved by ENGINEER.
 2. Portland cement shall be produced by one facility. Alternate cement sources may be used provided that mix design has been approved and acceptable trial batch verifying performance has been made.
 3. Do not use cement that has deteriorated because of improper storage or handling.
- B. Fly Ash Mineral Admixture:
 1. Mineral admixtures, when used, shall conform to the requirements of ASTM C618 Class F, except as follows:

- a. The loss on ignition shall be a maximum of four percent.
 - b. The maximum percent of sulfur trioxide (SO₃) shall be 4.0.
 2. Fly ash shall be considered to be a cementitious material.
 3. Laboratory trial batches shall be tested to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.
- C. Slag Cement:
1. Slag Cement, when used, shall conform to ASTM C989, Grade 120.
 2. GGBS is considered a cementitious material.
 3. Perform laboratory tests on trial batches to determine compliance with strength requirements, times of setting, slump, slump loss, and shrinkage characteristics.
- D. Silica Fume:
1. Silica fume mineral admixture shall be dry compacted or slurry form and shall conform to ASTM C1240. Silica fume is considered a cementitious material. Application rate shall be seven percent by weight of cement, unless indicated otherwise.
- E. For all classes of concrete, when Type II(MH) Cement is used, fly ash or slag cement may be used within the following percentages by weight. When Type II Cement is used, fly ash or slag cement shall be used within the following percentages by weight. When Type I Cement is used, in lieu of Type II(MH) Cement, fly ash or slag cement shall be used such that total tricalcium aluminate content (C₃A) of the resulting cementitious material is not greater than eight percent.
1. When fly ash is used, material shall have minimum of 20 percent and maximum of 25 percent of total weight of cementitious material.
 2. When slag cement is used, material shall have minimum of 40 percent and maximum of 50 percent of total weight of cementitious material.

2.3 AGGREGATES

- A. General:
1. Aggregates shall conform to ASTM C33, Class Designation 4S, and as specified in this Section.
 2. Do not use aggregates containing soluble salts or other substances, such as iron sulfides, pyrite, marcasite, ochre, or other materials, that can cause stains on exposed concrete surfaces.
- B. Fine Aggregate:
1. Provide clean, sharp, natural sand free of loam, clay, lumps, and other deleterious substances.
 2. Dune sand, bank run sand, and manufactured sand are unacceptable.
- C. Coarse Aggregate:
1. Provide clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - a. Crushed stone, processed from natural rock or stone.

- b. Washed gravel, either natural or crushed. Slag, pit gravel, and bank run gravel are unacceptable.

2.4 WATER

- A. Water used in producing and curing concrete shall be clean and free of injurious quantities of oils, acids, alkalis, organic materials, and other substances that may be deleterious to concrete and steel.

2.5 CONCRETE ADMIXTURES

- A. Provide admixtures in accordance with product manufacturer's published instructions. Admixtures shall be compatible with each other. Admixtures shall not contain thiocyanates, shall not contain more than 0.05 percent chloride ion, and shall be non-toxic in the concrete mix after 30 days. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise approved by ENGINEER.
- B. Air Entraining Admixtures: ASTM C260.
 - 1. Air entraining admixture shall be vinsol resin or vinsol rosin-based.
- C. Water-Reducing Admixture: ASTM C494, Type A or D.
 - 1. Proportion Class "A", Class "AF" and Class "B" concrete with non-air entraining, normal setting, water-reducing, aqueous solution of modified organic polymer. Admixture shall not contain lignin, nitrates, or chlorides added during manufacturing.
- D. High Range Water-Reducing Admixture (HRWR): ASTM C494, Type F or G.
 - 1. Use high range water-reducing admixture in the concrete classifications so specified or indicated. Use of HRWR admixture is allowed at CONTRACTOR's option in all other classifications of concrete. When used, HRWR admixture shall be added to concrete in accordance with admixture manufacturer's published instructions. Specific admixture formulation shall be as recommended by admixture manufacturer for Project conditions.
- E. Plasticizing Admixtures: ASTM C1017, Type I or Type II
 - 1. Use plasticizing admixture as an alternate to high range water-reducing admixture. Specific admixture formulation shall be as recommended by admixture manufacturer for Project conditions.
- F. Set Control Admixtures: In accordance with ASTM C494. Use the following as required:
 - 1. Type B, Retarding.
 - 2. Type C, Accelerating.
 - 3. Type D, Water reducing and Retarding.
 - 4. Type E, Water reducing and Accelerating.
 - 5. Type F, Water-reducing, high range admixtures.
 - 6. Type G, Water-reducing, high range, and retarding admixtures.

- G. Calcium Chloride: Do not use calcium chloride.
- H. Shrinkage Reducing Admixture:
1. Shrinkage reducing admixture may be used in mix design when necessary to conform to specified shrinkage limitations, provided that specified strength requirements are complied with and there is no reduction in sulfate resistance in the concrete and no increase in concrete permeability.
- I. Corrosion-Inhibiting Admixtures:
1. Corrosion-inhibiting admixture shall be calcium nitrite solution containing minimum of 30 percent calcium nitrite. Admixture shall be added at dosage rate of five gallons per cubic yard of concrete.
 2. Product and Manufacturer: Provide one of the following:
 - a. DCI or DCI-S, by Grace Construction Products.
 - b. MasterLife CI 222, by Master Builders, Inc.
 - c. Eucon CIA, by Euclid Chemical Company.
 - d. Or equal.
 3. Adjust quantity of mix water to account for water portion of calcium nitrite solution.
 4. Provide retarding admixtures as required, if set time is accelerated.
- J. Colored Cement Pigments:
1. Provide the following, where shown or indicated: Commercial iron oxide, manganese dioxide, ultramarine blue, chromium oxide, or carbon black compounded for use in concrete.
 2. Product and Manufacturer: Provide one of the following:
 - a. Truetone Mortar Colors by Frank D Davis Company, subsidiary of Rockwood Industries, Inc.
 - b. Sonobrite by Sonneborn Building Products, division of Rexnord Chemical Products, Inc.
 - c. Or equal.
 3. Do not exceed pigment-to-cement ratios, by weight, of one-to-35 for carbon black, and one-to-seven for other pigments.
 4. ENGINEER will select colors from manufacturer's full range of standard colors.

2.6 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare concrete design mixes in accordance with Table 03300-A:

TABLE 03300-A
CONCRETE DESIGN MIX CRITERIA

Concrete Class	Coarse Aggregate ⁽¹⁾		Minimum	Max. W/CM ⁽⁴⁾	Slump ⁽²⁾	Air (%)	Min. Comp Strength ⁽³⁾ (psi)
	Size A	Size B	Cementitious (lbs/cu yd)				
Class "A"	No. 57	No. 8	564	0.40	4" max.	6 +/- 1	4,500

Class "AF"	No. 467	No. 8	517	0.40	4" max.	5 +/- 1	4,500
Class "B"	No. 57 or No. 67		517	0.50	4" max.	6 +/- 1	3,000
Class "D"	Any ASTM C33	← No requirements →					2,000

Notes Applicable to Table 03300-A:

1. Coarse aggregate size numbers refer to ASTM C33. Where Size A and B are designated in Table 03300-A, it is intended that the smaller Size B aggregate is to be added, replacing a portion of the coarse or fine aggregate, in the minimum amount necessary to make a workable and pumpable mix with sand content not exceeding 41 percent of total aggregate.
 2. Slumps indicated are prior to addition of high range water reducer (super plasticizer).
 3. Mix designs shall be made for all but Class "D", which does not require trial batch, so that the compressive strength achieved for laboratory trial batches will not be less than 125 percent of specified design strength.
 4. Quantity of water to be used in the determination of water-cementitious materials (W/CM) ratio shall include free water on aggregates in excess of SSD and water portion of admixtures.
 5. Minimum cementitious content shall be adjusted in accordance with the requirements of Table 5.2.2.1 of ACI 350.5 and Table 4.2.2.1 of ACI 301 if smaller maximum coarse aggregate size is used.
 6. Required air content listed shall be adjusted in accordance with the requirements of Table 5.2.2.4 of ACI 350.5 and Table 4.2.2.7.b.1 of ACI 301 for severe exposure if a different maximum coarse aggregate size is used.
- B. Adjustment to Concrete Mixes: Mix design adjustments may be requested by CONTRACTOR when characteristics of materials, Site conditions, weather, test results, or other circumstances warrant; at no additional cost to OWNER and as approved by ENGINEER. Before using adjusted concrete mixes, laboratory test data and strength results shall be submitted to and approved by ENGINEER.
- C. Admixtures:
1. Use air-entraining admixture in concrete, unless otherwise shown or indicated. Add air-entraining admixture at admixture manufacturer's prescribed rate to produce concrete at point of placement having air content within prescribed limits.
 2. Use water-reducing or high-range water-reducing admixtures in all Class "A" and Class "AF" concrete.
 3. Use amounts of admixtures recommended by admixture manufacturer for climatic conditions prevailing at the Site at time of placing. Adjust quantities and types of admixtures as required to maintain quality.

- D. Slump Limits with High-Range Water Reducer:
1. Slump shall not exceed four inches prior to adding high-range water reducer and shall not exceed eight inches, measured at point of placement, after adding high-range water reducer.
- E. Shrinkage Limitation:
1. Concrete shrinkage for specimens cast in laboratory from trial batch with total water of 30.2 gallons per cubic yard or less, as measured at 21-day drying age and at 28-day drying age shall not exceed 0.039 percent and 0.045 percent, respectively. For trial batch with total water of 32.7 gallons per cubic yard or greater respective limits shall not exceed 0.035 percent and 0.040 percent. Limits in between shall be linear interpolated. Use mix design for construction that complies with trial batch shrinkage requirements. Shrinkage limitations apply to Class "A" concrete and Class "AF" concrete.
 2. Trial Batch Does Not Comply with Shrinkage Limitation:
 - a. If trial batch results do not comply with shrinkage limitation specified in the Contract Documents, redesign the mix to reduce shrinkage.
 - b. After mix has been repeatedly redesigned and ENGINEER is satisfied that all reasonable means to provide concrete mix that complies with shrinkage requirement have been exercised; and mix design still fails to comply with shrinkage limitation in the Contract Documents, ENGINEER reserves the right to accept the higher-shrinkage mix, provided that the quantity of shrinkage reinforcing in structures is increased.
 - c. "Reasonable means" will be construed as reducing the total water content to a maximum of 27 gallons per cubic yard, having the large aggregate blended so that eight percent to 18 percent of combined aggregate is retained on each sieve, using an alternate aggregate source, and a combination of these means.
 - d. Basis for shrinkage reinforcing increase will be proportional to amount that shrinkage value is over the specified shrinkage limitation and will be determined by ENGINEER. The cost of providing additional shrinkage reinforcement will be paid by the Owner.
- F. Color: Provide colored concrete where shown and indicated. Incorporate pigments into concrete mix according to pigment manufacturer's written instructions. Match color of Sample approved by ENGINEER.

2.7 BONDING AGENT

- A. Provide epoxy and epoxy-cement bonding agents in accordance with Section 03251, Concrete Accessories.

2.8 CONCRETE CURING MATERIALS

- A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M 182, Class 3.

- B. Curing Mats: Shall be heavy carpets or cotton mats, quilted at four inches on centers, and weighing minimum of 12 ounces per square yard when dry.
- C. Moisture-Retaining Cover: Provide one of the following, complying with ASTM C171:
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. White burlap polyethylene sheet.
- D. Liquid Curing Compound: ASTM C309 Type 1-D (water retention requirements):
 - 1. Provide fugitive dye.
 - 2. Curing compound shall be applied by roller or power sprayer.
 - 3. Product shall be listed in NSF/ANSI 61 if intended to be used on concrete which will come in contact with potable water.

2.9 FINISHING AIDS

- A. Evaporation Retardant:
 - 1. Product and Manufacturer: Provide one of the following:
 - a. MasterKure ER 50, by Master Builders.
 - b. Eucobar, by Euclid Chemical Company.
 - c. SikaFilm, by Sika Corporation.
 - d. Or equal.

2.10 CRACK INJECTION MATERIALS

- A. Structural Crack Repair System:
 - 1. Epoxy for Injection: Low-viscosity, high-modulus moisture insensitive type.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, by Sika Corporation.
 - b. Eucopoxy Injection Resin, by Euclid Chemical Company.
 - c. Or equal.
 - 3. Product shall be listed in NSF/ANSI 61 if intended to be used on concrete which will come in contact with potable water.
- B. Non-structural Crack Repair System:
 - 1. Hydrophobic Polyurethane Chemical Grout:
 - a. Provide hydrophobic polyurethane that forms a flexible gasket.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) SikaFix HH LV, by Sika Chemical Company.
 - 2) Hydro Active Flex SLV, by De Neef Construction Chemicals, Inc.
 - 3) Or equal.

- c. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.
 - d. Minimum elongation of 250 percent in accordance with ASTM D3574.
 - e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.
 - f. Product shall be listed in NSF/ANSI 61 if intended to be used on concrete which will come in contact with potable water.
2. Hydrophilic Acrylate-Ester Resin:
- a. Hydrophilic crack repair system shall be acrylate-ester resin that forms a flexible gasket and increase in volume a minimum of 50 percent when in contact with water.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Duroseal Multigel 850, manufactured by BBZ USA, Inc.
 - 2) Or equal.
 - c. Product shall be listed in NSF/ANSI 61 if intended to be used on concrete which will come in contact with potable water.

2.11 CONCRETE REPAIR MATERIALS

- A. Concrete repair mortar shall be pre-packaged, polymer-modified cementitious repair mortar with the following minimum properties:
 - 1. Compressive Strength at One Day: 2,000 psi (ASTM C109).
 - 2. Compressive Strength at 28 Days: 6,000 psi (ASTM C109).
 - 3. Bond Strength at 28 Days: 1,800 psi (ASTM C882 modified).
 - 4. Material shall be listed in NSF/ANSI 61 if intended to be used on concrete which will come in contact with potable water.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Five Star Structural Concrete, by Five Star Products, Inc. Use formulation recommended by manufacturer for the specific application conditions.
 - 2. SikaTop 122 Plus, SikaTop 123 Plus, SikaTop 111 Plus, or Sikacem 133, by Sika Corporation. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 - 3. MasterEmaco S 488 CI or S 466CI, by Master Builders Inc. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 - 4. Verticoat, Verticoat Supreme, or Euco SR-VO, by Euclid Chemical Company. Use formulation from among those listed in this paragraph recommended by manufacturer for specific application conditions.
 - 5. Or equal.
- C. Cement Mortar: Shall consist of mix of one part cement to 1.5 parts sand with sufficient water to form trowelable consistency. Minimum compressive strength at 28 days shall be 4,000 psi. Where required to match the color of adjacent concrete surfaces, blend white portland cement with standard portland cement so that, when dry, patching mortar matches the color of surrounding concrete.

2.12 CHEMICAL HARDENER

- A. Provide clear chemical hardener of fluosilicate family.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Lapidolith, by Sonneborn ChemRex Inc.
 - 2. Hornolith, by A.C. Horn, Inc.
 - 3. Or equal.

2.13 SHAKE-ON METALLIC HARDENER

- A. Provide metallic hardener formulated, processed, and packaged under stringent quality control at metallic hardener manufacturer-owned and -controlled factory. Hardener shall be a mixture of specially-processed and -graded aggregate, selected portland cement, and plasticizing agents.
- B. Product and Manufacturer: Provide one of the following:
 - 1. Euco-Plate H.D., by Euclid Chemical Company.
 - 2. Mastertop 200, by Master Builders, Inc.
 - 3. Or equal.

2.14 VAPOR RETARDER

- A. Vapor Retarder:
 - 1. Vapor retarder membrane shall comply with the following.
 - a. Water Vapor Transmission Rate, ASTM E96: 0.04 perms or lower.
 - b. Water Vapor Retarder, ASTM E1745: Meets or exceeds Class C.
 - c. Thickness of Retarder (plastic), ACI 302 1R: Not less than 10 mils.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Stego Wrap 10-mil Vapor Retarder, by Stego Industries LLC.
 - b. Griffolyn 10-mil, by Reef Industries.
 - c. Moistop Ultra, by Fortifiber Industries.
 - d. Or equal.
- B. Accessories:
 - 1. Provide accessories by same manufacturer as vapor retarder.
 - 2. Seam Tape:
 - a. Tape shall have water vapor transmission rate (ASTM E96) of 0.3 perms or lower.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Stego Tape by Stego Industries LLC.
 - 2) Griffolyn Fab Tape by Reef Industries.
 - 3) Moistop Tape by Fortifiber Industries.
 - 4) Or equal.
 - 3. Vapor Proofing Mastic:

- a. Mastic shall have a water vapor transmission rate ASTM E96, 0.3 perms or lower.
- 4. Pipe Boots:
 - a. Construct pipe boots from vapor barrier material, pressure sensitive tape, mastic, or a combination thereof, in accordance with manufacturer's recommendations.

2.15 SOURCE QUALITY CONTROL

- A. Concrete materials may require testing, as directed by ENGINEER, at any time during the Work if concrete quality is in question. Provide access to material stockpiles and facilities at all times. Tests shall be done at no expense to OWNER.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the substrate and conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 CONCRETE MIXING

- A. General:
 - 1. Concrete may be produced at batch plants or by the ready-mixed process. Batch plants shall comply with recommendations of ACI 304R and have sufficient capacity to produce concrete of qualities required and in quantities required to comply with the accepted Progress Schedule. All plant facilities are subject to acceptance of ENGINEER.
 - 2. Mixing:
 - a. Mix concrete with a rotating type batch machine, except where hand mixing of very small quantities is approved by ENGINEER.
 - b. Remove hardened accumulations of cement and concrete from drum and blades to ensure proper mixing action.
 - c. Replace mixer blades upon loss of ten percent of mixer blades' original height.
- B. Site Mixing:
 - 1. When Site mixing of concrete is approved by ENGINEER mix all materials for concrete in a drum-type batch mixer.
 - a. For mixers of one cubic yard or smaller capacity, continue mixing at least 1.5 minutes but not more than five minutes after all ingredients are in the mixer, before any part of batch is released.
 - b. For mixers of capacity larger than one cubic yard, increase minimum 1.5 minutes of mixing time by 15 seconds for each additional cubic yard or fraction thereof.

2. Do not exceed mixer manufacturer's published rating of the mixer, or mixer nameplate capacity, for total volume of materials used per batch.
 3. Equip mixer with automatic controls for proportioning materials and proper, measured quantities.
 4. Do not exceed 45 minutes total elapsed time between intermingling of damp aggregates and cement to discharge of completed mix.
- C. Ready-Mix Concrete:
1. Comply with ASTM C94 and the Contract Documents.
 - a. Plant Equipment and Facilities: Conform to requirements of NRMCA certification.
 - b. Mix concrete in revolving-type truck mixers that are in good condition and produce thoroughly-mixed concrete conforming to the Contract Documents.
 - c. Do not exceed rated capacity of mixer.
 - d. Mix concrete for minimum of two minutes after arrival at the Site, or as recommended by mixer manufacturer.
 - e. Do not allow drum to mix while in transit.
 - f. Mix at proper speed until concrete is discharged from mixer.
 - g. Maintain adequate facilities at the Site for continuous delivery of concrete at required rates.
 - h. Provide access to mixing plant for ENGINEER upon request.
 2. When silica fume is used in dry compacted form, comply with the following mix requirements and ensure full dispersion:
 - a. For all types of mixing equipment, increase mix times by 40 percent over minimum mix time required to achieve mix uniformity defined in ASTM C94.
 - b. For truck-mixed and central-mixed concrete, maximum allowable batch size shall be 80 percent of maximum in accordance with ASTM C94.
- D. Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery to prevent delay of placing concrete after mixing, or holding dry-mixed materials too long in mixer before the adding water and admixtures.

3.3 TRANSPORTING CONCRETE

- A. Transport and place concrete not more than 90 minutes after water has been added to the dry ingredients.
- B. Avoid spilling and separation of concrete mixture during transportation.
- C. Do not place concrete in which the ingredients have separated.
- D. Do not retemper partially set concrete.
- E. Use suitable equipment for transporting concrete from mixer to forms.

3.4 PREPARATION FOR CONCRETING

- A. Submit to ENGINEER laboratory trial batch test results for proposed mixes at least 15 days prior to start of Work. Do not begin concrete production until associated laboratory trial batch test result submittal has been approved by ENGINEER.
- B. Notify ENGINEER a minimum of 24 hours in advance of placing concrete to allow for inspection of form work, joints, waterstops, reinforcement, embedded items, and vapor retarders. The section to be placed shall be fully prepared for concrete placement at the time of notice. Confirm inspection status with ENGINEER a minimum of 4 hours prior to concrete placement. Do not begin placing concrete until Work is in conformance with the Contract Documents.
- C. Subgrade surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- D. Reinforcing steel and embedded items shall be completely cleaned of mortar, loose rust, form release compounds, dirt, or any other substance which would interfere with proper bonding with concrete. Protective coatings on embedded aluminum items shall continuously cover the surface to be in contact with concrete. Any defects in the coating shall be repaired.
- E. Do not place concrete until flow of water entering space to be filled with concrete has been properly stopped or has been diverted by pipes, or other means, and carried out of the forms, clear of the Work. Do not deposit concrete underwater, and do not allow water to rise on concrete surfaces until concrete has attained its initial set. Do not allow water to flow over concrete surface in manner and or velocity that will injure concrete surface finish. Provide temporary pumping or other dewatering operations for removing water as required.
- F. Prepare joint surfaces in accordance with Section 03251, Concrete Accessories.
- G. Installation of Vapor Retarder:
 - 1. Provide vapor retarder under slabs-on-grade and outside walls to receive resilient floor finishes, carpet, ceramic and slate tile, chemical resistant coatings, and where shown or indicated on the Drawings.
 - 2. Install in accordance with manufacturer's instructions, ASTM E1643, and the following:
 - a. Unroll vapor retarder with longest dimension parallel with direction of the pour.
 - b. Lap vapor retarder over footings and seal to foundation walls.
 - c. Overlap vapor retarder joints by six inches and seal with vapor retarder manufacturer's tape.

- d. Seal penetrations, including pipes, in accordance with vapor retarder manufacturer's instructions.
- e. Penetration of vapor retarder is not allowed except for reinforcing steel and permanent utilities.
- f. Repair damaged areas of vapor retarder by providing, for each damaged area, patch of vapor retarder material and overlapping damaged area with the patch by six inches on each side, and securely and continuously taping all four sides of patch to undamaged vapor retarder.

3.5 CONCRETE PLACEMENT

A. General:

- 1. Place concrete continuously, so that no concrete will be placed on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. If section cannot be placed continuously, provide construction joints in accordance with Section 03251, Concrete Accessories.
- 2. Deposit concrete as nearly as practical in its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to action that may cause segregation.
- 3. Screed concrete that is to receive other construction to proper level to avoid excessive skimming or grouting.
- 4. Do not use concrete that becomes non-plastic and unworkable, or does not conform to required quality limits, or that has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the Site and dispose of it in conformance with Laws and Regulations.
- 5. Do not place concrete until forms, bracing, reinforcing, and embedded items are each in final position and secure.
- 6. Do not place footings in freezing weather unless adequate precautions are taken against frost action.
- 7. Do not place footings, piers or pile caps on frozen soil.
- 8. Unless otherwise instructed, place concrete only when ENGINEER is present.
- 9. Allow minimum of three days between adjoining concrete placements.

B. Bonding for Next Concrete Pour:

- 1. Prepare for bonding of fresh concrete to concrete that has set but is not fully cured, as follows:
 - a. Thoroughly wet the surface, but allow no free-standing water.
 - b. For horizontal surfaces place a six-inch layer of Construction Joint Grout, as specified in Section 03600, Grouting, over the hardened concrete surface.
 - c. Place fresh concrete before the grout has attained its initial set.
- 2. Accomplish bonding of fresh concrete to fully cured, hardened, existing concrete by using a bonding agent as specified in Section 03251, Concrete Accessories.

C. Concrete Conveying:

1. Handle concrete from point of delivery at the Site, transfer to concrete conveying equipment, and transfer to locations of final deposit as rapidly as practical by methods that prevent segregation and loss of concrete mix materials.
2. Provide mechanical equipment for conveying concrete to ensure continuous flow of concrete at delivery end of conveyor. Provide runways for wheeled concrete conveying equipment from concrete delivery point to locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice, and other deleterious materials.
3. Do not use chutes for distributing concrete, unless accepted by ENGINEER.
4. Pumping concrete is allowed, however do not use aluminum pipe for conveying concrete.

D. Placing Concrete into Forms:

1. Deposit concrete in forms in horizontal layers not deeper than 18 inches each and in manner that avoids inclined construction joints. Where placement consists of several layers, place concrete at such rate that concrete being integrated with fresh concrete while still plastic.
2. Do not allow concrete to free-fall within the form from height exceeding four feet. Where high-range water reducer is used to extend slump to at least six inches, maximum allowable free-fall of concrete is six feet. Use “elephant trunks” to prevent free-fall and excessive splashing of concrete on forms and reinforcing. Discontinue free-falls in excess of four feet if there is evidence of segregation.
3. Remove temporary spreaders in forms when concrete placing has reached elevation of such spreaders.
4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidating concrete in accordance with applicable recommended practices in ACI 309. Vibration of forms and reinforcing is not allowed unless otherwise accepted by ENGINEER.
5. Where height of concrete placement in walls exceeds 14 feet, provide temporary windows in formwork to facilitate vibration. Properly close temporary windows when height of concrete approaches windows. Determine location, size, and spacing of temporary windows to suit equipment used.
6. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly-spaced locations not farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate the layer of concrete and at least six inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcing and other embedded items without causing segregation of concrete mix.
7. Do not place concrete in beam and slab forms until concrete previously placed in columns and walls is no longer plastic.

8. Prevent voids in the concrete. Force concrete under pipes, sleeves, openings, and inserts from one side until visible from the other side.
- E. Placing Concrete Slabs:
1. Deposit and consolidate concrete slabs in continuous operation, within limits of construction joints, until placing of a slab panel or section is completed.
 2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcing and other embedded items and into corners.
 3. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified in this Article for formed concrete structures.
 4. Bring slab surfaces to correct elevation and level. Smooth the surface, leaving surface free of humps or hollows. Do not sprinkle water on surface while concrete is plastic. Do not disturb slab surfaces prior to commencing concrete finishing.
 5. Where slabs are placed in conditions of high temperature or wind that could lead to formation of plastic shrinkage cracks, provide evaporation retardant applied in accordance with retardant manufacturer's recommendations, when required by ENGINEER.
- F. Quality of Concrete Work:
1. Concrete shall be solid, compact, and smooth, and free of laitance, cracks, and cold joints.
 2. Concrete for liquid-retaining structures, and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.
 3. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces with cracks or voids, that are unduly rough, or are defective in any other way. Thin patches or plastering are unacceptable.
 4. Leaks through concrete that exhibit flowing water, and cracks, holes, or other defective concrete in areas of potential leakage, shall be repaired and made watertight.
 5. Repair, removal, and replacement of defective concrete as directed by ENGINEER shall be at no additional cost to OWNER.
- G. Cold Weather Placing:
1. Protect concrete Work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures, in compliance with ACI 306.1 and the Contract Documents.
 2. When air temperature has fallen to or may be expected to fall below 40 degrees F, provide adequate means to maintain temperature in area where concrete is being placed between 50 degrees F and 70 degrees F for at least seven days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain temporary heating and protection as necessary so that ambient temperature does not fall more than 30 degrees F in the 24 hours

following the seven-day period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.

3. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing for concrete as required to obtain concrete mixture temperature not less than 55 degrees F and not more than 85 degrees F at point of placement.
4. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Before placing concrete, verify that forms, reinforcing, and adjacent concrete surfaces are entirely free of frost, snow, and ice.
5. Do not use salt or other materials containing antifreeze agents. Do not use chemical accelerators or set-control admixtures unless approved by ENGINEER and tested in mix design proposed for use.

H. Hot Weather Placing:

1. When hot weather conditions exist that would impair the quality and strength of concrete, place concrete in compliance with ACI 305.1 and the Contract Documents.
2. When ambient air temperature is at or above 90 degrees F and rising, cool ingredients before mixing concrete to maintain concrete temperature at time of placement below 80 degrees F. When ambient air temperature is at or above 90 degrees F and falling, cool the ingredients before mixing concrete to maintain concrete temperature at time of placement below 85 degrees F. In no case shall the concrete temperature at time of placement exceed 90 degrees F.
3. Mixing water may be chilled, or chopped ice may be used to control concrete temperature provided the water equivalent of ice is calculated in total amount of mixing water. If required, reduce the time from addition of mix water to placement, or use set-retarding admixture.
4. Cover reinforcing materials with water-soaked burlap if ambient air temperature becomes too hot, so that reinforcing material temperature does not exceed ambient air temperature immediately before embedment of reinforcing in concrete.
5. Wet forms thoroughly before placing concrete.
6. Do not place concrete at temperature that causes difficulty from loss of slump, flash set, or cold joints.
7. Do not use set-control admixtures unless approved by ENGINEER in mix design.
8. Obtain ENGINEER's approval of substitute methods and materials proposed for use.

3.6 FINISHING OF FORMED SURFACES

A. Standard Form Finish:

1. Standard form finish shall be basically smooth and even, but is allowed to have texture imparted by the form material used. Repair defects in accordance with the Contract Documents.
2. Use standard form finish for the following:

- a. Exterior vertical surfaces from foundation up to one foot below grade.
- b. Vertical surfaces not exposed to view.
- c. Other areas shown or indicated.

B. Smooth Form Finish:

- 1. Produce smooth form finish by selecting form materials that will impart smooth, hard, uniform texture. Arrange panels in orderly and symmetrical manner with minimum of seams. Repair and patch defective areas in accordance with the Contract Documents.
- 2. Use smooth form finish for the following:
 - a. Exterior surfaces exposed to view.
 - b. Surfaces to be covered with coating material. Coating material may be applied directly to concrete or may be a covering bonded to concrete such as waterproofing, dampproofing, painting, or other similar system.
 - c. Interior vertical surfaces of liquid-containers.
 - d. Interior and exterior exposed beams and undersides of slabs.
 - e. Surfaces to receive abrasive blasted finish.
 - f. Surfaces to receive smooth rubbed or grout cleaned finish.
 - g. Other areas shown or indicated.

C. Smooth Rubbed Finish:

- 1. Provide smooth rubbed finish to concrete surfaces that have received smooth form finish and where defects have been repaired, as follows:
 - a. Rubbing of concrete surfaces not later than the day after form removal.
 - b. Moistening of concrete surfaces and rubbing with carborundum brick or other abrasive until uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.
- 2. Use smooth rubbed finish for the following:
 - a. Interior exposed walls and other vertical surfaces.
 - b. Exterior exposed walls and other vertical surfaces down to one foot below grade.
 - c. Interior and exterior horizontal surfaces, except exterior exposed slabs and steps.
 - e. Other areas shown or indicated.

D. Related Unformed Surfaces:

- 1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown or indicated.

3.7 SLAB FINISHES

A. Float Finish:

- 1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete

has stiffened sufficiently. Check and level the surface plane to tolerance not exceeding 1/4-inch in ten feet when tested with a ten-foot straightedge placed on surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture.

2. Use float finish for the following:
 - a. Interior exposed horizontal surfaces of liquid-containing structures, except those to receive grout topping.
 - b. Exterior below-grade horizontal surfaces.
 - c. Surfaces to receive additional finishes, except as shown or indicated.
- B. Trowel Finish:
1. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
 2. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten foot straight edge. Grind smooth surface defects that would otherwise project through applied floor covering system.
 3. Use trowel finish for the following:
 - a. Interior exposed slabs, unless otherwise shown or indicated.
 - b. Slabs that receive one of the following: resilient flooring, carpeting, or ceramic tile.
- C. Non-Slip Broom Finish:
1. Immediately after float finishing, slightly roughen concrete surface by brooming in direction perpendicular to main traffic route. Use fine fiber-bristle broom, unless otherwise directed by ENGINEER. Coordinate required final finish with ENGINEER before applying finish.
 2. Use non-slip broom finish for the following:
 - a. Exterior exposed horizontal surfaces subject to lightweight foot traffic.
 - b. Interior and exterior concrete steps and ramps.
- D. Scratched Finish:
1. After providing float finish, roughen concrete surface with rake before concrete's final set. Amplitude of surface shall be minimum of 1/4-inch.
 2. Provide scratched finish for the following:
 - a. Horizontal surfaces that will receive grout topping or concrete equipment pad.
 - b. Surfaces so indicated on the Drawings or elsewhere in the Contract Documents.

3.8 CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying, excessive cold or hot temperatures, and maintain without drying at relatively constant temperature for period necessary for hydration of cement and proper hardening of concrete.
2. Start curing after placing and finishing concrete, as soon as free moisture has disappeared from concrete surface. Keep surface continuously moist during entire curing period. Cure for a minimum of 10 days and in accordance with ACI 301, and ACI 308.1 procedures. For concrete sections over 30-inches thick, the curing period shall be for a minimum of 14 days. Avoid rapid drying at end of final curing period.
3. For curing, use water that is free of impurities that could etch or discolor exposed concrete surfaces.
4. Confine water for curing to area being cured.

B. Curing Methods: Curing methods are specified below. Curing methods to be used on each type of concrete surface are specified elsewhere in this Article.

1. Water Curing. Cure by one of the following methods:
 - a. Keep concrete surface continuously wet.
 - b. Ponding or immersion.
 - c. Continuous water-fog spray.
 - d. Covering concrete surface with curing mats, thoroughly saturating mats with water, and keeping mats continuously wet with sprinklers or porous hoses. Place curing mats to cover concrete surfaces and edges with four-inch horizontal lap over adjacent mats; provide eight-inch lap over adjacent mats at vertical surfaces. If necessary, weigh down curing cover to maintain contact with concrete surface.
2. Form Curing. Cure by one of the following methods:
 - a. Forms shall be maintained and loosened during curing period.
 - b. Immediately after forms are loosened or removed, continue with the required curing method as applicable, for remainder of curing period.
 - c. Where wood forms are kept in place, apply water to keep forms wet.
3. Moisture Retaining Cover Curing. Cure as follows:
 - a. Cover concrete surfaces with the required moisture retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least three inches and sealed using waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover material and waterproof tape.
4. Liquid Compound Curing. Cure as follows:
 - a. Unless otherwise approved by ENGINEER, provide water curing or form curing. Request to use liquid curing compound will be considered by ENGINEER on case-by-case basis. Construction joints, formed surfaces prior to receiving specified form finish, and concrete to receive surface treatment where surface treatment will be bonded to concrete surface (such as, but not limited to grout fill, hardener, coatings, lining, water repellent, painting, resilient flooring, terrazzo flooring, ceramic tile, quarry tile, chemical resistant coatings, or other applications) shall be water-cured or form-cured.

- b. In liquid-retaining structures, provide water curing or form curing, unless other curing method is approved by ENGINEER. Requests to use liquid curing compound will be considered by ENGINEER on case-by-case basis. Request shall provide valid construction reason or safety reason for using liquid compound curing including reason why other curing methods are not viable.
- c. Apply curing compounds immediately after final finishing or after terminating water curing. Apply curing compound in continuous operation by power spray equipment in accordance with curing compound manufacturer's directions. If areas are subjected to rainfall within three hours after completing curing compound application, area shall be recoated. Maintain coating continuity and repair areas damaged during curing period.
- d. When liquid curing compound is used, apply first coat of liquid curing compound at compound manufacturer's recommended coverage rate, and subsequently apply second coat at identical rate, thus providing twice the curing compound manufacturer's recommended coverage.
- e. At end of curing period, remove liquid curing compound where required.

C. Formed Surfaces: Use the following curing methods:

- 1. Walls That Will Retain Liquid or That are Under Ground Surface:
 - a. If forms are wood, form curing is allowed for entire curing period. If forms are steel, form curing is allowed for maximum of three days after which forms shall be removed so that concrete is free of the forms for remainder of the curing process.
 - b. Immediately after the forms are loosened or removed, continue with water curing for remainder of curing period.
 - c. When wall surface will not receive surface treatment and when allowed by ENGINEER, use of liquid curing compound is allowed. Before using liquid compound curing, use water curing or form curing for at least the first three days of curing.
- 2. Formed Slab Underside and Beam Surfaces Where Will Retain Liquid:
 - a. Form curing is allowed for the full curing period.
 - b. Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.
 - c. When slab surface will not receive surface treatment and when allowed by ENGINEER, use of liquid curing compound is allowed.
- 3. Vertical Joint Surfaces and Surfaces to Receive Surface Treatment:
 - a. Form curing is allowed for entire curing period.
 - b. Immediately after forms are loosened or removed, continue with water curing for remainder of curing period.
- 4. Cure other formed surfaces using an appropriate curing method specified in the Contract Documents.

D. Unformed Surfaces: Treat with one of the following curing methods:

- 1. Slabs and Mats That Will Retain Liquid or are Below Ground Surface:
 - a. Water curing.

- b. Moisture-retaining cover curing when allowed by ENGINEER.
 - c. When slab or mat surface will not receive surface treatment and when allowed by ENGINEER, use of liquid curing compound is allowed. Before using liquid compound curing, use water curing or form curing for at least the first three days of curing.
 - 2. Construction Joint Surfaces and Slab and Mat Surfaces to Receive Surface Treatment.
 - a. Water curing.
 - b. Moisture-retaining cover curing.
 - 3. Cure other formed surfaces using an appropriate curing method specified in the Contract Documents.
- E. Temperature of Concrete During Curing:
 - 1. When ambient temperature is 40 degrees F or less, continuously maintain concrete temperature between 50 degrees F and 70 degrees F throughout curing period. When necessary, before concrete placing provide for temporary heating, covering, insulation, or housing as required to continuously maintain specified temperatures and moisture conditions throughout concrete curing period. Provide cold weather protection in accordance with ACI 306.1.
 - 2. When the ambient temperature is 80 degrees F and above, or during other climatic conditions that would cause too-rapid drying of concrete, before starting concrete placing, provide wind breaks and shading as required, and fog spraying, wet sprinkling, or moisture retaining coverings as required. Continuously protect concrete throughout concrete curing period. Provide hot weather protection in accordance with ACI 305.1, unless otherwise specified.
 - 3. Maintain concrete temperature as uniformly as possible, and protect from rapid ambient temperature changes. Avoid concrete temperature changes that exceed five degrees F in one hour and 50 degrees F in 24-hour period.
- F. Protection:
 - 1. During curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and damage by rain and flowing water. Protect finished concrete surfaces from damage by subsequent construction operations.

3.9 CONCRETE INSTALLATION TOLERANCES

- A. Installation Tolerances:
 - 1. Concrete placement tolerances, unless otherwise specified in the Contract Documents, shall be in accordance with ACI 117.
 - 2. Notify ENGINEER in writing when concrete placement does not conform with required tolerances, as soon as the condition is known to CONTRACTOR.
 - 3. When concrete installation does not conform to required tolerances, do not repair or correct by grinding unless specified in the Contract Documents or approved by ENGINEER in writing.
 - 4. Verification Measurements:

- a. If surfaces where tolerances are in question, obtain measurements to verify conformance with tolerances in manner acceptable to ENGINEER.
- b. If surfaces tolerances are in question, cost of obtaining measurements shall be at no additional cost to the OWNER.
- c. Before obtaining measurements, obtain ENGINEER's acceptance of method proposed for obtaining measurements.
- d. After obtaining measurements, submit measurements to ENGINEER.
5. Submit with verification measurements submittal proposed method to rectify out-of-tolerance concrete. Do not start repair Work without obtaining ENGINEER's approval.

3.10 FIELD QUALITY CONTROL

A. Field Testing Services:

1. OWNER will employ testing laboratory to perform field quality control testing for concrete. ENGINEER will direct the testing requirements.
2. Testing laboratory will make standard compression test cylinders and entrained air tests as specified in this Article, under observation of ENGINEER or Resident Project Representative.
3. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.
4. CONTRACTOR shall provide all curing and necessary cylinder storage facilities in accordance with ASTM C31.

B. Quality Control Testing During Construction:

1. Perform sampling and testing for field quality control during placement of concrete, as follows:
 - a. Sampling Fresh Concrete: ASTM C172.
 - b. Slump: ASTM C143; one test for each concrete load at point of discharge.
 - c. Concrete Temperature: ASTM C1064; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
 - d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
 - e. Unit Weight: ASTM C138; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
 - f. Compression Test Specimens:
 - 1) In accordance with ASTM C31; make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
 - 2) Cast, store, and cure specimens in accordance with ASTM C31.

- 3) Test and record the following when cylinders are cast: slump, concrete temperature, air content, water/cementitious materials ratio, and unit weight.
 - g. Compressive Strength Tests:
 - 1) In accordance with ASTM C39; one specimen tested at seven days, and two specimens tested at 28 days. Test fourth cylinder if needed to verify test results. If 4-inch by 8-inch cylinders are used, three specimens shall be tested at 28 days.
 - 2) Adjust mix design if test results are unsatisfactory and resubmit for approval.
 - 3) Concrete that does not comply with strength requirements will be considered as defective Work.
 - h. Water/Cementitious Materials Ratio: Perform one test from each sample from which compression test specimens are taken, in accordance with AASHTO TP23.
 - i. Within 24 hours of completion of test, testing laboratory will submit certified copy of test results to CONTRACTOR and ENGINEER.
- C. Evaluation of Field Quality Control Tests:
1. Do not use concrete delivered to final point of placement having slump, concrete temperature, total air content or unit weight outside specified values.
 2. Water/Cementitious Materials Ratio:
 - a. When water content testing indicates water/cementitious materials ratio to exceed specified requirements by greater than 0.02, remaining batches required to complete concrete placement shall have water content decreased in the mix and water reducing admixture dosage increased as required to bring subsequently-batched concrete within specified water/cementitious materials ratio.
 - b. Perform additional testing to verify compliance with specified water/cementitious materials ratio.
 - c. Do not resume concrete production for further concrete placement until CONTRACTOR has identified cause of excess water in the mix and revised batching procedures, or adjusted the mix design (and obtained ENGINEER's associated approval) to bring water/cementitious materials ratio into conformance with the Contract Documents.
 3. Compressive Strength:
 - a. Compressive strength tests for laboratory-cured cylinders will be acceptable if the averages of all sets of three consecutive compressive strength tests results equal or exceed specified 28-day design compressive strength of the associated type or class of concrete, and no individual strength test falls below required compressive strength by more than 500 psi.
 - b. Questionable Field Conditions During Concrete Placement:
 - 1) Where questionable field conditions exist during concrete placement or immediately thereafter, strength tests of specimens cured under field conditions will be required by ENGINEER to check adequacy of curing and protecting of concrete placed. Specimens shall be molded

at the same time and from the same samples as laboratory-cured specimens.

- 2) Provide improved means and procedures for protecting concrete when 28-day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory cured cylinders.
 - 3) When laboratory-cured cylinder strengths are appreciably higher than minimum required compressive strength, field-cured cylinder strengths need not exceed minimum required compressive strength by greater than 500 psi even though the 85 percent criterion may not be met.
 - 4) If individual tests of laboratory-cured specimens produce strengths more than 500 psi below the required minimum compressive strength, or if tests of field-cured cylinders indicate deficiencies in protection and curing, provide additional measures to ensure that load-bearing capacity of the structure is not jeopardized or impaired. If likelihood of low-strength concrete is confirmed and evaluations indicate load-bearing capacity may have been reduced, perform tests of cores from the concrete in question at CONTRACTOR's expense.
- c. If compressive strength tests fail to indicate compliance with minimum requirements of the Contract Documents, concrete represented by such tests will be considered defective.

D. Testing Concrete Structure for Strength:

1. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42 and the following:
 - a. Obtain at least three representative cores from each concrete member or suspect area of concrete at locations directed by ENGINEER.
 - b. Strength of concrete for each series of cores will be acceptable if average compressive strength is at least 85 percent of specified compressive strength and no single core is less than 75 percent of required 28-day required concrete compressive strength.
 - c. Testing laboratory shall submit test results to ENGINEER on same day that tests are completed. Include in test reports Project name and number (if any), date of sampling and testing, CONTRACTOR name, name of concrete testing laboratory, exact location of test core in the Work, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength, and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of concrete as placed, and moisture condition of the core at time of testing.
2. Fill core holes solid with non-shrink grout in accordance with Section 03600, Grouting, and finish to match adjacent concrete surfaces.

3. If results of core tests are unacceptable or if it is impractical to obtain cores, perform static load test and evaluations complying with ACI 318 and ACI 350, as directed by ENGINEER.
- E. Concrete Tolerance Verification Measurements: Refer to Article 3.9 of this Section.
- F. Supplier's Services:
1. Water-Reducing Admixture Manufacturer: Furnish services of qualified concrete technician employed by admixture manufacturer to assist in proportioning concrete for optimum use of admixture. Concrete technician shall advise on proper addition of admixture to concrete and on adjustment of concrete mix proportions to meet changing conditions at the Site.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Temporary Openings:
1. Openings in concrete walls and slabs required for passage of Work are allowed only upon approval of ENGINEER.
 2. Temporary openings made in concrete shall be provided with waterstop in below-ground or liquid-retaining members and structures. Reinforcement going through and around the opening shall be made continuous to provide continuity and shall be approved by the ENGINEER.
 3. Temporary openings that remain in concrete structures shall be filled with the same class of concrete as the adjoining construction, after the Work causing need for temporary opening is complete, unless otherwise shown or directed by ENGINEER. Mix, place, and cure concrete as specified in this Section to blend with in-place construction. Provide miscellaneous concrete filling shown or required to complete the Work.
- B. Bases or Pads for Piping, Panels, and Equipment:
1. Unless specifically shown or indicated otherwise, provide concrete bases or pads for equipment, floor-mounted panels, and floor-mounted supports for piping and similar construction. Provide all concrete pad and base Work not specifically included under other Sections .
 2. Dimensions and Elevations:
 - a. Coordinate and construct bases and pads to dimensions shown or indicated, or as required to comply with equipment, panel, or piping manufacturer's requirements and elevations indicated on the Drawing.
 - b. Unless otherwise shown or indicated, place concrete bases for equipment up to one-inch below the equipment manufacturer's base or mounting plate.
 - c. Where specific dimensions or elevations are not shown or indicated, bases and pads shall be six inches thick and extend three inches outside dimensions of the equipment, panel, or supports.
 3. Finish: Bases and pads outside of areas to receive non-shrink grout shall have smooth trowel finish, unless special finish such as terrazzo, ceramic tile, quarry tile, or heavy-duty concrete topping is required. In such cases, provide

appropriate concrete finish. Surfaces of bases and pads to receive non-shrink grout shall have broom finish.

C. Curbs:

1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green followed by steel-troweling surfaces to hard, dense finish with corners, intersections, and terminations slightly rounded.
2. Exterior curbs shall have rubbed finish for vertical surfaces and broomed finish for top surfaces.

D. Steel Pan Stairs:

1. Provide concrete fill for steel pan stair treads, landings, and associated items. Screed, tamp, and finish concrete surfaces as shown or indicated.
 - a. Cast into the concrete fill safety inserts and accessories as shown or indicated.

3.12 REPAIR OF CONCRETE PLACED UNDER THIS CONTRACT

A. Repair of Formed Surfaces:

1. Repair the following defects in all formed finishes:
 - a. Spalls, air bubbles, rock pockets, form depressions, and other defects that are more than 1/4-inch in depth.
 - b. Holes from tie rods and other form tie systems.
 - c. Fins, offsets, and other projections that extend more than 1/4-inch beyond designated concrete member surface.
 - d. Structural cracks, as defined by ENGINEER.
 - e. Non-structural cracks greater than 0.010-inch wide as defined by ENGINEER. In liquid-retaining structures, elevated slabs subject to the elements or washdowns, below-grade members, and cracks that evidence leakage. Where it is not possible to verify whether a crack is leaking, repair the crack.
2. Repair the following defects in smooth-finish surfaces, in addition to those listed above in this Section:
 - a. Spalls, air bubbles, rock pockets, form depressions, and other defects that extend to more than 1/2-inch in width in any direction, no matter how deep.
 - b. Spalls, air bubbles, rock pockets, form depressions, and other defects of any size that exceed three in number in a 12-inch by 12-inch area, or 12 in number in a three-foot by three-foot area.
 - c. Fins, offsets, and other projections shall be completely removed and smoothed.
 - d. Scratches and gouges in concrete surface.
 - e. Texture and color irregularities. In liquid-retaining surfaces, texture and color irregularities need not be repaired when greater than 12 inches below minimum normal operating liquid surface elevation, except where such defects are indicative of reduced durability.

3. Where smooth rubbed or grout cleaned finish is specified, minor surface defects repairable by the finishing process need not be repaired prior to finish application, when approved by ENGINEER.
- B. Method of Repair of Formed Surfaces:
1. Immediately after removing forms, repair and patch defective areas with cement mortar or concrete repair mortar as directed by ENGINEER. Make repairs made to liquid-retaining structures and below-grade surfaces with repair mortar only. Repair form tie holes in liquid-retaining or below-grade surfaces with non-shrink grout in accordance with Section 03600, Grouting.
 2. Honeycombs, Rock Pockets, and Holes Left by Tie Rods and Bolts:
 - a. Cut out honeycomb, rock pockets, voids, and holes left by tie rods and bolts, down to solid concrete but, in no case, to depth less than one-inch for cement mortar and 1/2-inch for repair mortar. Make edges of cuts perpendicular to concrete surface.
 - b. Before placing cement mortar, thoroughly clean and brush-coat area to be patched with specified bonding agent.
 - c. When using concrete repair mortar, use of bonding agent is optional; prepare the surface and place mortar in accordance with mortar manufacturer's recommendations.
 - d. Repairs at exposed-to-view surfaces shall match the color of surrounding concrete, except color matching is not required for interior surfaces of liquid-retaining surfaces up to one foot below typical minimum liquid level. Impart texture to repaired surfaces to match texture of existing adjacent surfaces. Provide test areas at inconspicuous locations to verify mixture, texture, and color match before proceeding with patching.
 - e. Compact mortar in place and strike off slightly higher than the surrounding surface.
 3. Structural Cracks: Pressure-grout structural cracks using injectable epoxy installed using pressurized system. Apply in accordance with epoxy manufacturer's directions and recommendations.
 4. Non-structural Cracks: Shall be pressure-grouted using hydrophobic or hydrophilic resin. Install in accordance with resin manufacturer's directions and recommendations.
 5. Determination of the crack type shall be made by the ENGINEER.
 6. Holes Through Concrete:
 - a. Using plunger-type gun or other suitable device, fill holes extending through concrete from least-exposed face, using flush stop held at exposed face; completely fill the hole with specified repair material.
 - b. At below-grade and liquid-containing members, fill holes with concrete repair mortar and use color-matched cement mortar for outer two inches at exposed-to-view surfaces.
 7. Where powerwashing or scrubbing is not adequate, abrasive blast exposed-to-view surfaces that require removal of stains, grout accumulations, sealing compounds, and other substances marring the surfaces. Use sand finer than No. 30 and air pressure from 15 to 25 psi.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to specified tolerances for each surface and finish. Correct low and high areas in accordance with this Section.
2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using template having the required slope. Correct high and low areas in accordance with this Section.
3. Repair finish of unformed surfaces containing defects that adversely affect concrete durability. Surface defects include crazing, cracks in excess of 0.01-inch wide, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
4. Repair structural cracks in all structures and non-structural cracks in liquid-retaining structures. In liquid-retaining structures, where dry face of concrete member can be observed, repair all cracks evidencing any rate of water flow through crack. Where dry face of member cannot be observed, repair all cracks.

D. Methods of Repair of Unformed Surfaces:

1. Correct high areas in unformed surfaces by grinding, after concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
2. Correct low areas in unformed surfaces, during or immediately after completion of surface finishing, by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Where repairs are required and concrete has already set, sawcut around perimeter of area to be repaired to depth of 1/2-inch and remove concrete so that minimum thickness of repair is 1/2-inch. Apply specified concrete repair mortar in accordance with repair mortar manufacturer's directions and recommendations.
3. Repair defective areas, except random cracks and single holes not exceeding one-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Minimum thickness of repair shall be 1.5 inches. Dampen concrete surfaces in contact with patching concrete and brush with specified bonding agent. Place patching concrete while bonding agent is tacky. Mix patching concrete of same materials and proportions to provide concrete of same classification as original, adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
4. Repair isolated, random, non-structural cracks (in members that are not below grade or liquid-retaining), and single holes not greater than one-inch diameter, by dry-pack method. Groove top of cracks, and cut out holes to sound concrete, and clean repair area of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with the specified bonding agent. Place dry-pack before cement grout takes its initial set. Mix dry-pack, consisting of one part portland cement to 2.5 parts fine aggregate passing No. 16 mesh sieve, using only enough water as required for handling and placing. Compact

dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for at least 72 hours.

5. Structural cracks shall be pressure-grouted using injectable epoxy. Apply in accordance with epoxy manufacturer's directions and recommendations.
6. Non-structural cracks in below-grade and liquid-retaining structures shall be pressure-grouted using hydrophilic resin. Apply in accordance with resin manufacturer's directions and recommendations.
7. Determination of crack type will be by ENGINEER.
8. Ensure that surface is acceptable for flooring material to be installed in accordance with flooring manufacturer's recommendations.

E. Other Methods of Repair:

1. Repair methods not specified in this Section may be used when approved by ENGINEER.

+ + END OF SECTION + +

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SECTION 03420

DESIGNED PRECAST CONCRETE VAULTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all professional services, labor, materials, equipment and incidentals as shown, specified and required to design, furnish, and install all precast concrete structures.
2. The Work includes:
 - a. Precast Pigging Station Vault
 - 1) Interior dimensions: 10'-6" long, 8'-0" wide, 8'-4" high

B. General:

1. Structures shall conform in shape, size, dimensions, material, and other respects to the details shown or as ordered by ENGINEER.
2. Concrete for inverts in precast concrete structures shall be Class A and shall conform to the requirements specified under Section 03300, Cast-In-Place Concrete.

C. Related Sections:

1. Section 03300, Cast-In-Place Concrete.
2. Section 02200, Earthwork.
3. Section 15052, Exposed Piping Installation.

1.2 QUALITY ASSURANCE

A. Standards referenced in this Section are:

1. American Association of State Highway and Transportation Officials (AASHTO) HS-20.
2. ASTM A 82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
3. ASTM A 153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A 185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
5. ASTM A 497, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
6. ASTM A 615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
7. ASTM A 706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
8. ASTM C 33, Standard Specification for Concrete Aggregates.

9. AWWA C 302, Reinforced Concrete Pressure Pipe, Non-Cylinder Type for Water and Other Liquids.
 10. ASTM C 150, Standard Specification for Portland Cement.
 11. ASTM C 260, Air-Entraining Admixtures for Concrete.
 12. ASTM C 478, Specification for Precast Reinforced Concrete Manhole Sections. ASTM C 494, Standard Specification for Chemical Admixtures for Concrete.
 13. PCI MNL-116, Manual for Quality Control for Plants and Production of Structural Precast Concrete Products.
 14. ACI 318 Building Code Requirements for Structural Concrete
 15. ACI 350 Code Requirements for Environmental Engineering Concrete Structures
 16. ASTM C 858, Specification for Underground, Pre-Cast Concrete Utility Structures
 17. ASTM C 857, Practice for Minimum Structural Design for Loading for Underground, Pre-Cast Concrete Utility Structures
- B. Fabrication Tolerances:
1. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL-116, unless otherwise indicated. The use of smaller bars at smaller spacing rather than larger bars at larger spacing is preferred to aid in crack control.
 2. Units shall be true to dimensions. Unit bow, as fabricated and installed, shall not exceed 1/8 inch per unit in the short dimension and 1/4-inch per unit in the long dimension. Step in alignment face and jog in alignment shall not exceed 1/4-inch. Provide a 3/4-inch chamfer or 1 x 2-inch radius on all exposed edges and corners.
 3. Imperfections such as air bubbles, ripples, joint lines, warpage, stains, projections, honeycombs, uneven matrix plate, and other defects will not be acceptable.
- C. Qualifications and Responsibilities of Contractor's Design Professional:
1. Professional Engineer:
 - a. Engage a registered professional engineer qualified to practice in the State of New York and experienced in providing engineering services of the kind indicated.
 - b. Responsibilities include but are not necessarily limited to:
 - 1) Carefully reviewing precast concrete structure performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER.
 - 3) Preparing or supervising the preparation of design calculations and related drawings, Shop Drawings, testing plan development, test-result interpretation and a comprehensive engineering analysis verifying compliance of the precast concrete structure with the requirements of the Contract Documents.
 - 4) Signing and sealing all calculations and design drawings, and Shop Drawings.
 - 5) Certifying that:

- i. The Contractor's Design Professional has performed the design of the precast concrete structure in accordance with the performance and design criteria stated in the Contract Documents, and
- ii. The said design conforms to all applicable local, state and federal codes, rules and regulations, and to the prevailing standards of practice.

D. Fabricator Qualifications:

1. Manufacturer shall be PCI certified (Group C) with a Quality Assurance Plan in accordance with MNL-116.
2. Fabricated by a firm regularly engaged in the manufacture of precast structural concrete vaults for at least five years.
3. Manufacturer to participate in and furnish evidence to ENGINEER of plant certification program.
4. Manufacturer: Provide precast structural concrete vaults as manufactured by one of the following:
 - a. Oldcastle Infrastructure
 - b. United Concrete Products, Inc.
 - c. Or equal.

1.3 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Qualifications:
 - a. Submit qualifications data for the Contractor's Design Professional.
 - b. Submit previous similar projects performed by the manufacturer.
2. Precast Structures:
 - a. Submit concrete mix design for approval.
 - b. Drawing showing design and construction of all precast concrete, as well as the location and details of all items that are to be embedded in the precast units and concrete cover for reinforcing.
 - c. Complete vault design calculations, including but not limited to all connections, buoyancy check, and shop drawings, signed and stamped with a seal of a Registered Professional Engineer licensed to practice in the State of New York.
 - d. Test result from concrete cylinder strength tests.
3. Certificate of Performance: Submit certification of performance of the delegated design by the Contractor's design professional (See Attachment A).

B. Shop Tests:

1. Submit description of proposed testing methods, procedures and apparatus. Prepare and submit report for each test.

1.4 FABRICATION, DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials:

1. Deliver precast concrete units to project site in such quantities and at such times to assure continuity of installation.
- B. Storage of Materials:
 1. Store units at project site in a manner that will prevent cracking, distortion, warping, staining, or other physical damage and so that precast copings are without damage at time of installation.
- C. Handling of Materials:
 1. Lift and support units only at designated lifting or supporting points as shown on final Shop Drawings.

PART 2 – PRODUCTS

2.1 PRECAST CONCRETE STRUCTURES

- A. Layout and details shall be as shown and specified. Design shall be adequate to withstand live loads, lateral earth pressure loading, and uplift case. The precast concrete structures shall be constructed to the lengths, widths and heights as shown on the contract drawings. The structure shall be designed to adequately and safely support all live and dead loads to which the structure will be subjected, and to withstand all conditions which may be encountered. Minimum structure design shall be a minimum of HS-20 truck loading.
 1. Design Criteria:
 - a. Top slab live load: 300 psf or AASHTO HS-20 truck wheel loads, whichever causes the greater stress.
 - b. Lateral soil pressure above ground water surface: 60 pcf equivalent fluid pressure.
 - c. Lateral soil pressure below ground water surface: 92 pcf equivalent fluid pressure.
 - d. Maximum allowable soil bearing pressure: 3500 psf.
 - e. Unit weight of soil = 120 pcf.
 - f. Observed ground water table = Groundwater was encountered at approximately 8 feet bgs during drilling of all borings.
 - g. Design ground water table for 100 year storm = Top of slab
 - h. Vertical surcharge on soil of 300 psf.
 - i. Lateral load due to surcharge: $0.5q$, where q is the vertical surcharge pressure in psf. Lateral surcharge pressure shall be applied to the full height of the structure.
 - j. Safety factor for uplift normal ground water > 1.5. (safety factor for uplift shall exclude the existing mat foundation)
 - k. Safety factor for uplift 100 year storm ground water > 1.1. (safety factor for uplift shall exclude the existing mat foundation)
 2. Design shall meet the requirements of ACI 350 and the Building Code.
- B. Concrete Mix: Standard-weight concrete consisting of specified portland cement,

pigments, aggregates, admixtures, and water per section 03300 to produce the following properties:

1. Compressive Strength: 5,000 psi minimum at 28 days.
 2. Total Air Content: Not less than 4 percent nor more than 6 percent.
- C. Where precast structures are made up of various precast components such as base sections, riser sections and top sections, the joint between sections shall be watertight and be the tongue and groove type complying with AWWA C302. No reinforcement shall pass through joints.
- D. Walls shall be precast with wall pipes or with pipe sleeves with water stop suitable for use with mechanical link seal as shown on the Mechanical Drawings.
- E. Precast structure shall be designed and constructed to accept access hatches or castings as shown and specified.
- F. Underground precast units shall have a shop-applied waterproofing membrane applied to the exterior surface.
- G. Lifting holes, if used, shall be tapered. Tapered, solid rubber plugs shall be furnished to seal the lifting holes. The lifting holes shall be made to be sealed by plugs driven from the outside face only.
- H. All wall penetrations shall be formed utilizing flanged-by-mechanical joint wall pipes, which shall be cast in the concrete as shown on the drawings. The wall pipe shall be constructed of Class 53 ductile iron pipe with one (1) ductile iron threaded Class 150 flange meeting ANSI A21.15 specifications. The other side of the pipe shall be supplied with a mechanical joint threaded bell. The water stop shall extend 3" min per side / 6" larger in diameter than the exterior of the pipe. The stop shall be welded to provide a watertight seal. The interior of the pipe shall be double cement lined and seal coated in accordance with ANSI A21.4.
- I. Mark date of manufacture and name of trademark of manufacturer on inside of barrel.
- J. Butyl Joint Sealer
1. Products and Manufacturers: Provide one of the following:
 - a. ConSeal CS-202 ASTM C990 by ConSeal Concrete Sealants Inc.
 - b. Or approved equal.
 2. Precaster is required to submit a detail describing the material and procedure used to seal joints.
 3. Contractor shall apply to all joints of precast sections according to manufacturer instructions.
- K. Exterior Coating
1. Products and Manufacturers: Provide one of the following:

- a. ConSeal CS-1800 by ConSeal Concrete Sealants Inc.
 - b. Or approved equal.
- 2. All exterior surfaces of precast sections to be coated according to manufacturer instructions.

L. Exterior Joint Wrap

- 1. Products and Manufacturers: Provide one of the following
 - a. ConSeal CS-212 by ConSeal Concrete Sealants Inc.
 - b. Or approved equal.
- 2. Polyolefin Backed Exterior Joint Wrap:
 - a. Thickness: Minimum of 0.10”.
 - b. Width: Minimum of 12”.
- 3. Contractor to wrap all exterior joints of precast sections in field according to manufacturer instructions.

M. Single Component, Non-Sag, Moisture Cure, Polyurethane Joint Sealant

- 1. Products and Manufacturers: Provide one of the following:
 - a. Dymonic 100 by TREMCO, Inc.
 - b. Or approved equal
- 2. Sealants shall meet the requirements of ASTM C920
 - a. Type: S
 - b. Grade: NS
 - c. Class: 50
 - d. Use: NT

N. Miscellaneous Materials:

- 1. Joint Cleaner: As recommended by sealant and coating manufacturer and compatible with the substrate.
- 2. Joint Primer: As recommended by sealant and coating manufacturer and compatible with the substrate.
- 3. Cylindrical Sealant Backing: ASTM C 1330, Type B non-absorbent, bi-cellular material with surface skin, or Type O open-cell polyurethane, as recommended by sealant manufacturer for application.
- 4. Masking tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces.

2.2 ACCESS HATCHES AND CASTINGS

- A. All necessary access hatches, manhole covers, and castings as shown and specified shall be cast into concrete as necessary. Manhole covers shall be as shown on the Contract Drawings and as specified in Section 16134, Electric Manholes.

2.3 SHOP TESTING

- A. Shop Tests:

1. At a minimum, conduct the following shop tests:
 - a. Conduct concrete cylinder strength tests. Cylinders shall be cured in the same manner as the precast structures. Collect a minimum of five test cylinders from every 50 cubic yards of concrete poured at a minimum.

PART 3 – EXECUTION

3.1 STORAGE

- A. Fabrication, curing and storage of precast concrete units shall be in accordance with MNL-116.
- B. Units showing signs of damage shall be repaired on site or replaced, with the damaged structure removed from site. Repairing or replacing the unit shall be at no cost to the OWNER. Removal of the damaged structure shall be at no cost to the OWNER.

3.2 INSPECTION

- A. CONTRACTOR and his installer shall examine the substrate and the conditions under which Work is to be performed and notify OWNER of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to OWNER.

3.3 INSTALLATION

- A. Set units in true alignment. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.
- B. Precast structures shall be set on a crushed stone, crushed gravel, or concrete foundation as shown on drawings and in accordance with geotechnical recommendations. Precast units shall be set at the proper grade and carefully leveled and aligned.
- C. Install units in accordance with manufacturer's recommendations. Install sealants and exterior joint wraps per manufacturer's recommendation.
- D. Replace precast concrete units damaged for any reason or which fail to perform as specified.

3.4 ATTACHMENTS

- A. Attachments listed below, following the "End of Section" designation, are part of this Specification section.
 1. Attachment A, Professional Design Services Performance Certification.

3.5 VAULT WATERTIGHTNESS

A. Testing:

1. All vaults and chambers shall be hydrostatically field-tested for exfiltration.
2. Hydrostatic Testing:
 - a. Hydrostatic testing shall be performed by exfiltration testing. During exfiltration testing, the vault shall be filled with potable water by CONTRACTOR to the top of the vault. Water shall be supplied by CONTRACTOR.
 - b. During exfiltration testing, CONTRACTOR shall furnish, install, and remove temporary bulkheads as required to perform the test.
 - c. Allowable leakage (exfiltration or infiltration test) for concrete vaults is 100 gallons per day (24 hours) per equivalent inch of vault barrel diameter per mile of vault depth. The test shall be conducted for a minimum of 24 hours. For example, a vault with interior dimensions of 9 feet x 14 feet has a floor area of 126 square feet, which is equivalent to a circular area with a diameter of 12.7 feet. If the chamber has a depth of 12 feet from the water surface during testing to the bottom slab of the vault, the chamber is equivalent to a circular pipe, 12.7 feet (152 inches in diameter and $12/5280 = 0.0023$ miles in length. The allowable leakage is thus: 100 gallons/day x 152 inches x 0.0023 miles, or 34.96 gallons in 24 hours.
3. Allow for initial absorption of water before the test begins. Replenish the water that is absorbed by the concrete before the commencement of the test.
4. Any vault which fails the test applied shall be repaired and retested by CONTRACTOR at his expense until satisfactory results are obtained.
5. Any leaks discovered after testing and/or during the maintenance period shall be repaired by CONTRACTOR at his expense. Any leaks discovered after the initial testing shall require re-testing of the vault after repairs are made.
6. All precast vaults shall be free of all visible leaks through the concrete. Any vault section exhibiting visible leaks shall be replaced by CONTRACTOR at his expense. Any repairs proposed require approval of ENGINEER. If approved by ENGINEER, repairs shall be performed by CONTRACTOR at no additional expense to the OWNER.
7. Testing requirements of this section apply to all special chambers as well as vaults.

+ + END OF SECTION + +

ATTACHMENT A

Professional Design Services Performance Certification

1. My name is _____.
2. My State of New York professional engineering license number is _____.
3. My license expires _____, 20____.
4. The Project for which I have performed professional design services is described as
_____.
5. The Specification Section(s) under which I have performed my services is/are
_____.
6. The name and address of the individual or entity for whom I have performed my professional design services is:

ATTACHMENT A (continued)

Professional Design Services Performance Certification (cont'd)

7. I hereby certify that, to the best of my knowledge, information and belief, I have performed or supervised the performance of the professional design services hereunder, and that said services have been performed in accordance with all applicable local, state and federal codes, rules and regulations and in accordance with the standard of care currently expected of professional engineers/architects performing similar services for projects of similar size and complexity in the State of New York.

Signature

Typed or Printed Name

Name of Firm

Street Address

[SEAL] _____
City/State/Zip Code

Telephone: _____

Fax: _____

SECTION 03600

GROUTING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install grout and perform grouting Work.
- B. Coordination:
1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before grouting Work.
- C. Related Sections:
1. Section 03251, Concrete Accessories.
 2. Section 03300, Cast-In-Place Concrete.
- D. Application and Grout Material:
1. The following is a listing of grouting applications and the corresponding type of grout material to be provided for the associated application. Unless shown or indicated otherwise in the Contract Documents, provide grout in accordance with the following:

TABLE 03600-A, GROUT APPLICATIONS AND MATERIAL TYPES

Application	Required Grout Material Type
Beam and column (one- or two-story height) base plates and precast concrete bearing less than 16 inches in the least dimension	Class II Non-Shrink
Column base plates and precast concrete bearing (greater than two-story height or larger than 16 inches in the least dimension)	Class I Non-Shrink
Base plates for storage tanks and other non-motorized equipment, and motorized equipment or machinery less than 50 horsepower	Class I Non-Shrink (unless otherwise recommended by equipment manufacturer)
Motorized equipment or machinery equal to and greater than 50 horsepower, and motorized equipment or machinery less than 50 horsepower subject to severe shock loads or high vibration	Class III Non-Shrink Epoxy (unless otherwise recommended by equipment manufacturer)
Filling blockout spaces for embedded items	Class II Non-Shrink (Class I where

such as railing posts, guide frames for hydraulic gates, and similar applications	placement time exceeds 15 minutes)
Grout fill or grout toppings less than four inches thick	Grout Fill
Grout fill greater than four inches thick	Class "B" Concrete in accordance with Section 03300, Cast-In-Place Concrete
Grout for setting filter underdrain blocks, and for filling voids between filter underdrain blocks, and for filling voids between filter underdrain blocks and walls	Filter Underdrain Blocks Grout
Applications not listed above, where grout is indicated on the Drawings	Class I Non-Shrink, unless shown or indicated otherwise

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 211.1, Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
2. ACI 301, Structural Concrete for Buildings.
3. ASTM C33/C33M, Specification for Concrete Aggregates.
4. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
5. ASTM C230/C230M, Specification for Flow Table for Use in Tests of Hydraulic Cement.
6. ASTM C531, Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
7. ASTM C579, Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
8. ASTM C827, Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
9. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
10. ASTM C939, Text Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
11. ASTM C1107/C1107M, Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
12. ASTM C1181, Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
13. NSF/ANSI 61, Drinking Water System Components - Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Grout Testing Laboratory:
 - a. Independent testing laboratory employed for design and testing of grout materials and mixes shall comply with testing laboratory requirements in

Section 03300, Cast-in-Place Concrete and other applicable requirements in the Contract Documents.

2. Manufacturer: Shall have a minimum of five years experience of producing products substantially similar to that required and shall be able to submit documentation of at least five satisfactory installations that have been in successful operation for at least five years each.
3. Manufacturer's Field Service Technician: When required, provide services of manufacturer's full-time employee, factory-trained in handling, use, and installing the products required, with at least five years of experience in field applications of the products required.

B. Trial Batch:

1. Each grout fill and construction joint grout mix proportion and design shall be verified by laboratory trial batch or field experience methods. Comply with ACI 211.1 and submit to ENGINEER a report with the following data:
 - a. Complete identification of aggregate source of supply.
 - b. Tests of aggregates for compliance with specified requirements.
 - c. Scale weight of each aggregate.
 - d. Absorbed water in each aggregate.
 - e. Brand, type, and composition of cement.
 - f. Brand, type, and amount of each admixture.
 - g. Amounts of water used in trial mixes.
 - h. Proportions of each material per cubic yard.
 - i. Unit weight and yield per cubic yard of trial mixtures.
 - j. Measured slump.
 - k. Measured air content.
 - l. Compressive strength developed at seven days and 28 days, from not less than three test specimens cast for each seven-day and 28-day test, and for each design mix.
2. Laboratory Trial Batches: When laboratory trial batches are used to select grout proportions, prepare test specimens and conduct strength tests as specified in ACI 301.
3. Field Experience Method: When field experience methods are used to select grout proportions, establish proportions as specified in ACI 301.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Schedule of Project-specific grout applications, installation locations, and the grout type proposed for each.
 - b. List of grout materials and proportions for the proposed mix designs. Include data sheets, test results, certifications, and mill reports to qualify the materials proposed for use in the mix designs. Do not start laboratory trial batch testing until submittal is approved by ENGINEER.
 - c. Trial Batch Reports: Submit laboratory test reports for grout materials and mix design tests.

2. Product Data:
 - a. Data sheets, certifications, and manufacturer's specifications for all materials proposed for use.
- B. Informational Submittals: Submit the following:
 1. Manufacturer's Instructions:
 - a. Special instructions for shipping, storing, protecting, and handling.
 - b. Installation instructions for the materials.
 2. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's field service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 3. Qualifications Statements:
 - a. Testing laboratory, when not submitted under other Sections.
 - b. Manufacturer, when submittal of qualifications is required by ENGINEER.
 - c. Manufacturer's field service technician, when submittal of qualifications is required by ENGINEER.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Storage of Materials: Store grout materials in a dry location, protected from weather and protected from moisture.

PART 2 – PRODUCTS

2.1 GENERAL

- A. All grout materials, admixtures, cementitious materials, and other materials used in grout that contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

2.2 NON-SHRINK GROUT MATERIALS

- A. General: Non-shrink grout shall be a prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or container in which the materials are packaged. Specific formulation for each type or class of non-shrink grout specified in this Section shall be that recommended by the grout manufacturer for the particular application.
- B. Class I Non-Shrink Grout:
 1. Class I non-shrink grouts shall have a minimum 28-day compressive strength of 7,000 psi. Use grout for precision grouting and where water-tightness and

non-shrink reliability in both plastic and hardened states is critical, in accordance with Table 03600-A in this Section.

2. Products and Manufacturer: Provide one of the following:
 - a. Masterflow 928, by Master Builders, Inc.
 - b. Five Star Grout, by Five Star Products, Inc.
 - c. Hi-Flow Grout, by Euclid Chemical Company.
 - d. Or equal.
 3. Comply with ASTM C1107/C1107M, Grade C and B (as modified below) when tested using amount of water required to achieve the following properties:
 - a. Fluid consistency (20 to 30 seconds) shall be in accordance with ASTM C939.
 - b. At temperatures of 45, 73.4, and 95 degrees F.
 4. Length change from placing to time of final set shall not have shrinkage greater than the expansion measured at three or fourteen days. Expansion at three or fourteen days shall not exceed the 28-day expansion.
 5. Non-shrink property shall not be based on chemically-generated gas or gypsum expansion.
 6. Fluid grout shall pass through the flow cone, with continuous flow, one hour after mixing.
- C. Class II Non-Shrink Grout:
1. Class II non-shrink grouts shall have minimum 28-day compressive strength of 7,000 psi. Use grout for general-purpose grouting applications in accordance with Table 03600-A in this Section.
 2. Products and Manufacturer: Provide one of the following:
 - a. Masterflow 100, by Master Builders, Inc.
 - b. NS Grout, by Euclid Chemical Company.
 - c. Or equal.
 3. Comply with ASTM C1107/C1107M and the following when tested using the quantity of water required to achieve the following properties:
 - a. Flowable consistency (140 percent flow in accordance with ASTM C230/C230M, five drops in 30 seconds).
 - b. Fluid working time of at least 15 minutes.
 - c. Flowable for at least 30 minutes.
 4. When tested, grout shall not bleed at maximum allowed water.
 5. Non-shrink property shall not be based on chemically-generated gas or gypsum expansion.
- D. Class III Non-Shrink Epoxy Grout:
1. Epoxy grout shall be a pourable, non-shrink, 100-percent solids system.
 2. Products and Manufacturer: Provide one of the following:
 - a. E3G, by Euclid Chemical Company.
 - b. Sikadur 42 Grout Pak, by Sika Corporation.
 - c. HP Epoxy Grout, by Five Star Products, Inc.
 - d. Or equal.

3. Epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all pre-measured and prepackaged. Resin component shall not contain non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are unacceptable. Variation of component ratios is not allowed without specific recommendation by manufacturer. Manufacturer's instructions shall be printed on each container in which products are packaged.
4. The following properties shall be attained with the minimum quantity of aggregate allowed by epoxy grout manufacturer.
 - a. Vertical volume change at all times before hardening shall be between zero percent shrinkage and 4.0 percent expansion when measured in accordance with ASTM C827 (modified for epoxy grouts by using an indicator ball with specific gravity between 0.9 and 1.1).
 - b. Length change after hardening shall be less than 0.0006-inch per inch and coefficient of thermal expansion shall be less than 0.00003-inch per inch per degree F when tested in accordance with ASTM C531.
 - c. Compressive creep at one year shall be less than 0.001-inch per inch when tested under a 400-psi constant load at 140 degrees F in accordance with ASTM C1181.
 - d. Minimum seven-day compressive strength shall be 14,000 psi when tested in accordance with ASTM C579
 - e. Grout shall be capable of maintaining at least a flowable consistency for minimum of 30 minutes at 70 degrees F.
 - f. Shear bond strength to portland cement concrete shall be greater than shear strength of concrete when tested in accordance with ASTM C882/C882M.
 - g. Minimum effective bearing area shall be 95 percent.

2.3 GROUT MATERIALS OTHER THAN NON-SHRINK GROUT

- A. General: Materials for grouts (other than non-shrink grouts) shall be in accordance with Section 03300, Cast-In-Place Concrete, except as otherwise specified in this Section.
- B. Grout Fill:
 1. Grout fill shall be comprised of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed in accordance with this Section.
 - a. Minimum Compressive Strength: 4,000 psi at 28 days.
 - b. Maximum Water-Cement Ratio: 0.45 by weight.
 - c. Coarse Aggregate: ASTM C33/C33M, No. 8 size.
 - d. Fine Aggregate: ASTM C33/C33M, approximately 60 percent by weight of total aggregate.
 - e. Air Content: Seven percent (plus or minus one percent).
 - f. Minimum Cement Content: 564 pounds per cubic yard.
 - g. Slump for grout fill shall be adjusted to match placing and finishing conditions, and shall not exceed four inches.

C. Construction Joint Grout:

1. Construction joint grout shall be comprised of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned with similar cementitious characteristics as Class "A" concrete specified in Section 03300, Cast-In-Place Concrete. Mix design shall result in grout that is flowable with high mortar content. Mix requirements are:
 - a. Minimum Compressive Strength: 4,500 psi at 28 days.
 - b. Maximum Water-Cement Ratio: 0.40 by weight.
 - c. Coarse Aggregate: ASTM C33/C33M, No. 8 size.
 - d. Fine Aggregate: ASTM C33/C33M, approximately 60 percent by weight of total aggregate.
 - e. Air Content: Seven percent (plus or minus one percent).
 - f. Minimum Cement Content: 752 pounds per cubic yard.
 - g. Slump for Construction Joint Grout: Seven inches (plus or minus one inch).

D. Filter Underdrain Blocks Grout:

1. Grout shall comply with Article 2.1 of this Section. Grout shall consist of one part cement to two parts sand with shrinkage-reducing admixture. Class I or Class II non-shrink grout may be used in lieu of filter underdrain blocks grout.
 - a. Minimum Compressive Strength: 4,000 psi at 28 days.
 - b. Maximum Water-Cement Ratio: 0.45 by weight.

2.4 CURING MATERIALS

- A. Curing materials shall comply with Section 03300, Cast-in-Place Concrete, and shall be as recommended by the manufacturer of prepackaged grouts.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine substrate and conditions under which grouting will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:

1. Place grout as shown and indicated, and in accordance with Laws and Regulations and grout manufacturer's instructions. If manufacturer's instructions conflict with the Contract Documents, obtain clarification or interpretation from ENGINEER before proceeding.
2. Consistency of non-shrink grouts shall be as required to completely fill the space to be grouted for the particular application. Do not install grout for dry-packing without approval of ENGINEER. When dry-packing is approved by

ENGINEER, dry-pack consistency shall be such that grout has sufficient water to ensure hydration and grout strength development, and remains plastic, moldable, and that does not flow.

3. Grouting shall comply with temperature and weather limitations in Section 03300, Cast-In-Place Concrete.
4. Cure grout in accordance with grout manufacturer's instructions for prepackaged grout and Section 03300, Cast-In-Place Concrete, for grout fill.

B. Columns and Beams:

1. After shimming columns and beams to proper elevation, securely tighten anchors. Properly form around base plates allowing sufficient room around edges for placing grout. Provide adequate depth between bottom of base plate and top of concrete base to assure that void is completely filled with non-shrink grout.

C. Equipment Bases:

1. Install equipment in accordance to manufacturer's recommendations, Laws, and Regulations, and the Contract Documents. After shimming equipment to proper elevation, securely tighten anchors. Properly form around base plates, allowing sufficient room around edges for placing grout. Provide adequate depth between bottom of equipment base and top of concrete base to ensure that voids are completely filled with non-shrink grout.

D. Handrail Posts:

1. After posts have been properly inserted into holes or sleeves, fill annular space between posts and sleeve with non-shrink grout. Bevel grout at juncture with post so that water will flow away from post.

D. Construction Joints:

1. Place a six-inch minimum thick layer of construction joint grout over contact surface of concrete at interface of horizontal construction joints in accordance with Section 03251, Concrete Accessories, and Section 03300, Cast-In-Place Concrete.

E. Grout Fill:

1. All mechanical, electrical, and finish work shall be completed prior to placing grout fill. Base slab shall be provided with a scratched finish in accordance with Section 03300, Cast-In-Place Concrete. Roughen existing slabs shall by abrasive blasting or hydroblasting exposing aggregates to ensure bonding to base slab.
2. Minimum thickness of grout fill shall be one-inch. Where finished surface of grout fill is to form an intersecting angle of less than 45 degrees with concrete surface against which grout will be placed, form a key in the concrete surface at the intersection point. Key shall be minimum of 3.5 inches wide by 1.5 inches deep.
3. Thoroughly clean and wet base slab prior to placing grout fill. Do not place grout fill until slab is completely free of standing water. A thin coat of neat

Type II cement slurry shall be broomed into surface of slab. Place grout fill while slurry is wet. Grout fill shall be compacted by rolling or tamping, brought to elevation, and floated. In tanks and basins where scraping-type equipment will be installed, grout fill shall be screeded by blades attached to revolving mechanism of equipment in accordance with procedures recommended by equipment manufacturer after grout is brought to elevation.

4. Grout fill placed on sloping slabs shall be installed uniformly from bottom of slab to top, for full width of placement.
5. Test grout fill surface with a straight edge to detect high and low spots; immediately correct high and low spots in grout fill. When grout fill has hardened sufficiently, grout fill shall be steel troweled to provide a smooth surface free of bug holes and other imperfections. While an acceptable type of mechanical trowel may be used in this operation, the last pass over the grout fill surface shall be by hand-troweling. During finishing, do not apply the following to the grout fill surface: water, dry cement, or mixture of dry cement and sand.
6. Cure and protect grout fill in accordance with Section 03300, Cast-In-Place Concrete.

3.3 FIELD QUALITY CONTROL

A. Field Testing Services:

1. CONTRACTOR shall employ an independent testing laboratory to perform field quality control testing for grout. ENGINEER will direct where samples are to be obtained.
2. CONTRACTOR shall provide all curing and necessary cube storage Facilities in accordance with ASTM C31.
3. Comply with testing laboratory requirements in Section 03300, Cast-In-Place Concrete for required testing laboratory qualifications.

B. Quality Control Testing During Construction:

1. Grout Fill: Perform sampling and testing for field quality control during grout fill placing as follows:
 - a. Sampling Fresh Grout Fill: ASTM C172.
 - b. Slump: ASTM C143; one test for each load of grout at point of discharge.
 - c. Air Content: ASTM C231; one sample for every two grout loads at point of discharge, and when a change in the grout is observed.
 - e. Compression Test Specimens:
 - 1) In accordance with ASTM C109/C109M; make one set of compression cubes for each 50 cubic yards of grout, or fraction thereof, of each mix design placed each day. Each set shall be four standard cubes, unless otherwise directed by ENGINEER.
2. Non-shrink Grout: Perform sampling and testing for field quality control during non-shrink grout placing as follows:
 - a. Perform compression testing of non-shrink grout in accordance to ASTM C109/C109M at intervals during construction as selected by ENGINEER.

Make a set of four specimens for testing compressive strength at a period of time selected by the ENGINEER.

- b. Perform compression tests on epoxy grout and fabricate specimens for epoxy grout testing in accordance with ASTM C579, Method B, at intervals during construction as selected by the ENGINEER. Make a set of four specimens for testing compressive strength at a period of time selected by ENGINEER.

C. Evaluation of Field Quality Control Tests:

1. Do not use grout, delivered to final point of placement, having slump or total air content that does not comply with the Contract Documents.
2. Compressive strength tests for laboratory-cured cubes will be acceptable if averages of all sets of three consecutive compressive strength test results equal or exceed the required 28-day design compressive strength of the associated type of grout.
3. If the compressive strength tests do not comply with the requirements in the Contract Documents, the grout represented by such tests will be considered defective and shall be removed and replaced, or subject to other action required by ENGINEER, at CONTRACTOR's expense.

D. Manufacturer's Services:

1. Manufacturers of proprietary materials shall make available upon 72 hours notification the services of qualified, full time employee, experienced in serving as a field service technician for the products required, to aid in assuring proper use of products under the actual conditions at the Site.

+ + END OF SECTION + +

SECTION 03930

REPAIR AND REHABILITATION OF CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to repair or rehabilitate, as required, all existing concrete shown or indicated in the Contract Documents as being repaired or rehabilitated.
2. CONTRACTOR shall repair all damage to new concrete construction as specified in this Section except for repair Work specified in Section 03300, Cast-In-Place Concrete.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the Work that must be installed with or before repair and rehabilitation of concrete.

C. Related Sections:

1. Section 03251, Concrete Accessories.
2. Section 03300, Cast-In-Place Concrete.
3. Section 03600, Grouting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
2. ASTM C882/C882M, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
3. ASTM D1042, Test Method for Linear Dimensional Changes of Plastics Under Accelerated Service Conditions.
4. ASTM D3574, Test Methods for Flexible Cellular Materials – Slab, Bonded, and Molded Urethane Foams.
5. ASTM G109, Test Method for Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments.
6. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:

1. Product Data: Information on all products proposed for use, including manufacturer's brochures, technical data, specifications, and other applicable data.
- B. Informational Submittals: Submit the following:
 1. Certificates: Certificates documenting that repair materials that will be in contact with potable water or water that will be treated to become potable are listed in NSF/ANSI 61.
 2. Manufacturer's Instructions: Manufacturer's recommended procedures for installing materials proposed for use.
 3. Site Quality Control Submittals: Results of specified Site quality control testing.
 4. Special Procedure Submittals: When requested by ENGINEER, submit information on methods for supporting during demolition and repair Work existing structures, pipes, and other existing facilities affected by the Work.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery and Handling of Materials:
 1. Conform to Section 01610, Transportation and Handling of Materials and Equipment, and this Section.
 2. Clearly mark on containers manufacturer's name and label, name or title of material, manufacturer's stock number, and date of manufacture.
 3. Handle materials carefully to prevent inclusion of foreign matter.
 4. Do not open containers or mix components until necessary preparatory Work has been completed and application Work is to start immediately.
- B. Storage of Materials:
 1. Conform to Section 01610, Transportation and Handling of Materials and Equipment, and this Section.
 2. Store only approved materials at the Site.

PART 2 – PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. All repair and rehabilitation materials that can or will come into contact with potable water or that will be treated to become potable shall be listed in ANSI/NSF 61.

2.2 REPAIR MORTAR

- A. Product Description: Repair mortar shall be prepackaged, cement-based product specifically formulated for repairing concrete surface defects.
- B. Products and Manufacturers: Provide one of the following:

1. SikaTop 122 Plus, SikaTop 123 Plus, or SikaTop 126 Plus, by Sika Corporation.
2. DuralTop Gel, DuralTop Flowable Mortar by Euclid Chemical Company.
3. Or equal.

C. Materials:

1. Provide a two-component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar. Repair mortar shall be enhanced with penetrating corrosion inhibitor, and shall have the following properties:

Physical Property	Value	ASTM Standard
Minimum Compressive Strength at One Day	2,000 psi	C109
Minimum Compressive Strength at 28 Days	6,000 psi	C109
Minimum Bond Strength at 28 Days	1,800 psi	C882*
* Modified for use with repair mortars.		

2. Where the least dimension of the placement in width or thickness exceeds four inches, extend repair mortar by adding aggregate as recommended by repair mortar manufacturer.
3. Product shall be listed in NSF/ANSI 61.

2.3 EXPANSION JOINT REPAIR SYSTEM

- A. System Description: Joint repair system shall consist of two components: an epoxy resin adhesive and hypalon sheeting.

B. Products and Manufacturers: Provide one of the following:

1. Sikadur Combiflex, by Sika Corporation.
2. Or equal.

C. Materials:

1. Epoxy Resin Adhesive: Provide two-component epoxy resin as follows:
 - a. Component "A" shall be modified epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents and pigments. Resin shall not contain butyl glycidyl ether.
 - b. Component "B" shall be primarily a reaction product of selected amine blend with epoxy resin of epichlorohydrin bisphenol-A type containing suitable viscosity control agents, pigments, and accelerators.
2. Hypalon Sheeting:
 - a. Provide sheeting of hypalon rubber, perforated along bonding edge to provide mechanical key. Sheeting shall have ability to be vulcanized with hydrocarbon solvent for adhesion to an epoxy resin adhesive.
 - b. Provide sheeting in 12-inch width with thickness of 40 mils.
 - c. Sheeting shall be able to be lapped or seamed by heat or by anaromatic hydrosolvent strip.

- d. Provide sheeting with removable center expansion strip.
- 3. Products shall be listed in NSF/ANSI 61.

2.4 REPAIR OF EXPOSED REINFORCING STEEL

- A. System Description: System for repair of exposed reinforcing steel shall consist of two components: an initial application of corrosion inhibitor and subsequent application of protective slurry mortar.
- B. Corrosion Inhibitor:
 - 1. Corrosion inhibitor shall penetrate the hardened concrete surface and form a protective layer on reinforcing steel.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sika FerroGard 903, by Sika Corporation.
 - b. Or equal.
 - 3. Corrosion inhibitor shall:
 - a. Not change the substrate's color, appearance, or texture.
 - b. Penetrate independently of orientation (horizontal, vertical, overhead) at rate up to 1/10 to 4/5 inches per day, depending on density of concrete, measured using secondary neutron mass spectroscopy.
 - c. Form on reinforcing steel a protective layer of high integrity of at least 100 angstroms thickness, measured using x-ray photon spectroscopy and secondary ion mass spectroscopy.
 - d. Demonstrate reduction in corrosion currents after treatment as determined using cracked beam corrosion tests of concrete, as adapted from ASTM G109.
 - e. Be capable of reducing active corrosion rates by at least 65 percent. Reduction shall be demonstrated by project references and an independent corrosion engineer using linear polarization resistance.
 - f. Penetrate up to three inches in 28 days, measured using secondary neutron mass spectroscopy.
 - g. Product shall be listed in NSF/ANSI 61.
- C. Protective Slurry Mortar:
 - 1. Material shall be two-component, polymer-modified, cementitious waterproofing and protective slurry mortar. Provide two coats at coverage of 50 square feet per gallon per coat.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sikatop Seal 107, by Sika Corporation.
 - b. Or equal.
 - 3. Product shall be listed in NSF/ANSI 61.

2.5 CRACK INJECTION MATERIALS

- A. Structural Crack Repair System:
 - 1. Epoxy for injection shall be low-viscosity, high-modulus moisture insensitive type.

2. Products and Manufacturers: Provide one of the following:
 - a. Sikadur 35, Hi-Mod L.V. and Sikadur 31, Hi-Mod Gel, by Sika Corporation.
 - b. Eucopoxy Injection Resin, by Euclid Chemical Company.
 - c. Or equal.
 3. Product shall be listed in NSF/ANSI 61.
- B. Non-structural Crack Repair System:
1. Hydrophobic Polyurethane Chemical Grout:
 - a. Provide hydrophobic polyurethane that forms a flexible gasket.
 2. Products and Manufacturers: Provide one of the following:
 - 1) SikaFix HH LV, by Sika Chemical Company.
 - 2) Hydro Active Flex SLV, by De Neef Construction Chemicals, Inc.
 - 3) Or equal.
 - c. Shrinkage limit shall not exceed 4.0 percent in accordance with ASTM D1042.
 - d. Minimum elongation of 250 percent in accordance with ASTM D3574.
 - e. Minimum tensile strength of 150 psi in accordance with ASTM D3574.
 - f. Product shall be listed in NSF/ANSI 61.
 2. Hydrophilic Acrylate-Ester Resin:
 - a. Hydrophilic crack repair system shall be acrylate-ester resin that forms a flexible gasket and increase in volume by at least 50 percent when in contact with water.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Sika Injection-306, by Sika Chemical Company
 - 2) Or equal.
 - c. Product shall be listed in NSF/ANSI 61.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which the repair Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation:
 1. Initial Surface Preparation: Remove by chipping, abrasive blasting, or hydro blasting all laitance, foreign material, and unsound concrete from entire area to be repaired. Further roughen surface as specified in this Section. Where non-shrink grout or repair mortar is used, perform additional surface preparation, if any, recommended by product manufacturer.

2. Wetting Procedure: Where repair concrete, shotcrete, or cement grout is used, and bonding agent is not required, or where repair mortar or non-shrink grout manufacturer recommends wet or saturated surface, perform the following:
 - a. Continuously apply water for at least four hours to surface being repaired. Where large surface areas are to be repaired, use fog-spray nozzles, mounted on stands, in sufficient number so that entire surface to be repaired is contacted by fog spray cloud.
 - b. Prevent concrete from drying until after repair is completed. Re-wet surfaces not yet repaired using water sprays at least a daily; should more than four days elapse without re-wetting surfaces not yet repaired, repeat the original saturating procedure.
 - c. Remove standing water in areas to be repaired before placing repair material. Provide means to remove excess water from structure.
3. Preparation for Epoxy Bonding Agent: Where repair material manufacturer recommends use of epoxy-bonding agent, conform to recommendations of both repair material manufacturer and bonding agent manufacturer.

3.3 INSTALLATION, GENERAL

- A. Construction Tolerances: Shall be as specified in Section 03300, Cast-In-Place Concrete, except as specified in this Section and elsewhere in the Contract Documents.
- B. Care shall be taken to fully consolidate repair material, completely filling all portions of space to be filled.
- C. Bring surface being repaired into alignment with adjacent surfaces, providing uniform, even surface. Surface repaired shall match adjacent existing surfaces in texture and shall receive coatings or surface treatments, if any, provided for the existing surface adjacent to repaired surface.
- D. Curing:
 1. Curing of repair mortar and non-shrink grout shall be in accordance with manufacturer's recommendations, except that minimum cure period shall be three days.
 2. Curing of other materials shall be in accordance with requirements of Section 03300, Cast-In-Place Concrete.

3.4 REPAIR OF SURFACE DEFECTS

- A. Surface defects are depressions in a concrete surface that do not extend all the way through the concrete. Surface defects can result from removal of an embedded item, removal of an intersecting concrete member, physical damage, or unrepaired rock pockets created during original placement. For spalls that result from corroded reinforcing steel or other embedment refer to Article 3.7 of this Section.

- B. Preparation: Perform the following in addition to requirements of Article 3.2 of this Section:
1. Remove by chipping all loose, damaged concrete to sound material.
 2. Where existing reinforcing is exposed, remove concrete to minimum of one-inch around exposed bars. If existing bars are cut through, cracked, or cross sectional area is reduced by more than 25 percent from original, immediately notify ENGINEER.
 3. Score-cut perimeter of area to be repaired to minimum depth of 1/2-inch and maximum depth that will not cut existing reinforcing steel. Chip out existing concrete to the score line so that minimum thickness of repair mortar will be 1/2-inch.
- C. Repair Material:
1. Completely fill the surface defect with specified repair material, in accordance with material manufacturer's instructions and the Contract Documents.
 2. Perform, with repair mortar, repairs of surface defects in concrete normally in contact with water or soil, and interior surfaces of structures that contain water.
 3. Repair of other surface defects may be performed by applying repair mortar, repair concrete, shotcrete, or cement grout, as appropriate.

3.5 PATCHING OF HOLES IN CONCRETE

- A. For holes larger than 8-inch diameter or equivalent area of hole, refer to the Drawings for reinforcing details.
- B. Fill openings less than four inches in their least dimension with Class III non-shrink epoxy grout in accordance with Section 03600, Grouting.
- C. Openings greater than four inches and less than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class I non-shrink grout in accordance with Section 03600, Grouting.
- D. Openings greater than 16 inches in their least dimension shall be coated with an epoxy bonding agent prior to filling with Class A concrete in accordance with Section 03300, Cast-In-Place Concrete.
- E. Where repaired holes are in contact with water or soil, provide hydrophilic rubber waterstop within the opening in accordance with Section 03251, Concrete Accessories, prior to filling with repair material.

3.6 REPAIR OF LINED HOLES

- A. This Article applies to openings with embedded material over all or a portion of inside surface of hole. Where indicated on the Drawings, remove embedded

materials and repair the hole in accordance with Article 3.5 of this Section, as modified in this Article 3.6.

- B. Where embedded material is allowed to remain, remove embedded material to at least two inches into the hole, as measured from the plane surface of concrete wall or slab, as applicable. Embedded material left in place shall be roughened or abraded for proper bonding to repair material. Completely remove substances that interfere with proper bonding.
- C. Completely remove embedded items not securely and permanently anchored into concrete.
- D. Completely remove embedded items larger than 12 inches in their smallest dimension. In lieu of removing the embedded item, where reinforcing is required as shown or indicated in the Contract Documents, weld reinforcing to embedded item to remain, provided embedded item to remain is composed of metal to which reinforcing steel can be welded.

3.7 REPAIR OF DETERIORATED CONCRETE

- A. This Article pertains to deteriorated concrete which has been damaged due to corrosion of reinforcing steel, physical damage due to abrasion, or damage due to chemical attack. Use repair mortar, as specified in this Article, for repairing deteriorated concrete. Where repaired surface will be subsequently covered with plastic liner material, coordinate finishing with requirements for installing plastic liner material.
- B. Surface Preparation: In addition to requirements of Article 3.2 of this Section, perform the following surface preparation:
 - 1. Remove loose, broken, softened, and acid-contaminated concrete by abrasive blasting and chipping to sound, uncontaminated concrete.
 - 2. Upon completion of removal of deteriorated concrete, notify ENGINEER in writing. Allow two weeks for ENGINEER to evaluate the surface, perform testing for acid contamination if required, determine if additional concrete shall be removed, and to develop special repair details (if any) required. Should ENGINEER determine that additional concrete be removed to reach sound, uncontaminated concrete, allow another two-week period for further evaluation and testing following the additional removal.
 - 3. Surface preparation shall conform to recommendations of repair mortar manufacturer.
 - 4. Repair and rehabilitate isolated areas of exposed reinforcing bars in accordance with Article 3.4 of this Section. If extensive areas of reinforcing steel are uncovered after removal of deteriorated concrete, ENGINEER will determine the repair methods required.
- C. Repair Mortar Placing:

1. Conform to manufacturer's recommended procedures for mixing and placing repair mortar.
2. After initial mixing of repair mortar, addition of water is not allowed.
3. Minimum Thickness:
 - a. Install repair mortar to not less than minimum thickness recommended by manufacturer, and not less than 1/2-inch.
 - b. Where removal of deteriorated concrete results in repair thickness of less than minimum required thickness to return to original concrete surface in isolated areas totaling less than ten percent of total repair surface area, remove additional concrete to obtain at least the required minimum thickness.
 - c. Where surface area with repair thickness less than minimum required thickness exceeds ten percent of total repair area, notify ENGINEER.
 - d. Provide repair mortar so that minimum cover over existing reinforcing steel is two inches. Do not place repair mortar creating locally raised areas.
 - e. Where transitioning to or from wall surfaces not requiring repair, do not feather-out repair mortar at transition. Instead, form the transition by saw cutting a score line to not less than minimum required repair mortar depth and chip out concrete to the saw cut line. Do not cut or otherwise damage reinforcing steel.
4. Place repair mortar to an even, uniform plane to restore concrete member to its original surface. Out-of-plane tolerance shall be such that the gap between 12-inch long straight edge and repair mortar surface does not exceed 1/8-inch, and gap between a four-foot long straight edge and repair mortar surface shall not exceed 1/4-inch. Tolerances specified in this paragraph apply to straight edges placed in any orientation at any location.

D. Finishing:

1. Provide smooth, steel trowel finish to repair mortar.
2. When completed, there shall be no sharp edges. Provide exterior corners, such as at penetrations, one-inch radius. Interior corners shall be square, except corners to receive plastic lining which shall be made with two-inch fillet in repair mortar.

3.8 REPAIR OF EXPANSION JOINTS

- A. Surface Preparation: Remove the following from surfaces to be repaired: laitance, foreign material, and unsound concrete. Remove by chipping, abrasive blasting, or hydro blasting. Additional surface preparation, if required, shall be as recommended by expansion joint repair system manufacturer.
- B. Installation: Installation shall be as recommended by expansion joint repair system manufacturer.

3.9 REPAIR OF EXPOSED REINFORCING

- A. Remove, by abrasive blasting or hydro blasting, all corrosion, foreign materials, and unsound concrete from area to be repaired.
- B. Surface shall be visually dry before applying corrosion inhibitor. Liberally apply corrosion inhibitor to achieve coverage of 100 square feet per gallon in two or more coats, by allowing corrosion inhibitor to soak into substrate. Time between coats shall be the longer of: one hour, or as recommended by corrosion inhibitor manufacturer. Apply using rollers, brushes, or hand-pressure spray equipment.
- C. After applying final coat of corrosion inhibitor, minimum cure time of 24 hours is required.
- D. Provide high-pressure wash to surfaces to be repaired to remove filmy residue from corrosion inhibitor.
- E. For mortar coating, conform to Paragraphs 3.7.C, 3.7.D, 3.7.E of this Section.

3.10 CRACK INJECTION

- A. Examine areas under which injection Work will be installed and locate cracks that require injection. Identify and inject cracks greater than 0.010-inch wide in structures that retain or contain water, wastewater, or similar liquid.
- B. Install injection material in accordance with crack injection manufacturer's requirements.
- C. After injecting and curing, verify that injected material penetrated the crack adequately and that there is no visible leakage through the crack. After injecting, if crack continues to leak, re-inject crack at no additional cost to OWNER until structure is watertight.
- D. If proper penetration of crack cannot be achieved, submit to ENGINEER a proposed alternate approach for modifying the specified injection procedure to properly seal the crack. In new concrete and in concrete cracked as a result of CONTRACTOR's operations, perform modifications to crack injection procedure and fully repair the crack without additional cost to OWNER or extension of the Contract Times.

3.11 SITE QUALITY CONTROL

- A. OWNER will employ and pay for services of testing laboratory for Site quality control testing. ENGINEER will direct the number of tests and specimens required, including providing necessary materials for making and facility for storing test specimens. CONTRACTOR shall make standard compression test specimens as specified in this Section under the observation of ENGINEER. CONTRACTOR shall provide:

1. Necessary assistance required by ENGINEER.
 2. All labor, material, and equipment required, including rods, molds, thermometer, curing in heated storage box, and all other incidentals required, subject to approval by ENGINEER.
 3. All necessary storage, curing, and transportation required for testing.
 4. CONTRACTOR will be charged for cost of additional testing and investigation, if any, for Work performed that is not in accordance with the Contract Documents or is otherwise defective.
- B. Site Tests of Cement-based Grouts and Repair Mortar:
1. Obtain compression test specimens during construction from first placement of each type of mortar or grout, and at intervals thereafter as selected by ENGINEER, to verify compliance with the Contract Documents. Specimens will be made by ENGINEER or ENGINEER's representative.
 2. Compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed in accordance with ASTM C109. Set of three specimens will be made for each test. Tests will be made at seven days, 28 days, and additional time periods as deemed appropriate by ENGINEER.
 3. Material, already placed, failing to conform to the Contract Documents, is defective.
- C. Repair Concrete: Repair concrete shall be tested as required in Section 03300, Cast-In-Place Concrete.

+ + END OF SECTION + +

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SECTION 04060

MASONRY MORTARING AND GROUTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install masonry mortaring and grouting for unit masonry construction.
2. This Section includes masonry mortaring and grouting for masonry products specified in:
 - a. Section 04220, Concrete Unit Masonry.
3. Types of materials required under this Section include:
 - a. Portland cement-lime mortars.
 - b. Ready-mixed mortar
 - c. Fine grout.
 - d. Coarse grout.
 - e. Grout fill around reinforcement in masonry lintels and bond beams.

B. Related Sections:

1. Section 04201, Unit Masonry Construction.
2. Section 04220, Concrete Unit Masonry.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C5, Specification for Quicklime for Structural Purposes.
2. ASTM C144, Specification for Aggregate for Masonry Mortar.
3. ASTM C150/C150M, Specification for Portland Cement.
4. ASTM C207, Specification for Hydrated Lime for Masonry Purposes.
5. ASTM C270, Specification for Mortar for Unit Masonry.
6. ASTM C387/C387M, Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
7. ASTM C404, Specification for Aggregates for Masonry Grout.
8. ASTM C1019, Test Method for Sampling and Testing Grout.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Do not change source or brands of mortar materials during the Project.

B. Job Mockup: Refer to Section 04201, Unit Masonry Construction.

Long Beach WPCP Consolidation
Pump Station Conversion

04060-1

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Schedule of locations where each mortar type will be used in the Work.
 - b. Grout mix design and material certification.
 - 2. Product Data:
 - a. Manufacturer's specifications and instructions for each manufactured material or product.
 - b. Compression test results of grout mix, for identical mix previously prepared and tested, in accordance with ASTM C1019, at maximum aggregate allowed. If no previously-prepared mix is identical, perform tests on the job mix design in accordance with ASTM C1019 and submit to Engineer.
 - c. Product data and specifications for integral waterproofing admixture.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Portland Cement: Provide the following for portland cement-lime mortars:
 - 1. ASTM C150/C150M:
 - a. Use Type I when installation temperature is 50 degrees F or higher.
 - b. Use Type III, high-early strength, when installation temperature is lower than 50 degrees F.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Type I and Type III Portland Cement, by Essroc Italcementi Group.
 - b. Type I and Type III Portland Cement, by Lehigh Portland Cement Company.
 - c. Or equal.
 - 3. Provide non-staining portland cement of natural color.
- B. Hydrated Lime: ASTM C207, Type S, or lime putty ASTM C5.
- C. Sand Aggregates:
 - 1. Mortar Aggregates: ASTM C144, except for joints less than 1/4-inch use aggregate graded with 100 percent passing the No. 16 sieve.
 - 2. Fine Aggregate for Grout: ASTM C404, Size No. 1.
 - 3. Coarse Aggregate for Grout: ASTM C404, Size No. 8 or Size No. 89.
- D. Ready-mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in Article 2.1 of this Section, combined with set-

controlling admixtures to produce a ready-mixed mortar complying with ASTM C270 and ASTM C387/C387M.

- E. Water: Free of injurious amounts of oils, acids, alkalis, and organic matter, and clean, fresh, and potable.

2.2 MORTAR MIXES

A. General:

- 1. Material Performance:
 - a. Masonry Strength: Refer to Section 04201, Unit Masonry Construction.
 - b. If questions of compliance with the Contract Documents arise, Specifications for mortar properties shall take precedence over Specification for mortar proportions.
- 2. Do not change proportions established for mortar approved, and do not use materials with different physical characteristics in mortar used in the Work, unless compliance with the Contract Documents for mortar properties is re-established via submittals approved by Engineer.
- 4. Do not combine in mortar different air-entraining materials.
- 5. Anti-freeze Admixture or Agents: Not allowed.
- 6. Calcium Chloride: Not allowed.

B. Mortar for All Other Unit Masonry: Comply with ASTM C270, Table 2, except limit materials to those specified in this Section. Limit cement-to-lime ratio by volume as follows:

- 1. Type N:
 - a. Provide the following proportions by volume:
 - 1) Portland Cement: One part.
 - 2) Hydrated Lime or Lime Putty: Over 1/2 to 1-1/4, maximum.
 - 3) Aggregate Ratio (measured in damp loose condition): Not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
 - b. Properties:
 - 1) Average Compressive Strength, ASTM C270: 750 psi.
 - 2) Minimum Water Retention, ASTM C270: 75 percent.
 - 3) Maximum Air Content, ASTM C270: 12 percent.

C. Grout:

- 1. Fine Grout:
 - a. Provide the following proportions by volume:
 - 1) Portland Cement: One part.
 - 2) Hydrated Lime or Lime Putty: Zero to 1/10 part.

- 3) Aggregate Ratio (measured in a damp loose condition): Sand; not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
 - b. Mix grout to have slump of ten inches plus or minus one inch at time of placement.
 - 2. Coarse Grout:
 - a. Provide the following proportions by volume:
 - 1) Portland Cement: One part.
 - 2) Hydrated Lime or Lime Putty: Zero to 1/10 part.
 - 3) Fine Aggregate Ratio (measured in a damp loose condition): Sand; not less than 2-1/4 and not more than three times sum of volumes of cementitious materials.
 - 4) Coarse Aggregate Ratio: Not less than one and not more than two times the sum of volumes of cementitious materials.
 - b. Mix grout to have slump of ten inches plus or minus one inch at time of placement.
- D Grout Fill Around Reinforcement in Masonry Lintels: Portland cement, sand, gravel and water, to be proportioned as required to provide 28-day minimum compressive strength of 2,000 psi.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Measurement of Materials:
 - 1. Cement and Hydrated Lime: Batched by the bag.
 - 2. Sand: Batched by volume in suitably calibrated containers. Make allowance for bulking and consolidation, and for weight per cubic foot of contained moisture.
 - 3. Proportion of Volumetric Mixtures: One 94-pound sack of portland cement and one 50-pound sack of hydrated lime constitute nominal one cubic foot.
 - 4. Shovel measurement: Unacceptable.
- B. Mortar Mixing:
 - 1. Type of Mixer: Machine mix in appropriate mixer in which quantity of water is accurately and uniformly controlled.

2. While mixer is operating, add approximately three-quarters of required water, half the sand, all the cement, and then add remainder of sand.
3. Allow batch to mix briefly and then add balance of water in small quantities until satisfactory workability is obtained.
4. Mix for not less than five minutes after all materials have been added.
5. Hydrated Lime for Mortar Requiring Lime Content: Use dry-mix method. Turn materials over together for each batch until even color of mixed, dry materials indicates that cementitious material has been thoroughly distributed throughout the mass, and then add water to obtain required plasticity.
6. Prepare lime putty, if approved for use, in accordance with ASTM C5.
7. Waterproofing Admixture: Add to mortar mix for all exterior masonry in accordance with manufacturer's instructions.
8. Mixer drum shall be completely emptied before recharging the next batch.
9. Limit batch size to avoid re-tempering. Re-tempering of mortar is not allowed.

3.3 INSTALLATION AND MORTAR AND GROUT TYPE LOCATION

- A. For mortar and grout type, location, and installation requirements, refer to:
 1. Section 04201, Unit Masonry Construction.

3.4 FIELD QUALITY CONTROL

- A. Site Tests:
 1. Refer to Section 04201, Unit Masonry Construction, for load-bearing masonry wall strength tests.

+ + END OF SECTION + +

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SECTION 04090

MASONRY ANCHORAGE AND REINFORCING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install masonry anchorages and reinforcing.
2. Section specifies masonry anchorages and reinforcing for Work specified in:
 - a. Section 04201, Unit Masonry Construction.
3. Types of products required include:
 - a. Continuous horizontal wire reinforcing and ties.
 - b. Individual wire ties.
 - c. Anchoring and positioning devices.
 - d. Miscellaneous masonry accessories, reinforcing bars, and compressible filler.

B. Coordination:

1. Provide masonry anchorages and reinforcing of sizes, dimensions and configurations coordinated with unit masonry construction system component sizes, dimensions and configurations.

C. Related Sections:

1. Section 04201, Unit Masonry Construction.
2. Section 09900, Painting.
3. Section 13122, Metal Building Systems.

1.2 REFERENCES

A. Reference Standards: Standards referenced in this Section are:

1. ACI 315, Details and Detailing of Concrete Reinforcement.
2. ASTM A36/A36M, Specification for Carbon Structural Steel.
3. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
4. ASTM A153/A153M, Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
5. ASTM A240/A240M, Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

6. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
7. ASTM A663/A663M, Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
8. ASTM A1008/A1008M, Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
9. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
10. ASTM D2240, Test Method for Rubber Property – Durometer Hardness.
11. ASTM D2287, Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
12. UL U901, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR (ANSI/UL 263).
13. UL U902, Bearing Wall Rating – 4 HR., Alternative Detail (ANSI/UL 263).
14. UL U904, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).
15. UL U905, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
16. UL U906, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
17. UL U907, Nonbearing Wall Rating – 3 or 4 HR (ANSI/UL 263).
18. UL U909, Nonbearing Wall Rating – 3 or 4 HR (ANSI/UL 263).
19. UL U910, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR (ANSI/UL 263).
20. UL U912, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).
21. UL U913, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR (ANSI/UL 263).
22. UL U914, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR (ANSI/UL 263).

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Provide all metal sheet, wire, plate and bar stock masonry anchorages and reinforcing from same manufacturer.
2. Miscellaneous masonry accessory items other than metal sheet, wire, plate and bar stock shall each be obtained from a single, manufacturer, which may be different from the manufacturer of other products specified in this Section.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Submit drawings and material schedules showing all dimensions and sizes of masonry anchorages and reinforcing coordinated with unit masonry Work and other Work in which masonry anchorages and reinforcing will be embedded, be supported from, or restrained.
 - b. Submit schedule indicating type, location, and spacing of each masonry accessory in unit masonry construction and that type, location, and spacing are in compliance with code requirements.
2. Product Data:
 - a. Manufacturer's product literature and specifications for each masonry accessory required. Include data substantiating that materials comply with the Contract Documents.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions:
 - a. Manufacturer's instructions for handling, storing, and installing for each masonry accessory required.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with:

1. Applicable requirements of standards referenced in this Section.
2. Section 01610, Transportation and Handling of Materials and Equipment.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Continuous Horizontal Wire Reinforcing and Ties: Provide the following for all masonry walls unless otherwise shown or indicated:

1. General: Provide the following:
 - a. Reinforcement, wire and ties of cold-drawn steel wire complying with ASTM A82 and hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153 .
 - b. Welded wire units, prefabricated in straight lengths, at least ten feet long, with matching corner "L" and intersection "T" units, all with deformed continuous nine-gage side rods and plain nine-gage truss-type diagonal cross-rods, butt-welded to side rods, not more than 16 inches on centers, with unit width of 1.5 to two inches less than thickness of wall or partition.

- c. Rectangular boxes, pintles and ties fabricated of 3/16-inch diameter wire, unless otherwise specified.
 - 2. Single-wythe and Multi-wythe Masonry Walls (except cavity wall):
 - a. Wall reinforcement system with one horizontal rod beneath each unit masonry face shell wall.
 - b. Products and Manufacturers: Provide products of one of the following:
 - 1) Truss Mesh Reinforcement with #120 Truss-Mesh by Hohmann & Barnard, Inc.
 - 2) #DA 3100 Truss by Dur-O-Wal, Division of Dayton Superior.
 - 3) Or equal.
- B. Individual Wire Ties for Masonry: Provide the following:
 - 1. General: Provide the following:
 - a. Reinforcing, wire, and ties of Cold-drawn steel wire complying with ASTM A82 and hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153.
 - b. Crimped with vee-drip for use in cavity wall construction and of length required for proper embedment in outer-most face shell walls of wythes of masonry shown or indicated.
 - c. Rectangular box ties and adjustable box ties fabricated of 3/16-inch diameter wire.
 - 2. Single-piece Ties (where facing and back-up joints align):
 - a. For use with hollow masonry units laid with cells vertical and with solid masonry units or hollow units laid with cells horizontal, provide four-inch wide rectangular shaped box-ties.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Rectangular Box Ties, by Hohmann & Barnard, Inc.
 - 2) No. 253 Rectangular Wire Ties, by Heckmann Building Products.
 - 3) Or equal.
- C. Anchoring Devices for Masonry: Provide the following, unless otherwise shown or indicated:
 - 1. General: Provide the following:
 - a. Cold-rolled steel sheet complying with ASTM A1008; hot-rolled steel sheet and strip complying with ASTM A1011; plates and bars complying with ASTM A36; and cold-drawn steel wire complying with ASTM A82 all hot-dipped galvanized after fabrication with 1.5 ounces per square foot of zinc coating complying with ASTM A153
 - b. Rectangular, corrugated, one-inch wide ties, fabricated of 12-gage sheet metal, unless otherwise specified.
 - c. Size tie lengths to extend to within one-inch of outside face of outer wythe face shell of opposite face of masonry or to a maximum depth of 12 inches and between 1.5 to two inches less than width of masonry abutting webs and to maximum depth of 12 inches abutting flanges of

- structural supports. Provide wire crimped with a vee-drip for use in cavity wall construction.
- d. Flexible Anchors: Where masonry abuts structural walls or framework, provide flexible anchors that allow horizontal and vertical movement of masonry, but provides lateral restraint.
2. Anchorage to Steel Columns and Steel Beam Webs: Provide the following for lateral restraint of unit masonry walls at structural steel framework:
 - a. U-shaped, 7.5-inch long channels welded to steel structure, with 5.5 inches of vertical adjustment, fabricated from 11-gage steel with slotted ties.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) #360 - Gripstay Channels and #364 - Corrugated Gripstay Anchor, by Hohmann & Barnard, Inc.
 - 2) No. 130 Channel Anchor Slots and No. 134 Corrugated Anchor, by Heckmann Building Products.
 - 3) Or equal.
 3. Lateral Supporting Masonry Wall Anchors: Provide the following for bracing freestanding walls exceeding allowable unbraced span:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) #344 Rigid Partition Anchor, by Hohmann & Barnard, Inc.
 - 2) #140 Masonry Anchor, by Heckmann Building Products.
 - 3) Or equal.
 - b. Plate, 1/4-inch thick by two inches wide fabricated with two-inch long bent legs at 90 degrees to flat face of anchor and of length to extend to center of each wythe of wall, but not less than 2.33 feet long. Cut to length as required.
 4. Rebar Positioners: Provide the following:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) #RB Series and #RB-Twin Series Rebar Positioners, by Hohmann & Barnard, Inc.
 - 2) Rebar Positioners, by Heckmann Building Products.
 - 3) Or equal.
 - b. Nine-gage reinforcing bar positioners that accommodate both horizontal and vertical reinforcing steel.
 - c. Fabricate units as required for the Work.
- D. Miscellaneous Masonry Accessories: Provide the following where shown:
1. Reinforcing Bars:
 - a. Deformed carbon steel, ASTM A615, Grade 60 for bars No. 3 to No. 18, except as otherwise shown.
 - b. Plain carbon steel, ASTM A663, Grade 80 where No. 2 bars are shown or required.
 - c. Provide galvanized steel reinforcing bars complying with ASTM A153, Class B-1, where shown.

2. Compressible Filler: Provide watertight joint filler where unit masonry construction abuts structural framework members, or as shown. Provide the following:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Polytite Standard, by Polytite Manufacturing Corp.
 - 2) Polyseal, by Sandell Manufacturing Company, Inc.
 - 3) Or equal.
 - b. Polyurethane foam strip saturated with polybutylene waterproofing material that, when installed at a compression ratio of two-to-one, is impermeable to water.
 - c. Resilient to -40 degrees F with 100 percent movement recovery.
 - d. Elongation of 140 percent with a tensile strength of not less than 53 pounds per square inch.

2.2 FABRICATION

- A. Weld-in-place all channel slots and other specified weld-on anchors at the shop. Field welding is unacceptable.
- B. Coordinate location of weld-on anchors and show on structural steel Shop Drawings required under Section 13122, Metal Building Systems.
- C. Weld anchor slots and other required accessories in place before shop priming of structural steel.
- D. Prime coat weld-on anchors and other accessories and passivate anchor coating in accordance with Section 09900, Painting.
- E. Shop-fabricate reinforcing bars that are shown or required to be bent or hooked. Comply with ACI 315 for fabricating reinforcing steel for unit masonry Work.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to the following:
 1. Section 04201, Unit Masonry Construction.

+ + END OF SECTION + +

SECTION 04201

UNIT MASONRY CONSTRUCTION

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all unit masonry construction. The Work also includes:
 - a. Providing openings in unit masonry construction to accommodate the Work under this and other Sections and building into unit masonry construction all items such as sleeves, anchorage devices, inserts, and other items to be embedded in unit masonry construction for which placement is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items to be installed with or before unit masonry construction Work.
2. Remove and rebuild unit masonry construction advanced without built-in flashings and other built-in items at no additional cost to Owner, even after unit masonry construction has been completed.

C. Related Sections:

1. Section 04060, Masonry Mortaring and Grouting.
2. Section 04090, Masonry Anchorage and Reinforcing.
3. Section 07920, Joint Sealants.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 530, Building Code Requirements for Masonry Structures.
2. ACI 530.1, Specification for Masonry Structures.
3. ASTM C67, Test Methods for Sampling and Testing Brick and Structural Clay Tile.
4. ASTM C140, Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
5. ASTM C780, Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
6. ASTM C1091, Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines.

7. ASTM C1093, Practice for Accreditation of Testing Agencies for Unit Masonry.
8. ASTM C1314, Test Method for Compressive Strength of Masonry Prisms.
9. BIA, Technical Notes on Brick Construction.

1.3 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:
1. “Masonry control joint” is a joint in interior and exterior masonry walls that allows expansion and contraction to occur independently without damage to the masonry.
 2. “Masonry expansion joint” is a control joint in interior and exterior masonry walls, located at the separation between adjoining parts of a concrete or steel structure that is provided to allow movements transferred to the masonry to occur independently without damage to the masonry.

1.4 QUALITY ASSURANCE

- A. Qualifications:
1. Installer:
 - a. Engage a single installer regularly engaged in preformed unit masonry installation and with successful and documented experience in erecting unit masonry of the scope and type of Work required; and who employs only tradesmen with specific skill and successful experience in the type of Work required. Submit name and qualifications with the following information for a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects, or engineers responsible for projects.
 - 2) Approximate contract cost of unit masonry.
 - 3) Quantity (area) of unit masonry installed.
 2. Testing Laboratory:
 - a. In accordance with ASTM C1093.
- B. Component Supply and Compatibility:
1. Obtain each type of concrete masonry units from one manufacturer, cured by one process and of uniform texture and color or in an established uniform blend thereof.
 2. Use a single source and brand of mortar materials throughout the Work.
- C. Regulatory Requirements:
1. Where fire-resistance classification is shown or indicated (e.g., four-hour rating, three-hour rating, and similar designations) for unit masonry construction, comply with applicable requirements for materials and

installation established by UL tests referenced in this Section and requirements of authorities having jurisdiction.

D. Job Mock-up:

1. Prior to installing unit masonry and after Engineer's approval of Samples, erect job mock-ups using materials, pattern bond, and joint tooling shown or specified. Build mock-up at the Site, at location acceptable by Engineer, of full required wall thickness. Mock-up shall be approximately four feet by 3.33 feet unless another size or location is shown or indicated for the job mock-up. Provide special features as directed, including finished end, and masonry control joint. Indicate proposed range of color, texture, and workmanship to be expected in the completed Work. Obtain Engineer's approval of visual qualities of mock-up before starting unit masonry construction. Retain and protect mock-up during construction as a standard for judging unit masonry Work. Do not alter, move, or destroy mock-up until given permission by Engineer.
2. Build as many mock-up panels as required to obtain Engineer's approval.
3. Masonry construction that does not comply with standards approved on mock-up panel shall be removed and rebuilt to conform to the Contract Documents. Provide mock-up panel for the following:
 - a. Typical complete interior partition of concrete unit masonry where both sides will remain visually exposed upon completion of the Work.

E. Pre-Construction Masonry Conference:

1. Prior to installing unit masonry construction, Contractor and Contractor's installer shall attend pre-construction masonry conference at the Site. Review foreseeable methods and procedures related to unit masonry construction including, but not limited to, the following:
 - a. Requirements of the Contract Documents.
 - b. Structural concept.
 - c. Sequence of masonry construction.
 - d. Special masonry details.
 - e. Standard of workmanship.
 - f. Prism and grout sampling, and unit masonry test results.
 - g. Quality control requirements.
 - h. Project organization and availability of materials, tradesmen, equipment, and facilities required to avoid delays.
 - i. Masonry control and expansion joint locations and materials.
 - j. Modular planning requirements.
 - k. Weather and forecasted weather conditions, and procedures for coping with unfavorable conditions.
 - l. Required inspection, testing, and certifying procedures.
 - m. Requirements for complying with building codes.
2. Attendance at the conference is mandatory for the following:
 - a. Masonry Subcontractor's superintendent and foreman.

- b. Authorized representative of face brick and concrete unit masonry Suppliers.
- c. Engineer
- d. Resident Project Representative.
- e. Coordinating Special Inspector.
- 3. If additional information is required to adequately cover items on agenda, reconvene conference as soon as possible.
- 4. Contractor shall record discussions of conference and decisions and agreements (or disagreements) and furnish a copy of the record to each person and entity attending.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Complete layout of all masonry walls showing modular planning and all special shapes to be used in the Work. Show all details for each condition encountered in the Work. Submit plan and elevation views drawn at scale of 1/4-inch equal to one foot, and details drawn at scale of 1.5-inch equal to one foot. Show all items included in the unit masonry construction.
 - b. Masonry control joint locations and details.
 - c. Drawings showing location, extent, and accurate configuration and profile of all items required by the Contract Documents, in this and other Sections, for unit masonry construction. Provide elevations drawn at scale of 1/4-inch equal to one foot, and details drawn at scale of 1.5-inch equal to one foot.
 - d. Drawings for fabricating, bending, and placing of reinforcing bars. Submit bar schedules, diagrams of bent bars, stirrup spacing, lateral ties, and other arrangements and assemblies required for fabricating and placing of reinforcing for unit masonry construction.
 - e. Job Mock-Up: Shop Drawings showing location, extent, and accurate configuration of items to be built-in to mock-ups. Provide elevations drawn at scale of 1.5-inch equal to one foot.
- 2. Samples:
 - a. Mock-ups.

B. Informational Submittals: Submit the following:

- 1. Field Quality Control Submittals:
 - a. Pre-installation test results in accordance with ASTM C140 and ASTM C1314, and the field quality control Article of this Section.
 - b. Post-installation quality control submittals in accordance with the field quality control Article of this Section.
- 2. Qualifications Statements:
 - a. Installer.

- b. Testing laboratory.
- C. Closeout Submittals: Submit the following:
 - 1. Record Documentation:
 - a. Comply with Section 01720, Project Record Documents.
 - b. Indication location of all masonry control joints and expansion joints.

1.6 DELIVERY, STORAGE AND HANDLING

- A. General:
 - 1. Comply with:
 - a. Section 01610, Transportation and Handling of Materials and Equipment.
 - 2. Storage: Maintain temperatures in shelter so that masonry materials are above 20 degrees F when installed.

1.7 SITE CONDITIONS

- A. Environmental Requirements:
 - 1. General:
 - a. Temporary Facilities and Temporary Utilities: Provide supplemental heat sources and energy as required for unit masonry construction in cold weather.
 - b. Do not perform unit masonry construction when air temperature is below 28 degrees F for rising temperature, or below 36 degrees F for falling temperatures, without providing temporary enclosures and heat, or without heating materials or other measures necessary to prevent freezing as specified.
 - c. Do not use frozen materials and do not build on frozen unit masonry construction.
 - d. Remove and replace all unit masonry construction damaged by cold temperatures and freezing.
 - 2. Protection:
 - a. Cold Weather Protection: Protect unit masonry construction against freezing for at least 48 hours after placement, as follows:
 - 1) When anticipated minimum temperature will be between 40 degrees F and 25 degrees F, cover newly constructed masonry with weather-resistive membrane for 48 hours after installation.
 - 2) When anticipated minimum temperature will be between 25 degrees F and 20 degrees F, completely cover newly constructed masonry with weather-resistive insulating blankets, or equal protection, for 48 hours after installation.
 - 3) When anticipated minimum temperature will be below 20 degrees F, maintain newly constructed masonry at temperature above 32 degrees F for at least 48 hours after installation by using heated

- enclosures, electric heating blankets, infrared lamps, or other acceptable methods of supplementary heating.
- b. Hot Weather Protection: When mean daily temperature exceeds 100 degrees F, or exceeds 90 degrees F with wind velocity greater than eight miles per hour, fog-spray newly constructed masonry until damp at least three times per day until masonry is 72 hours old.
 - c. When Work is not in progress, protect partially-completed unit masonry construction against rapid heat loss and from water entering the masonry by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least two feet down both sides of wall and secure in place using wall cover clamps spaced at intervals of four feet and at each end, and at joints in the membrane.
 - d. Do not apply floor or roof loading for at least 72 hours after completing masonry columns or walls.
 - e. Do not apply concentrated loads for at least 168 hours after completing masonry columns or walls.
3. Cold Weather Unit Masonry Construction:
- a. When mean daily temperature is below 40 degrees F, mortar used in unit masonry construction shall be portland cement-lime-sand mortar using high-early strength portland cement. Use mortar within 1.5 hours of initial mixing. Use grout within 1.5 hours of initial mixing.
 - b. Clay or shale unit masonry with suctions in excess of 20 grams of water per 30 square inches per minute shall be sprinkled with heated water just prior to installation. Provide water temperature above 70 degrees F when temperature of masonry units is above 32 degrees F. Water temperature shall be above 120 degrees F when temperature of masonry units is below 32 degrees F.
 - c. For Air Temperatures of 40 degrees F to 32 degrees F: Water and aggregates used in mortar and grout shall not be heated above 140 degrees F. Heat mortar sand or mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F at time of mixing. Heat water and aggregates for grout when water or aggregate temperature is below 32 degrees F.
 - d. For Air Temperatures of 32 degrees F to 25 degrees F: Comply with Paragraph 1.7.A.3.c of this Section and the following: Maintain mortar temperature above freezing until used in masonry. Heat aggregates and mixing water for grout to produce grout temperature between 70 degrees F and 120 degrees F at time of mixing. Maintain grout temperature above 70 degrees F at time of grout placement.
 - e. For Air Temperatures of 25 degrees F to 20 degrees F: Comply with Paragraphs 1.7.A.3.c and 1.7.A.3.d of this Section and the following: Heat masonry surfaces under construction to 40 degrees F. Provide temporary wind breaks or enclosures when wind velocity exceeds 15 miles per hour. Prior to grouting, heat the masonry to minimum of 40 degrees F.

- f. For Air Temperatures of 20 degrees F and Below: Comply with Paragraphs 1.7.A.3.c, 1.7.A.3.d, and 1.7.A.3.e of this Section and the following: Provide temporary enclosures and auxiliary heat to maintain air temperature within temporary enclosure above 32 degrees F. Temperature of masonry units when laid shall not be less than 20 degrees F.
- 4. Hot Weather Unit Masonry Construction: Using methods acceptable to Engineer, protect unit masonry construction from direct exposure to wind and sun when ambient air temperature is 99 degrees F in shade with relative humidity less than 50 percent.
 - a. When ambient temperature exceeds 100 degrees F, or exceeds 90 degrees F with wind velocity greater than eight miles per hour, maintain temperature of mortar and grout below 120 degrees F. Flush mixers, mortar transport containers, and mortarboards with cool water before they come into contact with mortar ingredients or mortar. Maintain mortar consistency by re-tempering with cool water. Use mortar within two hours of initial mixing. Use grout within 1.5 hours of initial mixing. Maintain sand piles in damp, loose condition.
 - b. When ambient temperature exceeds 115 degrees F, or exceeds 105 degrees F with wind velocity greater than eight miles per hour, comply with Paragraph 1.7.A.4.a of this Section and the following: Use cool mixing water for mortar and grout. Use of ice will be allowed in mixing water prior to use; ice is not allowed in the mixing water when added to other mortar or grout materials. Shade materials and mixing equipment from exposure to direct sunlight.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Material requirements for masonry materials are in the following:
 - 1. Section 04060, Masonry Mortaring and Grouting.
 - 2. Section 04090, Masonry Anchorage and Reinforcing.
 - 3. Section 04220, Concrete Unit Masonry.
- B. Mortar, General:
 - 1. Where question of compliance with or interpretation of requirements of this Section arises, mortar properties Specification will take precedence over mortar proportion Specifications.
 - 2. Make no change in proportions established for mortar approved under property Specifications, and do not use materials with different physical characteristics in mortar unless compliance with requirements of property Specifications is re-established by Shop Drawing or submittal data.
 - 3. Do not combine two air-entraining materials in mortar.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which unit masonry construction will be installed, and notify Engineer in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Wetting of Masonry Units:
 - 1. Face Brick: Wet brick having ASTM C67 absorption rates in excess of 20 grams of water per 30 square inches per minute, so that rate of absorption when laid does not exceed the following.
 - a. Determine absorption by placing 20 drops of water using medicine dropper inside one-inch diameter circle on typical brick units. If water is absorbed within 90 seconds, wet the brick before laying.
 - 2. Use wetting methods that ensure that each masonry unit is nearly saturated, but surface-dry when laid.
 - 3. Concrete Masonry Units: Except for absorbent units specified to be wetted, lay masonry units dry. Do not wet concrete masonry units.
- B. Cleaning of Reinforcing: Before placing, remove loose rust, mill scale, earth, ice, and other contamination from reinforcing materials. Do not use reinforcing bars with kinks or bends not shown or approved Shop Drawings, or bars with reduced cross-section due to rusting or other causes.

3.3 INSTALLATION, GENERAL

- A. Thickness: Build walls, floors, and other unit masonry construction to thickness shown or indicated. Build single wythe walls to actual thickness of masonry units using units of nominal thickness shown or indicated.
- B. Build chases and recesses as shown or required by others, as specified. Provide not less than eight inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
- C. Leave openings for equipment, piping, ducts, and other items to be installed subsequent to starting unit masonry construction. After installation of said items, complete unit masonry construction to match the Work immediately adjacent to openings.

- D. Cut masonry units using motor-driven wet cutting saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining Work neatly. Use full-size units without cutting where possible. Provide special unit masonry shapes for transitions and intersections. Do not attempt to field-cut special shapes from regular unit masonry shapes, and do not use other options for special unit masonry shapes.
- E. Build interior masonry walls visible from both sides in the finished Work using two wythes of masonry. Masonry shall be continuous over entire plane of wall, including walls that continue behind fixtures, equipment, furniture, lockers, and similar items
- F. Matching Existing Masonry: Match with existing masonry the coursing, pattern bond, color, and texture of new unit masonry construction

3.4 LAYING MASONRY WALLS

- A. General:
 - 1. Mortar Types: Unless otherwise shown or indicated, use mortar specified in Section 04060, Mortar and Masonry Grout, as follows:
 - a. Use Type N mortar for interior, non-load-bearing walls.
 - b. Use grout fill for structural requirements and for grouting reinforcing steel in unit masonry construction.
 - c. Do not use mortar that has begun to set or if more than thirty minutes have elapsed since initial mixing. Re-temper mortar during the thirty-minute period only as required to restore workability.
 - 2. Lay out walls in advance for accurate spacing of surface pattern bond with uniform joint widths and to properly locate openings, masonry control joints, returns, and offsets. Avoid using less than half-size units at corners, jambs, and where possible at other locations.
 - 3. Lay up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced, and coordinated with other work.
 - 4. Pattern Bond:
 - a. Lay exterior, and interior concrete unit masonry in running bond pattern with vertical joints in each course centered on units in courses above and below. Avoid using less than full-size units.
 - b. Lay concrete unit masonry scheduled or shown to be concealed by finish materials, except paint, with units in wythe bonded by lapping not less than two inches.
 - c. Do not use units with less than four-inch horizontal face dimensions at corners or jambs.
 - 5. Color and Texture:
 - a. Lay concrete unit masonry using mortar of natural color.
- B. Construction Tolerances:

1. Variation from Plumb: For lines and surfaces of columns, walls and arises, do not exceed 1/4-inch in ten feet, or 3/8-inch in a story height (20 feet), maximum, nor 1/2-inch in 40 feet or more. Except for external corners, expansion joints and other conspicuous lines, do not exceed 1/4-inch in any story or 20 feet maximum, nor 1/2-inch in 40 feet or more.
 2. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
 3. Variation of Linear Building Line: For position shown and related portion of columns, walls and partitions, do not exceed 1/2-inch in any bay or 20 feet maximum, nor 3/4-inch in 40 feet or more.
 4. Variation in Cross Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4-inch nor plus 1/2-inch.
- C. Mortar Bedding and Jointing:
1. Lay solid masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
 2. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course of piers, columns, and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
 3. Maintain joint widths shown, except for minor variations required to maintain pattern bond alignment. If not shown, lay unit masonry to provide the following joint widths:
 - a. Brick and Concrete Unit Masonry: 3/8-inch.
 5. Cut joints flush for masonry walls to be concealed or to be covered by other materials, except paint, unless otherwise shown.
 6. Tool exposed joints slightly concave, when mortar is "thumbprint hard", unless otherwise required to match existing joint treatment. Rake out mortar 1/2-inch deep in preparation for application of calking or sealants.
 7. Concave-tool exterior joints below grade.
 8. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units that have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
- D. Stopping and Resuming Work: Rake back one unit masonry length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, if required, and remove loose masonry units and mortar prior to laying new masonry.

- E. Built-in Work:
1. As the Work progresses, build-in the items shown, specified or required in the Contract Documents. Fill cores in one-block width solidly with mortar around built-in items.
 2. Do not fill space between hollow metal frames and masonry solidly with mortar.
 3. Where built-in items are to be embedded in cores of hollow masonry units, place layer of cavity fill mesh in the joint below and rod mortar or grout into core.
 4. Where required by Laws or Regulations, or to comply with thickness-to-height ratio, or to provide required fire resistance, fill all cells of unit masonry construction solid with grout.
- F. Non-Load-Bearing Interior Partitions and Non-Load-Bearing Interior Cavity Wall Wythe:
1. Build full height of story to underside of structure above, unless otherwise shown or indicated.
 2. Tie non-load-bearing partitions and non-load-bearing interior wythe of cavity walls at top and sides with masonry anchors at terminations. Build in end blocks as shown and specified to facilitate placing compressible filler. Insert compressible filler, specified in Section 04090, Masonry Anchorage and Reinforcing, in all horizontal and vertical joints where non-load-bearing masonry and non-load-bearing interior wythe of cavity walls terminate. Insert filler 3/4-inch from both faces of masonry. Use filler four times as thick as widest part of joint. Thickness of filler shall be a minimum of 1.5 times the compressed thickness. Compress filler to less than thickness of joint and insert. At splices, overlap strips by three inches and compress ends to form tight joint. Finish with backer rod and sealant.
 3. At terminations of non-load-bearing masonry walls and non-load-bearing interior wythe of cavity walls requiring a fire rating, use fire-safing insulation specified in Section 07210, Building Insulation. Build in end blocks to facilitate placing fire-safing insulation. Insert insulation in a continuous, vapor-tight, solid blanket to 3/4-inch from both faces of masonry. Finish with backer rod and sealant.
- G. Horizontal Joint Reinforcing:
1. Provide continuous horizontal joint reinforcing as shown and specified. Refer to Section 04090, Masonry Accessories, for reinforcing units required. Fully embed longitudinal side rods in mortar for entire length of rods with minimum cover of 5/8-inch on exterior side of walls and 1/2-inch at other locations. Lap reinforcing minimum of six inches at ends of units. Do not bridge masonry control joints and building expansion joints with reinforcing.
 2. Reinforce walls with continuous horizontal joint reinforcing unless specifically indicated as being omitted.

3. Provide continuity at corners and wall intersections by using prefabricated “L” and “T” sections. Cut and bend units in accordance with manufacturer’s written instructions for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
4. Space continuous horizontal reinforcing as follows:
 - a. For multi-wythe walls, solid or cavity, that are structurally bonded by masonry headers or individual wire ties, space horizontal reinforcing two feet on centers vertically.
 - b. For multi-wythe walls, solid or cavity, where continuous horizontal reinforcing also acts as structural bond or tie between wythes, space reinforcing as required by Laws and Regulations, but not more than 16 inches on centers vertically.
 - c. For single-wythe walls, space reinforcing at 16 inches on centers vertically, unless otherwise shown.
 - d. For parapets, space reinforcing at eight inches on centers vertically, unless otherwise shown.
5. Reinforce masonry openings greater than 12 inches wide, with horizontal joint reinforcing placed in two horizontal joints approximately eight inches apart, immediately above lintel and immediately below sill. Extend reinforcing a minimum of two feet beyond jambs of opening.
6. In addition to wall reinforcing, provide additional reinforcing at openings as required to comply with the above.

H. Structural Reinforced Unit Masonry Construction:

1. Comply with ACI 530, ACI 530.1 and Laws and Regulations for structural reinforced unit masonry construction.
2. Shape and dimension reinforcement as shown and required by applicable ACI standards and Laws and Regulations.
3. Position reinforcing accurately at spacing shown on approved Shop Drawings. Support and secure vertical bars against displacement using rebar positioners.
4. Where vertical bars are shown in close proximity, provide clear distance between bars of not less than the greater of the nominal bar diameter or one-inch.
5. Provide lapped splices with reinforcing steel placed in contact and wire tied. Provide minimum lap required by Laws and Regulations, unless requirements that are more stringent are shown or indicated. Do not splice reinforcing at points other than shown or as approved on Shop Drawings.
6. Provide substantial and tight formwork and shores as required for temporary support of reinforced masonry elements. Design, erect, support, brace, and maintain formwork.
7. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar grout. Brace, tie, and support as required for maintaining position and shape during construction and curing of reinforced masonry.

8. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other temporary loads that may be placed on them during construction.
 9. Allow not less than the following duration to elapse after completing a member before removing shores or forms, provided suitable curing conditions have been obtained during the curing period:
 - a. Girders and Beams: Ten days.
 - b. Slabs: Seven days.
 - c. Reinforced Masonry Soffits: Seven days.
- I. Grouting Structural Reinforced Unit Masonry Construction:
1. Limit extent of masonry construction to sections that do not exceed the maximum pour requirements specified. Provide temporary dams or barriers to control horizontal flow of grout at ends of wall sections. Build dams to full height of grout pour. If masonry units are used, do not bond into permanent masonry wythes. Remove temporary dams after completing grout pour.
 2. Use fine grout for filling spaces less than four inches in both horizontal directions. Use coarse grout for filling spaces four inches or larger in both horizontal directions.
 3. For spaces 10 inches and larger, use concrete fill.
 4. Low-Lift Grouting:
 - a. Use low-lift grouting techniques using fine grout mix for the following:
 - 1) Two-wythe walls with grout space of two inches or less in width.
 - 2) Multi-wythe walls.
 - 3) Grout spaces less than 2-inches in width at intervals not to exceed two feet in lifts of six to eight inches.
 - 4) At Contractor's option, low-lift-grouting technique may be used for structural reinforced unit masonry construction with grout spaces wider than two inches, except use coarse grout mix and place in lifts not to exceed eight inches in height.
 - b. Construct low-lift structural reinforced unit masonry construction by placing reinforcing, laying masonry units and pouring grout as the Work progresses.
 - c. Place vertical reinforcing bars and supports prior to laying of masonry units. Extend above elevation of maximum pour height as required to allow for splicing. Horizontal reinforcing bars may be placed progressively with laying of masonry units.
 - d. Limit grout pours as required to prevent displacing masonry by grout pressure (blowout), but do not exceed 12-inch pour height.
 - e. Lay masonry units prior to each grout pour, but do not construct more than 12 inches above maximum grout pour height in one exterior wythe and four inches above in other exterior wythe. Provide metal wall ties, if required, to prevent blowouts.

- f. Pour grout using container with spout and consolidate immediately by rodding or puddling; do not use trowels. Place grout continuously; do not interrupt pouring of grout for more than one hour. If poured in lifts, place from center-to-center of masonry courses. Terminate pour 1.5 inches below top of highest course in pour.
5. High-Lift Grouting:
- a. High-lift grouting technique may be used for the following structural reinforced unit masonry construction:
 - 1) Two-wythe walls with grout spaces of 2.5 inches or greater width.
 - b. Place reinforcing and support in proper position, prior to laying of masonry units, except if shown to be placed in mortar joints, place as masonry units are laid. Place horizontal bars in grout spaces on same side of vertical bars.
 - c. Construct high-lift structural reinforced unit masonry construction by laying masonry to full height and width prior to placing of grout. Provide cleanout holes in first course of masonry, and use high-pressure water jet stream to remove excess mortar from grout spaces, reinforcing bars and top surface of structural members, which support wall. Clean grout spaces daily during construction of masonry.
 - d. Walls: Omit every other masonry unit in first course of one wythe to provide cleanout holes. Tie wythes together with metal ties as shown or required by Laws and Regulations, but provide not less than nine-gage wire ties spaced not less than two feet on centers horizontally and 16 inches on centers vertically for running pattern bond or 12 inches on centers vertically for stack bond.
 - e. Preparation of Grout Spaces: Prior to grouting, inspect and clean grout spaces. Remove dirt, dust, mortar droppings, loose pieces of masonry, and other foreign materials from grout spaces. Clean reinforcing and adjust to proper positioning. Clean top surface of structural members supporting masonry to ensure bond. After cleaning and inspection, close cleanout holes with matching masonry units and brace closures to resist grout pressures.
 - f. Place grout after entire height of masonry to be grouted has attained sufficient strength to resist grout pressure, but not less than three days curing time. Install shores and bracing, if required, before starting grouting operations.
 - g. Place grout by pumping into grout spaces, unless alternate methods are acceptable to Engineer.
 - h. Use coarse grout mix. Rod or vibrate each grout lift during placing and again after excess moisture has been absorbed, but before plasticity is lost. Do not penetrate or damage grout placed in previous lifts or pours.
 - i. Limit grout pours to sections that can be completed in one working day with not more than one-hour interruption of pouring operation.

Limit pours to not exceed capacity of masonry to resist displacement or loss of mortar bond due to grout pressures.

1) Do not exceed 12 feet pour height.

2) Do not exceed 25 feet horizontal pour dimension.

- j. Where pour height exceeds four feet place grout in series of lifts not exceeding four feet in height. Place each lift as continuous pouring operation. Allow at least 30 minutes and not more than 60 minutes between lifts of each pour.
- k. When more than one pour is required to complete a section of masonry, extend reinforcing beyond masonry as required for splicing. Pour grout to within 1.5 inches of top course of first pour. After grouted masonry is cured, remove temporary dams, lay masonry units, and place reinforcing for second pour section before grouting.

J. Anchoring Masonry Work:

- 1. Provide anchoring devices as specified under Section 04090, Anchorage and Reinforcing. If not shown or indicated, provide standard type for facing and back-up involved in compliance with Laws and Regulations.
- 2. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
 - a. Provide an open space not less than a 1/2-inch or more than one-inch in width between masonry and structural members, unless otherwise shown. Keep open space free of mortar and other rigid materials.
 - b. Anchor masonry to cast-in-place concrete and structural steel members with metal ties embedded in masonry joints and attached to structure. Provide anchors with flexible tie sections.
 - c. Space anchors as shown, but not more than two feet on center vertically and three feet on centers horizontally.
 - d. Provide end blocks where masonry abuts structural support to facilitate installation of compressible filler, fire-safing insulation, backer rod, and sealant.
- 3. Anchor single-wythe masonry veneer to backing with metal ties as follows:
 - a. Anchor veneer to structural members with metal anchors embedded in masonry joints and attached to structure. Provide anchors with flexible tie section, unless otherwise shown.
 - b. Anchor veneer to concrete back-up with dovetail anchors and to structural steel back-up with slotted anchors.
 - c. Space anchors as shown, but not more than two feet on centers vertically and three feet on centers horizontally.

K. Masonry Control and Expansion Joints:

- 1. Provide vertical expansion and control joints in masonry where shown. Build in related items as unit masonry construction progresses. Rake out mortar in preparation for application of calking and sealants, in accordance with Section 07920, Joint Sealants.

2. Provide masonry control and expansion joints items specified under Section 04090, Masonry Anchorage and Reinforcing where masonry control and expansion joints are shown.
 - a. Build-in compressible fillers as specified. Install in accordance with manufacturer's written instructions.
 - b. Build-in factory-premolded control joint strips into masonry. Build-in sash block and premolded control joint strips as the Work progresses.
 - c. Provide end blocks where masonry partitions abut structure to facilitate installation of compressible filler, fire-safing insulation, backer rod, and sealant.
- L. Lintels and Bond Beams:
1. Provide steel lintels where shown and as specified in Section 05501, Miscellaneous Metal Fabrications.
 2. Provide masonry lintels and bond beams where shown and where openings of 16-inches or greater are shown without structural steel lintels. Provide formed-in-place masonry lintels and bond beams. Temporarily support formed-in-place lintels and bond beams.
 - a. Unless otherwise shown or indicated, provide one horizontal No. 4 deformed reinforcing bar for each four inches of wall thickness.
 - b. For hollow masonry unit walls, use specially formed U-shaped lintel and bond beam units with reinforcing bars placed as shown, filled with grout as specified in Section 04060, Masonry Mortaring and Grouting.
 3. Provide minimum bearing at each jamb, of four inches for openings less than six feet wide, and eight inches for wider openings.
 4. On concrete and clay unit masonry walls where pattern bond remains visually exposed, increase minimum bearing of masonry lintels to maintain joint pattern of wall and install to be indistinguishable from surrounding masonry.

3.5 REPAIR, POINTING AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or defective, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point up all joints at corners, openings, and adjacent Work to provide a neat, uniform appearance, properly prepared for application of sealant compounds.
- C. Cleaning Exposed, Unglazed Masonry Surfaces:
1. Wipe off excess mortar as the Work progresses. Dry-brush at end of each day's work.

2. Final Cleaning: After mortar is thoroughly set and cured, clean sample wall area of approximately 20 square feet as described below. Obtain Engineer's acceptance of sample cleaning before proceeding to clean remainder of masonry Work.
 - a. Dry clean to remove large particles of mortar using wood paddles and scrappers. Use chisel or wire brush if required.
 - b. Presoak wall by saturating with water and flush off loose mortar and dirt.
 - c. Scrub down wall with stiff fiber brush and solution of half-cup of sodium hexameta phosphate and half-cup of household detergent dissolved in one gallon of water.
 - d. Rinse walls, using clean, pressurized water, to neutralize cleaning solution and remove loose material.
 - e. Acid cleaning of masonry is unacceptable.
- D. Protection:
1. Protect the unit masonry construction from deterioration, discoloration, and damage during subsequent construction operations.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Pre-construction Testing:
 - a. Engage independent testing laboratory to obtain samples and conduct the following tests prior to the start of installation of unit masonry construction:
 - 1) Mortar Test: For each mix required: ASTM C780.
 - 2) Grout Test: For each mix required: ASTM C1019 and ACI 530.1.
 - 3) Prism Test: For each type of construction required: ASTM C1314 and ACI 530.1.
 - 4) Compressive strength of completed concrete unit masonry walls shall be at least 1,500 psi as determined by methods in ACI 530.1.
 - b. Obtain Engineer's acceptance of tests results prior to commencing installation of materials.
 - c. After initial test, Engineer will require performance of up to five additional tests Engineer's discretion.
 2. During and After Installation:
 - a. Test and inspect unit masonry during construction in accordance with quality assurance program defined in ACI 530, ACI 530.1 and Laws and Regulations in effect at the Site, including building code. Level of special inspections shall comply with requirements of International Building Code classification and occupancy.
 3. Repair masonry walls that do not comply with requirements of the special inspections in a manner acceptable to Engineer.

++ END OF SECTION ++

SECTION 04220

CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete unit masonry.
2. Extent of each type of concrete unit masonry is shown and indicated.
3. Types of materials and features required include:
 - a. Hollow non-load-bearing units.
 - b. Lightweight aggregates, high recycle content, special and custom shapes required to complete the Work, complete selection of manufacturer's standard and custom colors and other special, and custom features.

B. Related Sections:

1. Section 04201, Unit Masonry Construction.
2. Section 09900, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C90, Specification for Load bearing Concrete Masonry Units.
2. ASTM C129, Specification for Non-load-bearing Concrete Masonry Units.
3. ASTM C140, Test Methods for Sampling and Testing Concrete Masonry Units.
4. ASTM C331, Specification for Lightweight Aggregates for Concrete Masonry Units.
5. ASTM C426, Test Method for Drying Shrinkage of Concrete Masonry Units.
6. ASTM C744, Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
7. ASTM C1093, Practice for Accreditation of Testing Agencies for Unit Masonry.
8. ASTM E84, Test Method for Surface Burning Characteristics of Building Materials.
9. ASTM E119, Test Methods for Fire Tests of Building Construction and Materials.
10. UL U 901, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR.
11. UL U 902, Bearing Wall Rating – 4 HR., Alternative Detail.

12. UL U 904, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
13. UL U 905, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
14. UL U 906, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
15. UL U 907, Nonbearing Wall Rating – 3 or 4 HR.
16. UL U 909, Nonbearing Wall Rating – 3 or 4 HR.
17. UL U 910, Bearing Wall Rating – 4 HR.; Nonbearing Wall Rating – 4 HR.
18. UL U 912, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.
19. UL U 913, Bearing Wall Rating – 2 HR.; Nonbearing Wall Rating – 2 HR.
20. UL U 914, Bearing Wall Rating – 3 HR.; Nonbearing Wall Rating – 3 HR.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 1. Testing Laboratory: In accordance with ASTM C1093.
- B. Component Supply and Compatibility:
 1. Obtain each type of concrete masonry units from one manufacturer, cured by one process and of uniform texture and color or an established uniform blend texture and color.
- C. Regulatory Requirements:
 1. Where fire-resistance classification is shown (four-hour, three-hour, and similar designations) for concrete unit masonry construction, provide materials complying with requirements established by UL tests referenced in this Section (UL U901 through UL U914), Laws and Regulations including applicable building codes, and requirements of authorities having jurisdiction.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Complete layout of masonry walls showing modular planning, colors, patterns and all special shapes to be provided. Show details for each condition encountered in the Work. Provide plans and elevation at scale of 1/4-inch equals one foot, and details at scale of 1.5-inch equals one foot.
 2. Product Data:
 - a. Manufacturer's specifications, manufacturing procedures, and test data for each material specified. Include instructions for handling, storage, installation, and protection of each type of concrete masonry unit.
 - b. Laboratory test reports in accordance with ASTM C140.
- B. Informational Submittals: Submit the following:

1. Certifications: Submit certification that concrete unit masonry has been manufactured using only licensing manufacturer's approved materials, manufacturing methods, product standards, and is in accordance with ASTM C744.
2. Source Quality Control Submittals:
 - a. Submit test results as specified in this Section.
3. Qualifications Statements:
 - a. Testing laboratory, if not explicitly included in submittals furnished under other Sections.

1.5 DELIVERY, STORAGE AND HANDLING

- A. At time of unloading at Site, concrete masonry units shall comply with ASTM C90, Table 2.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements: Maintain temperature in area of storage and installation so that masonry products are above 20 degrees F when installed.

PART 2 – PRODUCTS

2.1 GENERAL, CONCRETE UNIT MASONRY

- A. General:
 1. Unless specifically modified by other requirements of the Contract Documents, provide concrete unit masonry in compliance with classifications, weights, grades, colors, textures, scores, thermal resistance values, and other features specified in this Section.
 2. Cure units by autoclave treatment at minimum temperature of 350 degrees F, and minimum pressure of 125 pounds per square inch.
- B. Hollow and Solid Load-bearing Concrete Masonry Units: ASTM C90, with minimum of 15 percent coal fly ash and 50 percent recycle aggregate as part of concrete mix.
 1. Minimum compressive strength: 1,900-psi average of three units.
- C. Hollow Non-load-bearing Concrete Masonry Units: ASTM C129, with minimum of 15 percent coal fly ash and 50 percent recycle aggregate as part of concrete mix.
- D. Size: Manufacturer's standard units with nominal face dimensions of 16 inches long by eight inches high (15-5/8 inches by 7-5/8 inches actual).
- E. Moisture Control:

1. Limit total moisture absorption until time of installation to maximum percentage specified for the weight classification in ASTM C90, Table 2.
 2. Total linear dry shrinkage at time of installation shall be less than 0.065 percent.
- F. Special Shapes: Provide the following:
1. Lintels, bond beams, reinforcing units, and flush-end reinforcing units, interior and exterior corner shapes, solid jambs, sash block, coves, pre-molded control joint blocks, headers, and other special conditions.
 2. Bullnose units for outside vertical corners, unless specifically shown on the Drawings indicating that such feature is not required.
 3. End blocks at locations where masonry walls abut concrete, or steel columns, to facilitate installation of compressible filler, backer rod, and sealant or fire-rated fire stop sealant systems, if required.
- G. Weight: Provide lightweight units using aggregate complying with ASTM C331 producing dry net weight of not more than 105 pounds per cubic foot.
- H. Exposed Faces: Provide manufacturer's standard colors and textures as specified for type of concrete masonry unit.
- I. Provide two-core concrete masonry units.

2.2 SOURCE QUALITY CONTROL

- A. Tests:
1. Provide test data verifying total linear drying shrinkage based on tests of concrete masonry units made with same materials, concrete mix proportions, manufacturing process, and curing method, conducted in accordance with ASTM C426. Tests shall have been conducted within 24 months prior to delivery to Site.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Refer to Section 04201, Unit Masonry Construction.

+ + END OF SECTION + +

SECTION 05051

ANCHOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install anchor systems.
2. This Section includes all anchor systems required for the Work, but not specified under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before anchor systems Work.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ACI 318, Building Code Requirements for Structural Concrete.
2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures.
3. ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
4. ANSI B212.15, Cutting Tools - Carbide-tipped Masonry Drills And Blanks For Carbide-tipped Masonry Drills.
5. ANSI/MSS SP-58, Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
6. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
7. ASTM A276, Specification for Stainless Steel Bars and Shapes.
8. ASTM A493, Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
9. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
10. ASTM A1011/A1011M, Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
11. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
12. ASTM C307, Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
13. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
14. ASTM D695, Test Method for Compressive Properties of Rigid Plastics.
15. ASTM D790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

16. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
17. ASTM E488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F594, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
20. ASTM F1554, Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
21. FS A-A-1922A, Shield, Expansion (Caulking Anchors, Single Lead).
22. FS A-A-1923A, Concrete Expansion Anchors.
23. FS A-A-1925A, Shield, Expansion (Nail Anchors).
24. FS A-A-55614, Shield, Expansion (non-drilling expansion anchors).
25. ICC-ES AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.
26. ICC-ES AC58, Acceptance Criteria for Adhesive Anchors in Masonry Elements.
27. ICC-ES AC60, Acceptance Criteria for Anchors in Unreinforced Masonry Elements.
28. ICC-ES AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
29. ICC-ES AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
30. ISO 3506-1, Mechanical Properties of Corrosion-Resistant Stainless Steel Fasteners -- Part 1: Bolts, Screws and Studs.
31. NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Testing Laboratory: Shall comply with ASTM E329 and shall be experienced in tension testing of post-installed anchoring systems.
2. Post-installed Anchor Installer:
 - a. Mechanical Anchors: Installer shall be experienced and trained by post-installed anchor system manufacturer in proper installation of manufacturer's products. Product installation training by distributors or manufacturer's representatives is unacceptable unless the person furnishing the training is qualified as a trainer by the anchor manufacturer.
 - b. Adhesive Anchors: Installation shall be performed by personnel certified under an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchors Installer Certification Program, or equivalent. Description of equivalent programs shall be submitted for ENGINEER's approval and acceptance by the building official having jurisdiction.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Listing of all anchor systems products intended for use in the Work including product type, intended location in the Project, and embedded lengths.
 - 2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, acceptable base material conditions, acceptable drilling methods, and acceptable bored hole conditions.
 - b. When required by ENGINEER, copies of valid ICC ES reports that presents load-carrying capacities and installation requirements for anchor systems.
- B. Delegated Design Submittals:
 - 1. Design Data: Submit the following:
 - a. Design Calculations for delegated anchor systems. Structural calculations shall include all specified performance criteria. The magnitude of delegated system/anchorage reactions to supporting structure shall be clearly noted. Design calculations shall be signed, sealed and dated by CONTRACTOR's professional engineer.
- C. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. For each type of anchor bolt or threaded rod, submit copies of laboratory test reports and other data required to demonstrate compliance with the Contract Documents.
 - b. Post-installed anchor system manufacturer's certification that installer received training in the proper installation of manufacturer's products required for the Work.
 - c. For each adhesive anchor installer, submit ACI/CRSI Adhesive Anchor Installer Certification.
 - 2. Manufacturer's Instructions:
 - a. Installation instructions for each anchor system product proposed for use, including bore hole cleaning procedures and adhesive injection, cure and gel time tables, and temperature ranges (storage, installation and in-service).
 - 3. Field Quality Control Submittals:
 - a. Submit results of field quality control testing and inspections performed by testing laboratory.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection:
 - 1. Keep materials dry during delivery and storage.

2. Store adhesive materials within manufacturer's recommended storage temperature range.
3. Protect anchor systems from damage at the Site. Protect products from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. General:

1. At locations where conditions dictate that Work specified in other Sections is to be of corrosion resistant materials, provide associated anchor systems of stainless steel materials, unless other corrosion-resistant anchor system material is specified. Provide anchor systems of stainless steel materials where stainless steel materials are required in the Contract Documents.
2. Stainless Steel Nuts:
 - a. For anchor bolts and adhesive anchors, provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts for stainless steel anchors used for anchoring equipment, gates, and weirs, and other locations, if any, where the attachment will require future removal for operation or maintenance. Provide lock washer or double nuts on each anchorage device provided for equipment, as required by equipment manufacturer.
 - b. For other locations, provide for each anchorage device a nut as specified or as required by anchor manufacturer. When ASTM A194/A194M, Grade 8S (Nitronic 60) nuts are not required for anchor bolts and adhesive anchors as specified in this Section, provide anti-seizing compound where stainless steel rods are used with stainless steel nuts of the same type.
3. Materials that can contact potable water or water that will be treated to become potable shall be listed in NSF/ANSI 61.

B. Design Criteria

1. Size, Length, and Load-carrying Capacity: Comply with the Contract Documents. When size, length or load-carrying capacity of anchor system is not otherwise shown or indicated, provide the following:
 - a. Anchor Bolts: Provide size, length, and capacity required to carry design load based on values and requirements of Paragraph 3.2.A of this Section. For conditions outside limits of critical edge distance and spacing in Paragraph 3.2.A of this Section, minimum anchor bolt embedment as shown or indicated in Paragraph 3.2.A of this Section apply and capacity shall be based on requirements of Laws and Regulations, including applicable building codes.
 - b. Adhesive Anchors, Expansion Anchors, or Concrete Inserts: Provide size, length, type, and capacity required to carry design load. Anchor capacity shall be based on the procedures required by the building code in effect at the Site. Where Evaluation Service Reports issued by the ICC Evaluation Service are required in this Section, anchor capacities

shall be based on design procedure required in the applicable ICC Evaluation Service Report.

- 1) General: Determine capacity considering reductions due to installation and inspection procedures, embedment length, strength of base fastening materials, spacing, and edge distance, as indicated in the manufacturer's design guidelines. For capacity determination, concrete shall be assumed to be in the cracked condition, unless calculations demonstrate that the anchor system will be installed in an area that is not expected to crack under any and all conditions of design loading.
 - 2) Concrete Adhesive Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of the greater of the following: required to develop tensile strength of anchor, or a minimum embedment of 10 anchor diameters; and minimum anchor spacing and edge distance of 12 anchor diameters.
 - 3) Concrete Expansion Anchors: Unless otherwise shown or indicated in the Contract Documents or approved by ENGINEER, provide minimum embedment depth of six anchor diameters, and minimum anchor spacing and edge distance of seven anchor diameters.
 - 4) Concrete Undercut Anchors: Unless otherwise shown or indicated in the Contract Documents, or approved by ENGINEER, provide minimum anchor spacing and edge distance as tabulated in anchor manufacturer's instructions.
2. Delegated Design: When anchor systems are used for supporting materials, equipment, or systems delegated to CONTRACTOR, Subcontractor, or Supplier, provide anchor system suitable for loads indicated in delegated design documents and consistent with the design intent expressed in the Contract Documents. Anchor system shall be designed by a professional engineer, retained by CONTRACTOR, Subcontractor, or Supplier, registered in the same state as the Site, with proper consideration of concrete strength, spacing and edge distance
- a. Design Loads. Comply with the Contract Documents. When design load of supported material, equipment, or system is not otherwise shown or indicated, provide the following:
 - 1) Equipment Anchors: Use design load recommended by equipment manufacturer. When equipment can be filled with fluid, use loads that incorporate equipment load and load imposed by fluid.
 - 2) Pipe Hangers and Supports: Use full weight of pipe, and fluid contained in pipe that are tributary to the support plus the full weight of valves and accessories located between the hanger or support being anchored and the next hanger or support.
 - 3) Hangers and Supports for Electrical Systems, and HVAC, Plumbing, and Fire Suppression Systems and Piping: Use the full weight of supported system that is tributary to the support plus the full weight of accessories located between the hanger or support being anchored and the next hanger or support. When piping or equipment is to be

filled with fluid, anchor systems shall be sized to support such loads in addition to the weight of the equipment, piping, or system, as applicable.

C. Application:

1. Anchor Bolts:
 - a. Where anchor bolt is shown or indicated, use cast-in-place anchor bolt unless another anchor type is approved by ENGINEER.
 - b. Provide anchor bolts as shown or indicated, or as required to secure structural element to appropriate anchor surface.
2. Concrete Adhesive Anchors:
 - a. Use where adhesive anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Suitable for use in exterior locations or locations subject to freezing.
 - d. Suitable for use in submerged, intermittently submerged, or buried locations.
 - e. Do not use in overhead applications, unless otherwise shown or approved by ENGINEER.
 - f. Do not use for pipe hangers, unless otherwise shown or approved by ENGINEER.
3. Concrete Wedge Expansion Anchors:
 - a. Use where expansion anchors are shown or indicated for installation in concrete.
 - b. Do not use where subject to vibration.
 - c. Do not use in exterior locations or locations subject to freezing.
 - d. Do not use in submerged, intermittently submerged, or buried locations.
 - e. Suitable for use in overhead applications.
4. Drop-in Expansion Anchors:
 - a. Use drop-in expansion anchors installed in concrete where light-duty anchors are required to support piping or conduit two-inch diameter or smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use where subject to vibration.
 - d. Do not use at submerged, intermittently submerged, or buried locations.
 - e. Do not use in exterior locations or locations subject to freezing.
 - f. Suitable for use in overhead applications.
5. Concrete Undercut Anchors:
 - a. Use where undercut anchors are shown or indicated for installation in concrete.
 - b. Suitable for use where subject to vibration.
 - c. Do not use in submerged, intermittently submerged, or buried locations.
 - d. Do not use in exterior locations or locations subject to freezing.
 - e. Suitable for use in overhead applications.
6. Concrete Inserts:

- a. Use only where shown or indicated in the Contract Documents.
- b. Allowed for use to support pipe hangers and pipe supports for pipe size and loading recommended by the concrete insert manufacturer.
- 7. Drive-In Expansion Anchors:
 - a. Use drive-in expansion anchors installed in concrete, precast concrete, grouted masonry units, or brick, where light-duty anchors are required to support piping or conduit one-inch diameter and smaller.
 - b. Do not use for attaching safety-related systems, such as piping conveying hazardous or potentially hazardous materials, or fire suppression systems.
 - c. Do not use in overhead applications.
- 8. For Use in Precast Concrete Planks:
 - a. To support piping or conduit two-inch diameter and smaller, use low-profile drop-in anchors, hollow concrete masonry adhesive anchors, or through-bolts.
 - b. For piping greater than two-inch diameter, or to support safety-related systems, use through-bolts. Each through-bolt shall consist of threaded rod, nuts, washers, and bearing plate.

2.2 MATERIALS

A. Anchor Bolts:

- 1. Interior Dry Non-corrosive Locations: Provide straight threaded carbon steel rods complying with ASTM F1554, Grade 36, with heavy hex nuts complying with ASTM A563 Grade A, unless otherwise shown or indicated on the Drawings. Hooked anchor bolts are unacceptable.
- 2. Exterior, Buried, Submerged Locations, or When Exposed to Wastewater: Provide stainless steel straight threaded rods complying with ASTM F593, AISI Type 316, Condition A, with ASTM F594, AISI Type 316, stainless steel nuts. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required. Other AISI types may be used when approved by ENGINEER. Hooked bolts are unacceptable.
- 3. Equipment: Provide anchor bolts complying with material requirements of this Section and equipment manufacturer's requirements relative to size, embedment length, and anchor bolt projection. Anchor bolts shall be straight threaded rods with washers and nuts as specified in this Section. Hooked bolts are unacceptable.
- 4. Anchoring of Structural Elements: Provide anchor bolts of size, material, and strength shown or indicated in the Contract Documents.

B. Concrete Adhesive Anchors:

- 1. General:
 - a. Adhesive anchors shall consist of threaded rods anchored into hardened concrete using an adhesive system.
- 2. Products and Manufacturers: Provide one of the following:
 - a. HIT-RE 500-V3 Injection Epoxy Adhesive Anchoring System, by Hilti Fastening Systems, Inc.

- b. HIT-HY 200-A and HIT-HY 200-R Adhesive Anchoring System, by Hilti Fastening Systems, Inc
 - c. SET-XP Adhesive anchoring system, by Simpson Strong-Tie Company, Inc.
 - d. Or equal.
3. Adhesive:
- a. Adhesive system shall use two-component adhesive mix.
 - b. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308, which incorporates the requirements of ACI 355.4-11
 - d. Adhesives shall have minimum bond strength and minimum design bond strength in accordance with Table 05051-A:

**TABLE 05051-A:
ADHESIVE BOND STRENGTH ^{1,2}**

Bond Strength (psi)					
Rod Diameter	Uncracked Concrete	Cracked Concrete	Dowel Size	Uncracked Concrete	Cracked Concrete
1/2-inch	1670	880	#4	1500	1080
5/8-inch	1670	750	#5	1460	1090
3/4-inch	1670	665	#6	1415	1015
7/8-inch	1525	610	#7	1370	835
1-inch	1360	595	#8	1330	760
-	-	-	#9	1560	850
1.25-inch	1070	595	#10	1240	475

Table Notes:

- 1. Bond strengths listed for hammer-drilled, dry hole.
- 2. Bond strengths listed for maximum short term concrete temperature of 130 degrees F and maximum long term concrete temperature of 110 degrees F.

4. Anchor:
- a. Provide continuously-threaded, AISI Type 316 stainless steel adhesive anchor rod. Threaded rods shall comply with the concrete adhesive anchor manufacturer's specifications as included in the ICC Service Evaluation Report for the anchor submitted. Nuts shall have specified proof load stresses equal to or greater than the minimum tensile strength of the stainless steel threaded rod used. Provide ASTM A194/A194M, Grade 8S (Nitronic 60) stainless steel nuts where required.

C. Concrete Wedge Expansion Anchors:

- 1. General:
 - a. Concrete wedge expansion anchors shall consist of stud, wedge, nut, and washer.
- 2. Products and Manufacturers: Provide one of the following:
 - a. Kwik Bolt TZ Wedge Anchor, by Hilti Fastening Systems, Inc.
 - b. Strong Bolt 2 Wedge Anchor, by Simpson Strong-Tie Company, Inc.

- c. Or equal.
 - 3. Anchors shall comply with physical requirements of FS A-A-1923A, Type 4. Provide concrete wedge expansion anchors suitable for use in cracked and uncracked concrete in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete wedge anchors in accordance with ACI 355.2 prequalification tests.
 - 4. Interior Dry Non-corrosive Locations: Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633.
 - 5. Other Locations: Provide expansion anchors complete with nuts and washers, AISI Type 304 stainless steel anchor body, in accordance with ASTM A276 or ASTM A493.
 - 6. Concrete wedge expansion anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete with seismic recognition in seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.
- D. Drop-in Expansion Anchors:
- 1. General:
 - a. Drop-in expansion anchors shall each consist of an internally threaded, deformation-controlled expansion anchor with pre-assembled expander plug.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. HDI Drop-In Anchors, by Hilti Fastening Systems, Inc.
 - b. Drop-In Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
 - 3. Provide carbon steel anchors complete with nuts and washers, zinc plated, in accordance with ASTM B633, complying with physical requirements of FS A-A-55614, Type I. Anchors shall be flush or shell type. Provide low-profile anchors for use in precast concrete planks.
- E. Concrete Undercut Anchors:
- 1. General:
 - a. Each concrete undercut anchor shall consist of threaded stud, thick-walled expansion sleeve, expander coupler, and nut and washer. Anchors shall be pre-set type or through-set type, as shown on the Drawings.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. HDA Undercut Anchor, by Hilti Fastening Systems, Inc.
 - b. DUC Ductile Undercut Anchor, by USP Structural Connectors.
 - c. Or equal
 - 3. Provide concrete undercut expansion anchors in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D. Demonstrate suitability of cracked concrete undercut anchors in accordance with ACI 355.2 prequalification tests.
 - 4. Installed anchor shall exhibit form fit between bearing elements and the undercut in the concrete.

5. Interior Dry Non-Corrosive Locations: Provide carbon steel anchors, complete with nuts and washers, zinc plated, in accordance with ASTM B633.
6. Other Locations: Provide stainless steel anchors, complete with nuts and washers, manufactured of AISI Type 316 stainless steel or materials complying with ISO 3506-1 and having corrosion resistance equivalent to AISI Type 316 stainless steel.
7. Concrete undercut anchors shall have a current ICC Evaluation Service Report for use in both cracked and uncracked concrete for seismic recognition for seismic design Categories A through F when tested and assessed in accordance with ICC-ES AC193.

F. Concrete Inserts:

1. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation.
 - b. Eaton B-Line, Inc.
 - c. Anvil International, Inc.
 - d. Or equal.
2. Spot Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall comply with ANSI/MSS SP-58, malleable iron, Type 18. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Provide nuts compatible with insert and to suit threaded hanger rod sizes.
3. Continuous Concrete Inserts:
 - a. Provide inserts recommended by insert manufacturer for required loading. Inserts shall be continuous type and shall be manufactured from minimum 12-gage cold-formed channel sections, complying with ASTM A1011/A1011M, stainless steel, Grade 33, complete with styrofoam inserts, end caps, and means for attaching to forms. Provide channel nuts compatible with insert suitable for threaded hanger rod sizes.
4. Provide inserts with plain finish.

G. Drive-In Expansion Anchors:

1. General:
 - a. Drive-In expansion anchors shall each consist of stainless steel drive pin and expanding alloy body.
2. Products and Manufacturers: Provide one of the following:
 - a. Metal HIT Anchor, by Hilti Fastening Systems, Inc.
 - b. Zinc Nailon Anchor, by Simpson Strong-Tie Company, Inc.
 - c. Or equal.
3. Provide Type 304 stainless steel drive pin with zinc alloy body. Anchor shall comply with physical requirements of FS A-A-1925A, Type 1.

H. Unless approved by ENGINEER, do not use power-actuated fasteners or other types of bolts and fasteners not specified in this Section.

- I. Anti-Seizing Compound:
 1. Products and Manufacturers: Provide one of the following:
 - a. Pure Nickel Never-Seez, by Bostik.
 - b. Nickel-Graf, by Anti-Seize Technology.
 - c. Or equal.
 2. Provide pure nickel anti-seizing compound.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials will be installed and advise ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Anchor Bolts:
 1. Provide anchor bolts as shown or indicated in the Contract Documents, or as required to secure structural element to the appropriate anchor surface.
 2. Locate and accurately set anchor bolts using templates or other devices as required, prior to placing concrete. Wet setting of anchor bolts is unacceptable.
 3. Protect threads and shank from damage during installation and subsequent construction operations.
 4. Unless otherwise shown or approved by ENGINEER anchor bolts shall comply with Table 05051-B:

**TABLE 05051-B:
SINGLE ANCHOR ALLOWABLE LOADS ON ANCHOR BOLTS ¹**

Bolt Diameter (inch)	F1554 Grade 36				F1554			
	F593 Type 316, Condition A				Grade 55			
	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ^{3,4} (lb)	Tension ³ (lb)	Minimum Embedment (inch)	Minimum Edge Distance and Spacing ² (inch)	Shear ³ (lb)	Tension ³ (lb)
1/2	6	9	1,262	2,420	8.5	12.75	1,660	3,190
5/8	7.5	11.25	2,010	3,860	10.5	15.75	2,640	5,080
3/4	9	13.5	2,974	5,720	13	19.5	3,910	7,520
7/8	10.5	15.75	4,106	7,890	15	22.5	5,400	10,390
1	12	18	5,386	10,360	17	25.5	7,090	13,450
1 1/8	13.5	20.25	6,787	13,052	19	28.5	8,930	16,580
1 1/4	15	22.5	8,617	16,572	21	31.5	11,340	20,040

Table Notes:

1. Table is based on ACI 318 Chapter 17 and ACI 350, Appendix D, $f'_c = 4000$ psi. Table 05051-B is not applicable to anchor bolts embedded in grouted masonry.

2. Critical edge distance and spacing are indicated in the table. Capacity of anchor bolts for other combination of edge distances and spacing shall be evaluated in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D.
 3. Values for shear and tension listed are not considered to act concurrently. Interaction of tension and shear will be evaluated by ENGINEER in accordance with ACI 318 Chapter 17 and ACI 350, Appendix D.
- B. Adhesive Anchors, Undercut Anchors, and Expansion Anchors – General:
1. Prior to drilling, locate existing reinforcing steel in vicinity of proposed holes. If reinforcing conflicts with proposed hole location, obtain ENGINEER's approval of alternate hole locations to avoid drilling through or damaging existing reinforcing bars.
- C. Adhesive Anchors:
1. Installation conditions shall comply with all requirements of the approved product Evaluation Service Report (ESR), including "Conditions of Use." Comply with manufacturer's written installation instructions and the following.
 2. Drill holes to adhesive system manufacturer's recommended drill bit diameter to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits that comply with the tolerances of ANSI B212.15. Core-drilled holes are unacceptable.
 3. Before setting adhesive anchor, hole shall be made free of dust and debris by method recommended by adhesive anchor system manufacturer. Hole shall be brushed with adhesive system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
 4. Before injecting adhesive, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
 5. Prior to injecting adhesive into the drilled hole, dispense, to a location appropriate for such waste, an initial amount of adhesive from the mixing nozzle, until adhesive is uniform color.
 6. Inject adhesive into hole through injection system-mixing nozzle and necessary extension tubes, placed to bottom of hole. Discharge end shall be withdrawn as adhesive is placed but kept immersed to prevent formation of air pockets. Fill hole to depth that ensures that excess material is expelled from hole during anchor placement.
 7. Twist anchors during insertion into partially-filled hole to guarantee full wetting of rod surface with adhesive. Insert rod slowly to avoid developing air pockets.
 8. Provide adequate curing in accordance to adhesive system manufacturer's requirements prior to continuing with adjoining Work that could place load on installed adhesive anchors. Do not begin adjoining Work until adhesive anchors are successfully tested or when allowed by ENGINEER.
 9. Limitations:
 - a. At time of anchor installation, concrete shall have compressive strength (f'_c) of not less than 2,500 psi.

- b. At time of anchor installation, concrete shall have age of not less than 21 days.
- c. Installation Temperature: Comply with manufacturer's instructions for installation temperature requirements. Provide temporary protection and other measures, such as heated enclosures, necessary to ensure that base material temperature complies with anchor systems manufacturer's requirements during installation and curing of adhesive anchor system.
- d. Oversized Holes: Advise ENGINEER immediately if size of drilled hole is larger than recommended by anchor system manufacturer. Cost of corrective measures, including but not limited to redesign of anchors due to decreased anchor capacities, shall be paid by CONTRACTOR.
- e. Embedment depths shall be based on installation in normal-weight concrete with compressive strength of 2,500 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.

D. Expansion Anchors:

- 1. Comply with expansion anchor manufacturer's written installation instructions and the following:
- 2. Drill holes using anchor system manufacturer's recommended drill bit diameter and to the specified depth. Drill holes in hammering and rotation mode with carbide-tipped drill bits complying with tolerances of ANSI B212.15. Core drilled holes are unacceptable.
- 3. Before installing anchor, hole shall be made free of dust and debris by method recommended by anchor system manufacturer. Hole shall be brushed with anchor system manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.
- 4. Before installing anchor, obtain ENGINEER's concurrence that hole is dry and free of oil and other contaminants.
- 5. Protect threads from damage during anchor installation. Drive anchors not less than four threads below surface of the attachment. Set anchors to anchor manufacturer's recommended torque using a torque wrench.
- 6. Limitations:
 - a. At time of anchor installation, concrete shall have age of not less than 7 days.
 - b. At time of anchor loading, concrete shall have attained full specified compressive strength (f'c).

E. Concrete Undercut Anchors:

- 1. Comply with undercut anchor manufacturer's written installation instructions and the following.
- 2. Protect threads from damage during anchor installation.
- 3. Drill hole to anchor manufacturer's specified depth and diameter using a drill bit matched to the specific anchor.
- 4. Before setting the undercut anchor, hole shall be free of dust and debris using method recommended by undercut anchor system manufacturer. Hole shall be blown clean with clean, dry, oil-free compressed air to remove all dust and loose particles.

5. Insert the anchor by hand until anchor reaches bottom of hole.
6. Set anchor in accordance with manufacturer's instructions using anchor manufacturer's specified setting tool.
7. Verify that the setting mark is visible on the threaded rod above the sleeve.
8. Anchor shall be set to manufacturer's recommended torque, using a torque wrench.
9. Limitations:
 - a. At time of anchor installation, concrete shall have age of not less than 7 days.
 - b. At time of anchor loading, concrete shall have attained full specified compressive strength (f'_c).

F. Concrete Inserts:

1. Comply with concrete insert manufacturer's installation instructions.
2. Inserts shall be flush with slab bottom surface.
3. Protect embedded items from damage during concrete placing. Ensure that embedded items are securely fastened to prevent movement during concrete placing, and ensure that embedded items do fill with concrete during concrete placing.
4. Inserts intended for piping greater than four-inch diameter shall be provided with hooked rods attached to concrete reinforcing.

G. Anti-Seizing Compound:

1. Provide anti-seizing compound in accordance with anti-seizing compound manufacturer's installation instructions, at locations indicated in Paragraph 2.1.B of this Section.
2. Do not use anti-seizing compound at locations where anchor bolt or adhesive anchor will contact potable water or water that will be treated to become potable.

3.3 CLEANING

- A. After embedding concrete is placed, remove protection and clean bolts and inserts.

3.4 FIELD QUALITY CONTROL

A. Site Tests:

1. Furnish services of independent testing laboratory to perform field quality tensile testing of production adhesive anchors at the Site, unless otherwise specified.
 - a. Testing shall comply with ASTM E488.
 - b. Test at least ten percent of all types of adhesive anchors. If one or more adhesive anchors fail the test, CONTRACTOR shall pay cost of testing all anchors of the same type installed in the Work. CONTRACTOR shall be responsible for retesting costs.
 - c. ENGINEER will direct which adhesive anchors are to be tested and indicate test load to be used

- d. Apply test loads with hydraulic ram.
- e. Displacement of post-installed anchors shall not exceed $D/10$, where D is nominal diameter of anchor being tested.
- 2. Mechanical Anchors:
 - a. Responsibility:
 - 1) Furnish services of independent testing laboratory to perform field quality control tensile testing of mechanical anchors at the Site.
 - 2) CONTRACTOR shall demonstrate competence in installing mechanical anchors by performing field quality control tests.
 - b. Perform field quality control tests on test anchors at location directed by ENGINEER. Test anchors shall not be part of the finished Work.
 - c. Test not less than one installation of each type of mechanical anchor used in the Work.
 - 1) ENGINEER will indicate test loads to be used.
 - 2) Testing shall comply with ASTM E488.
 - 3) Apply test loads with hydraulic ram.
 - d. Anchors that fail to reach the specified test load shall be considered as not passing the test and shall be re-tested at no additional cost to OWNER.
 - e. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.
- 3. Correct defective Work by removing and replacing or correcting, as directed by ENGINEER.
- 4. CONTRACTOR shall pay for all corrections and subsequent testing required to confirm competence in the installation of post-installed mechanical anchors.
- 5. Testing agency shall submit test results to CONTRACTOR and ENGINEER within 24 hours of completion of test.

B. Manufacturer's Services:

- 1. Provide at the Site services of qualified adhesive manufacturer's representative during initial installation of adhesive anchor systems to train CONTRACTOR's personnel in proper installation procedures. Manufacturer's representative shall observe to confirm that installer demonstrates proper installation procedures for adhesive anchors and adhesive material.

++ END OF SECTION ++

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SECTION 05120

STRUCTURAL STEEL FRAMING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide professional services, labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install structural steel framing, including surface preparation and shop priming.
2. Structural steel framing is the Work defined in AISC 303, Section 2, and as shown or indicated in the Contract Documents. The Work also includes:
 - a. Providing openings in and attachments to structural steel framing to accommodate the Work under this and other Sections, and providing for structural steel framing items such as anchorage devices, studs, and all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before structural steel framing Work.

C. Related Sections:

1. Section 03600, Grouting.
2. Section 05051, Anchor Systems.
3. Section 09900, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AISC 303, Code of Standard Practice for Steel Buildings and Bridges.
2. AISC 325, Steel Construction Manual.
3. AISC 360, Specification for Structural Steel Buildings.
4. ASME B46.1, Surface Texture (Surface Roughness, Waviness and Lay).
5. ASTM A6/A6M, Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
6. ASTM A36/A36M, Specification for Carbon Structural Steel.
7. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
8. ASTM A108, Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
9. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

10. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi Minimum Tensile Strength.
11. ASTM A500/A500M, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
12. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
13. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
14. ASTM A1085/A1085M, Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
15. ASTM A992/A992M, Specification for Structural Steel Shapes.
16. ASTM E329, for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.
17. ASTM F436, Specification for Hardened Steel Washers.
18. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
19. ASTM F959, Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
20. ASTM F1852, Specification for "Twist off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
21. AWS D1.1/D1.1M, Structural Welding Code-Steel.
22. CMAA 74, Specifications for Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.
23. ISO 2859-1, Sampling Procedures for Inspection by Attributes -- Part 1: Sampling Schemes Indexed by Acceptance Quality Limit (AQL) for Lot-by-Lot Inspection.
24. ISO 4017, Hexagon Head Screws -- Product Grades A and B.
25. RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Steel Fabricator:
 - a. Structural steel fabricating plant shall possess current certificate from AISC stating that the fabrication facility complies with requirements for "Certified Building Fabricator" (BU) of AISC's quality certification program. Fabricating plant shall maintain this certification throughout time of fabrication for this Project.
2. Welders and Welding Processes:
 - a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, Section 5, Qualification.
 - b. Each welder employed on or to be employed for the Work shall possess current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.
3. Professional Engineer:

- a. CONTRACTOR or structural steel framing manufacturer shall retain a registered professional engineer legally qualified to practice in the same state as the Site to design steel framing connections as indicated in the Contract Documents.
 - b. Responsibilities include but are not necessarily limited to:
 - 1) Reviewing steel framing connections performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to ENGINEER by CONTRACTOR.
 - 3) Preparing or supervising preparation of design calculations and related Shop Drawings.
 - 4) Signing and sealing all design calculations and Shop Drawings.
 - 5) Certifying that:
 - a) Design has been performed in accordance with performance and design criteria stated in the Contract Documents, and
 - b) Design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.
4. Surveyor:
- a. Engage a registered professional land surveyor legally qualified to practice in the same jurisdiction as the Site, and experienced in providing surveying services of the kind indicated.
 - b. Responsibilities include but are not necessarily limited to:
 - 1) Performing or supervising performance of field survey work to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices, before steel erection proceeds.
 - 2) Notifying CONTRACTOR and ENGINEER in writing when surveyed Work does not comply with the Contract Documents.
 - 3) Submit to CONTRACTOR field survey reports.
5. Testing Laboratory:
- a. CONTRACTOR shall retain the services of an independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials specified in this Section.
 - b. Laboratory shall comply with ASTM E329.
 - c. Testing laboratory shall be experienced in the types of testing required.
 - d. Welding inspection and welding inspector qualifications shall be in accordance with AWS D1.1/D1.1M
 - e. Selection of testing laboratory is subject to ENGINEER's acceptance

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures, and diagrams showing

proposed sequence of erection. Shop Drawings shall not be reproductions of Contract Drawings.

- b. Include complete information for fabrication of the structure's components, including but not limited to location, type, and size of bolts, details of blocks, copes and cuts, connections, camber, holes, member sizes and lengths, and other pertinent data. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld.
- c. Setting drawings, templates, and directions for installing anchorage devices.

2. Product Data:

- a. Manufacturer's specifications and installation instructions for products listed below.
 - 1) High-strength bolts of each type, including nuts and washers.
 - 2) Welding electrodes and rods.
 - 3) Load indicator bolts and washers.

B. Delegated Design Submittals:

1. Design Data: Submit the following:

- a. Design Calculations:
 - 1) Complete calculations required for the design of the delegated steel framing connections as one package with the Shop Drawings. Structural calculations shall include all specified performance criteria and design loads used in the design. All calculations and assumptions shall be presented so that ENGINEER can easily follow the progress and logic of CONTRACTOR's professional engineer. The design analysis shall include the name and office phone number of the designer to answer questions during the shop drawing review.
- b. Design calculations shall be signed, sealed, and dated by CONTRACTOR's professional engineer. State of professional engineer's registration, registration number, and name on seal shall be clearly legible.

C. Informational Submittals: Submit the following:

- 1. Certificates.
 - a. Fabricator's AISC quality certification.
 - b. Welders' certifications.
 - c. Certified reports of laboratory tests on previously-manufactured, identical materials, and other data as necessary, to demonstrate compliance with the Contract Documents for the materials listed below:
 - 1) Structural steel of each type, including certified mill reports indicating chemical and physical properties.
 - 2) High-strength bolts of each type, including nuts and washers.
- 2. Supplier Instructions:
 - a. Installation data, handling, and storage instructions.
- 3. Source Quality Control Submittals:

- a. When performed or when required by ENGINEER, submit results of source quality control testing and inspections performed at the mill or shop.
- 4. Field Quality Control Submittals:
 - a. Submit results of testing and inspection performed in the field by testing laboratory employed by CONTRACTOR.
 - b. Written field survey reports for all bearing surfaces surveyed, verifying tolerance requirements, areas out of tolerance, and corrective measures required.
- 5. Qualifications Statements.
 - a. Land surveyor.
 - b. Testing laboratory.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage:
 - 1. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Do not store materials in or on the building or structure in manner that may cause distortion or damage to structural steel members, building, or supporting structures.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Steel Types:
 - 1. W-Shapes and WT-Shapes: ASTM A992/A992M.
 - 2. S-shapes and Channels: ASTM A572/A572M, Grade 50.
 - 3. Hollow Structural Sections: ASTM A1085 or ASTM A500/A500M, Grade C.
 - 4. Angles, Plates, and Bars: ASTM A36/A36M.
 - 5. Steel Pipe: ASTM A53/A53M, Grade B.
- B. Anchorages, Fasteners, and Connectors:
 - 1. Anchorage Devices: Refer to Section 05051, Anchor Systems.
 - 2. High-Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, as follows:
 - a. Unless otherwise indicated, fasteners shall be quenched and tempered medium-carbon steel bolts, nuts and washers, complying with ASTM A325, Type I, nuts complying with ASTM A563C, A563DH or A194/A194M 2H, and hardened washers complying with ASTM F436. Bolts, nuts and washers shall be hot-dip galvanized where shown or indicated.
 - b. Tension control bolts, when used, shall comply with ASTM F1852.
 - c. Compressible washer-type direct-tension indicators, when used, shall comply with ASTM F959, Type 325.

- C. Electrodes for Welding: E70XX complying with AWS D1.1/D1.1M.

2.2 FABRICATION

A. Shop Fabrication and Assembly:

1. General:
 - a. Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC 325, the Contract Documents, and as shown on approved Shop Drawings. Provide camber in structural members as shown or indicated.
 - b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials for storage and minimize handling at the Site.
 - c. Where finishing is required, complete the assembly, including welding of units, before commencing finishing operations. Provide finish surfaces of members exposed-to-view in the completed Work that are free of markings, burrs, and other defects.
2. Connections:
 - a. The design of framing connections and for any part of the steel framing structure not specifically detailed on the Contract Drawings shall be completed by CONTRACTOR, per AISC 303 - Option 3, under the supervision of a professional engineer registered in the same state as the Site. Design loads are indicated on the Contract Drawings.

B. Connections:

1. Shop Connections:
 - a. Unless otherwise shown or indicated, shop connections may be welded or high-strength bolted connections. Welds shall be 3/16-inch minimum.
 - b. Where reaction values of beam are not shown or indicated, connections shall be detailed to support 70% of the total uniform load capacity tabulated in tables contained in part 10 of the AISC Manual for allowable loads on beams for the associated shape, span, and steel specified for the beam. Reaction used for design shall not be less than 6 kips.
 - c. Shop-welded connections shall be detailed to eliminate or minimize eccentricity in the connection.
 - d. End-connection angles fastened to webs of beams and girders, and the thickness of angles, size, and extent of fasteners or shop welds, shall comply with tables of "Framed Beam Connections" in AISC 325. Connections shall be two-sided, unless otherwise shown or indicated.
2. Field Connections:
 - a. Field connections, unless otherwise shown or indicated, shall be made with high-strength bolts, and shall be bearing-type connections.
 - b. Use field welding only where shown or indicated or where approved by ENGINEER.

3. High-Strength Bolted Construction:
 - a. Provide high-strength threaded fasteners in accordance with RCSC Specifications for Structural Joints using ASTM A325 or ASTM A490 Bolts.
 - b. High-strength bolt design shear values shall be as specified in AISC 325 for bolts with threads in the shear plane for bearing type connections, or as specified in this Section for slip-critical connections.
 - c. Bolted connections shown or indicated as "SC" shall comply with slip-critical connection requirements in RCSC Specifications for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
 - 1) Faying surfaces shall have a Class A surface condition.
 - 2) Slip-critical bolts shall be fully pre-tensioned to 70 percent of minimum specified tensile strength of the bolt using one of the following methods:
 - a) Turn of nut with matchmarking.
 - b) Twist-off tension control bolt (ASTM F1852).
 - c) Direct tension indicator washer (ASTM F959).
 - d. Minimum bolt diameter shall be 3/4-inch, unless otherwise shown or indicated.
 4. Welded Construction: Comply with AWS D1.1/D1.1M for procedures, appearance, and quality of welds, and methods used in correcting defective welding Work.
 5. Where rigid connections are required by stresses shown or indicated, provide web shear reinforcement and stiffeners in accordance with AISC 360.
- C. Bracing:
1. Bracing for which stress is not shown or indicated shall have minimum two-bolt connection, or shop-welded connection of equivalent strength.
 2. Vertical bracing and knee braces connecting to columns shall be on the centerline of columns, unless otherwise shown or indicated.
 3. Knee braces shall be at 45-degree angle, unless otherwise shown or indicated.
 4. Gussets shall be not less than 3/8-inch thick, unless otherwise shown or indicated.
- D. Columns: Column shafts shall have finished bearing surface roughness not greater than 500 micro-inch in accordance with ASME B46.1, and ends shall be square within tolerances for milled ends in accordance with ASTM A6/A6M at the base and at splice lines.
- E. Structural Tubing: Properly seal structural tubing to protect internal surfaces.
- F. Holes and Appurtenances for Other Work:
1. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on the approved Shop Drawings. If large block-outs are required and approved, reinforce the webs to develop specified shears. Provide threaded nuts welded

to framing and other specialty items as shown or indicated to receive other work.

2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.3 FINISHING

- A. Surface Preparation and Shop Priming: Structural steel shall be primed in the shop. For surface preparation and shop priming requirements refer to Section 09900, Painting.

2.4 SOURCE QUALITY CONTROL

- A. Inspection and Testing at the Mill or Shop:
 1. Perform fabricator's standard procedures for source quality control, including inspections and testing.
 2. Materials and fabrication procedures shall be subject to inspection and tests in mill and shop, conducted by a qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which the Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 ERECTION

- A. General: Comply with AISC 303, AISC 360, and the Contract Documents.
- B. Checking of Lines and Elevations: Before proceeding with structural steel erection, furnish services of a qualified surveyor to check lines and elevations of concrete and masonry bearing surfaces, and locations of anchorage devices and similar devices. Immediately report discrepancies to ENGINEER. Do not proceed with erection until defective Work that will support structural steel is corrected, including agreeing with ENGINEER upon compensating adjustments (if any) to structural steel Work.
- C. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy-lines to achieve proper alignment of structures as erection proceeds.

- D. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the Work. Provide sufficient planking to comply with Laws and Regulations, and provide tightly-planked substantial floor within two stories or 30 feet, whichever is less, below each tier of steel beams on which work is performed.
- E. Anchorage Devices:
1. Provide anchorage devices, including anchor bolts, and other connectors required for securing structural steel to foundations and other in-place construction.
 2. Provide templates and other devices necessary for presetting anchorage devices to accurate locations.
 3. Refer to Section 05051, Anchor Systems, for anchorage requirements.
- F. Setting Bases and Bearing Plates:
1. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 2. Set loose and attached base plates and bearing plates for structural members on steel wedges or other adjusting devices.
 3. Tighten anchorage devices after supported members are positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 4. Place grout between bearing surfaces and bases or plates in accordance with Section 03600, Grouting. Finish exposed surfaces, protect installed materials, and allow to cure in accordance with grout manufacturer's instructions, and as otherwise required.
 5. Do not use leveling plates or wood wedges.
- G. Field Assembly:
1. Set structural frames accurately to the lines and elevations shown and indicated. Align and adjust the various members forming part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 2. Level and plumb individual members of structure within tolerances as specified in AISC 325. For members requiring accurate alignment, provide clip angles, lintels, and other members, with slotted holes for horizontal adjustment at least 3/8-inch in each direction, or more when required.
 3. Splice members only where shown or indicated.
- H. Erection Bolts: On exposed-to-view, welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

I. Connections:

1. Comply with AISC 325 for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.
 2. Do not enlarge inadequate holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- J. Gas Cutting: Do not use gas-cutting torches for correcting fabrication defects in structural framing. Cutting will be allowed only on secondary members that are not under stress, as approved by ENGINEER. Finish gas-cut sections equal to a sheared appearance, when allowed.
- K. Crane Runways:
1. Provide crane stops and other required items. Set runway girders straight and level, and to tolerances specified in CMAA 74.
- L. Touch-up Painting:
1. Unless otherwise specified, comply with touch-up painting requirements in Section 09900, Painting.
 2. Immediately after erection, clean field welds, bolted connections, and damaged or abraded areas of shop-applied paint. Apply paint to exposed areas with the same paint or coating material applied in the shop. Apply by brush or spray to provide not less than the dry film thickness specified in Section 09900, Painting.

3.3 FIELD QUALITY CONTROL

- A. Site Tests and Inspections: Materials and erection procedures shall be subject to inspection and tests at the Site conducted by qualified inspection laboratory. Such inspections and tests do not relieve CONTRACTOR of responsibility for providing the Work in accordance with the Contract Documents.
1. Engage independent testing and inspection laboratory to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.
 - a. Testing laboratory shall conduct and interpret tests, prepare and state in each report of results whether test specimens comply with the Contract Documents and specifically indicate all deviations.
 - b. High-strength Bolted Connections: Each high-strength bolted connection shall be visually inspected. Inspection shall identify whether the Work complies with Sections 2, 3, and 8 of RCSC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - 1) For connections that are slip-critical or subject to axial tension, inspector shall verify proper pre-tensioning.
 - 2) For connections that are not slip critical and not subject to direct tension, bolt does not need to be inspected for bolt tension, but shall be visually inspected to verify that plies of connected elements are in snug contact.
 - 3) Where bolts or connections are defective, correct defective workmanship, remove and replace, or correct as required defective

bolts and connections. CONTRACTOR shall pay for correcting defective Work and tests required to confirm integrity of corrected Work.

- c. Welds: Each weld shall be visually inspected.
 - 1) Where visually defective welds are evident, further test welds using non-destructive methods. If welds are determined to be acceptable, OWNER will pay for non-destructive testing. When welds are defective, CONTRACTOR shall pay for non-destructive testing.
 - 2) Correct, or remove and replace, defective Work as directed by ENGINEER.
 - 3) CONTRACTOR shall pay for corrections and subsequent tests required to determine weld compliance with the Contract Documents.

+ + END OF SECTION + +

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SECTION 05130

STRUCTURAL ALUMINUM FRAMING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install structural aluminum framing.
2. The Work also includes:
 - a. Providing openings in and attachments to structural aluminum framing to accommodate the Work under this and other Sections, and providing for structural aluminum framing items such as anchorage devices, studs, and all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before structural aluminum framing Work.

C. Related Sections:

1. Section 03600, Grouting.
2. Section 05051, Anchor Systems.
3. Section 09900, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AA ADM-1, Aluminum Design Manual – Specifications for Aluminum Structures.
2. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM B211, Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
4. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
5. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
6. ASTM B429/B429M, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
7. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
8. ASTM F594, Specification for Stainless Steel Nuts.

9. AWS D1.2/D1.2M, Structural Welding Code - Aluminum.
10. NAAMM AMP 500, Metal Finishes Manual for Architectural and Metal Products.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Welders and Welding Processes:
 - a. Qualify welding processes and welding operators in accordance with AWS D1.2/D1.2M.
 - b. When requested by ENGINEER, provide certification that all welders employed on or to be employed on the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Complete details and schedules for fabrication and shop assembly of members and details, schedules, procedures, and diagrams showing proposed sequence of erection. Shop Drawings shall not be reproductions of Contract Drawings.
 - b. Include complete information for fabrication of the structure's components, including location, type, and size of bolts, details of blocks, copes and cuts, connections, camber, holes, member sizes and lengths, and other pertinent data. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld.
 - c. Provide setting drawings, templates, and directions for installing anchorage devices.

B. Informational Submittals: Submit the following:

1. Certificates.
 - a. Welders' certifications, when requested by ENGINEER.
2. Test Reports.
 - a. Laboratory test reports and other data required to show compliance with the Contract Documents for the following:
 - 1) Mill test report documenting chemical and physical properties of each type of aluminum framing material.
 - 2) Mill test report documenting chemical and physical properties of stainless steel connection bolts, nuts, and washers.

1.5 DELIVERY, STORAGE AND HANDLING

- #### A. Deliver materials to the Site at such intervals to ensure uninterrupted progress of the Work.

B. Storage:

1. Do not store materials in a manner that could cause distortion or damage to the members. Repair or replace damaged materials as directed by ENGINEER.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Aluminum Types:

1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B221, Alloy 6061-T6.
2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
3. Aluminum Bars and Rods: ASTM B211, Alloy 6061-T6.
4. Aluminum Plates: ASTM B209, Alloy 6061-T6.

B. Anchorages, Fasteners, and Connectors:

1. Anchorage Devices: Refer to Section 05051 Anchor Systems.
2. Threaded Fasteners: Stainless steel bolts, ASTM F593, AISI Type 303, and stainless steel nuts and washers, ASTM F594, AISI Type 303.

C. Electrodes for Welding: ER 5356 complying with AWS D1.2/D1.2M.

D. Finish: Provide mill finish as specified in NAAMM AMP 500.

2.2 FABRICATION

A. Shop Fabrication and Assembly:

1. General:

- a. Fabricate and assemble structural assemblies in the shop to greatest extent possible. Fabricate items of structural aluminum in accordance with AA ADM-1, the Contract Documents, and as shown on approved Shop Drawings. Provide camber in structural members as shown.
- b. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials for storage and minimize handling at the Site.
- c. Where finishing is required, complete the assembly, including welding of units, before commencing finishing operations. Provide finish surfaces of members exposed-to-view in the completed Work that are free of markings, burrs, and other defects.
- d. Design of Members and Connections:
 1. Details shown on the Drawings are typical; similar details apply to similar conditions, unless otherwise shown or specified.

B. Connections:

1. Shop Connections:
 - a. Unless otherwise shown or indicated, shop connections may be welded or stainless steel bolted. Unless shown otherwise, welds shall be 1/4-inch minimum.
 - b. Where reaction values of a beam are not shown or indicated, connections shall be detailed to support the total uniform load capacity tabulated in AA ADM-1 tables for allowable loads on beams for the given shape, span, and aluminum specified for beam in question.
 - c. Shop-welded connections shall be detailed to eliminate or minimize eccentricity in the connection.
 - d. End connection angles fastened to webs of beams and thickness of angles, size and extent of fasteners or shop welds, shall comply with design standards in AA ADM-1. Connections shall be two-sided unless otherwise shown or indicated.
 2. Fabrication Considerations Regarding Field Connections:
 - a. Unless otherwise specified below or indicated, make field connections using stainless steel bolts.
 - b. Field welding is not allowed.
 3. Bolted Construction:
 - a. Stainless steel design shear values shall be based on bolts with bearing type connections with threads in the shear plane.
 - b. Minimum bolt diameter shall be 3/4-inch, unless otherwise shown or indicated.
 4. Welded Construction: Comply with AWS D1.2/D1.2M for procedures, appearance, and quality of welds, and methods used in correcting defective welding Work.
- C. Bracing:
1. Bracing for which stress is not shown or indicated shall have minimum two-bolt connection, or shop-welded connection of equivalent strength.
 2. Vertical bracing and knee braces connecting to columns shall be on the centerline of columns, unless otherwise shown or indicated.
 3. Knee braces shall be at 45-degree angle, unless otherwise shown or indicated.
 4. Connection plates shall be minimum 3/8-inch thick, unless otherwise shown.
- D. Columns: Fabrication tolerances shall be as required by AA ADM-1 and AWS D1.2/D1.2M for welded members.
- E. Holes and Appurtenances for Other Work:
1. Provide holes required for securing other work to structural aluminum framing, and for passage of other work through framing members, as shown on the Shop Drawings and the Contract Documents. If large block-outs are required and approved, reinforce the webs to develop specified shear strength. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work.

2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not frame cut holes or enlarge holes by burning. Drill holes in bearing plates.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which structural aluminum Work will be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 ERECTION

- A. Comply with AA ADM-1 and the Contract Documents.
- B. Anchorage Devices:
 1. Provide anchorage devices, including anchor bolts, and other connectors required for securing structural aluminum to foundations and other in-place Work.
 2. Provide templates and other devices necessary for pre-setting anchorage devices to accurate locations.
 3. Refer to Section 05051, Anchor Systems, for anchorage requirements.
- C. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 1. Set loose and attached base plates and bearing plates for structural members on stainless steel wedges or other adjusting devices.
 2. Tighten anchorage devices after positioning and plumbing supported members. Do not remove wedges or shims, but if protruding, cut off flush with edge of the base or bearing plate prior to packing with grout.
 3. Place non-shrink grout between bearing surfaces and bases or plates in accordance with Section 03600, Grouting. Finish exposed surfaces, protect installed materials, and cure in compliance with grout manufacturer's instructions.
 4. Leveling plates and wood wedges are not allowed.
- D. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure within tolerances specified in AA ADM-1. For members requiring accurate alignment, provide clip angles, lintels and other members shall be with slotted holes for

horizontal adjustment at least 3/8-inch in each direction, or more when required.

2. Splice members only where shown or indicated.
- E. Erection Bolts: On exposed, welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.
- F. Gas Cutting: Do not use gas-cutting torches at the Site for correcting structural framing fabrication errors. Field-cutting will be allowed only on secondary members that are not under stress, as approved by ENGINEER. Finish gas-cut sections equal to sheared appearance when allowed.
- G. Protection of Aluminum from Dissimilar Materials:
1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09900, Painting.

3.3 FIELD QUALITY CONTROL

- A. OWNER will engage an independent testing and inspection agency to inspect stainless steel bolted connections and welded connections as follows:
1. Visually inspect all welds. Test wells that appear to be visually deficient using non-destructive methods by qualified testing laboratory. CONTRACTOR shall correct improper workmanship by removing and replacing, or repairing, as instructed by ENGINEER, welds that are defective. Pay for all corrections and subsequent retesting to confirm integrity of welds.
 2. Visually inspect all bolted connections.
 - a. Visually inspect connections to verify that plies of connected elements are in snug contact.
 - b. Where bolts or connections are defective, correct improper workmanship and materials by removing defective bolts and connections and replacing or repairing as directed by ENGINEER. Pay for corrections and subsequent tests required to confirm integrity of connection.
 3. Independent testing and inspection agency shall prepare a report on each structure. Report shall summarize observations made by inspector and be submitted to ENGINEER.
- B. Correct defective structural aluminum Work. Perform additional tests, at CONTRACTOR'S expense, necessary to confirm non-compliance of the original Work and to demonstrate compliance of corrected Work.

+ + END OF SECTION + +

SECTION 05501

MISCELLANEOUS METAL FABRICATIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish miscellaneous metal fabrications including surface preparation and shop priming.
2. The Work also includes:
 - a. Providing openings in miscellaneous metal fabrications to accommodate the Work under this and other Sections, and attaching to miscellaneous metal fabrications all items such as sleeves, bands, studs, fasteners, and all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the Work to be installed with, or attached to miscellaneous metal fabrications Work.
2. Hot-dip Galvanizing: Coordinate with steel fabricator detailing for and fabrication of assemblies to be hot-dip galvanized, to minimize distortion during galvanizing process.

C. Related Sections:

1. Section 03600, Grouting.
2. Section 05051, Anchor Systems.
3. Section 05522, Aluminum Handrails and Railings.
4. Section 05532, Aluminum Grating.
5. Section 09900, Painting,

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI A14.3, Ladders – Fixed – Safety Requirements.
2. ANSI Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
3. ASTM A36/A36M, Specification for Carbon Structural Steel.
4. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
5. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

6. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
8. ASTM A320/A320M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
9. ASTM A384/A384M-02 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
10. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
11. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
12. ASTM A793, Specification for Rolled Floor Plate, Stainless Steel.
13. ASTM A992/A992M, Specification for Structural Steel Shapes.
14. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
15. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
16. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
17. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
18. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
19. ASTM B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate.
20. AWS D1.1/D1.1M, Structural Welding Code – Steel.
21. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
22. AWS D1.6, Structural Welding Code – Stainless Steel.
23. NAAMM, Metal Finishes Manual.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Welding:

- a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, or D1.6, as applicable.
- b. When requested by ENGINEER, provide certification that each welder employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

B. Regulatory Requirements: Conform to the following:

1. 29 CFR 1910, Occupational Health and Safety Standards.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Fabrication and erection details for assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for locating and installing miscellaneous metal items and anchorage devices.
 2. Product Data:
 - a. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.
 3. Samples:
 - a. Sets of representative Samples of materials including nosings, rungs, and other finished products as requested by ENGINEER. ENGINEER's review will be for color, texture, style, and finish only. Compliance with other requirements is exclusive responsibility of CONTRACTOR.
- B. Informational Submittals: Submit the following:
1. Test and Evaluation Reports:
 - a. Mill test report that indicate chemical and physical properties of each type of material, when requested by ENGINEER.
 2. Qualifications Statements:
 - a. Copies of welder's certifications, when requested by ENGINEER.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in other construction in ample time to prevent delaying the Work.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Steel:
1. W-Shapes and WT-Shapes: ASTM A992/A992M.
 2. S-Shapes and Channels: ASTM A572/A572M, Grade 50.
 3. Hollow Structural Sections: ASTM A500, Grade B.
 4. Angles, Plates, Bars: ASTM A36/A36M.
 5. Steel Pipe: ASTM A53/A53M, Grade B.
- B. Aluminum:
1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B 221, Alloy 6061-T6.
 2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
 3. Aluminum Bars and Rod: ASTM B211, Alloy 6061-T6.

4. Aluminum Plates: ASTM B209, Alloy 6061-T6.
- C. Stainless Steel:
 1. Plates and Sheets: ASTM A240/A240M, Type 304L or Type 316 stainless steel.
 2. Submerged or Intermittently Submerged: Type 316 stainless steel.
 3. Non-submerged: Type 304L stainless steel.
- D. Stainless Steel Fasteners and Fittings: ASTM A 320/A 320M, Type 304L or Type 316 Stainless Steel.
- E. Zinc-coated Hardware: ASTM A153/A153M.

2.2 MISCELLANEOUS METAL ITEMS

- A. Shop Assembly:
 1. Pre-assemble items in the shop to the greatest extent possible to minimize field-splicing and field-assembly of units at the Site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Shelf Angles:
 1. Provide structural steel shelf angles of sizes shown, for attachment to concrete or masonry construction. Provide slotted holes to receive 3/4-inch bolts, spaced not more than six inches from ends and not more than 2.0 feet on centers, unless otherwise shown.
 - a. Provide galvanized shelf angles on outdoor construction.
 2. Provide wedge-type concrete inserts, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.
- C. Aluminum Stair Nosings:
 1. Manufacturers: Provide products of one of the following:
 - a. Supergrit Type 241BF by Wooster Products, Inc.
 - b. Or equal.
 2. Fabricate extruded aluminum nosing of sizes and configurations as shown on the Drawings.
 - a. Unless otherwise shown, provide ribbed abrasive filled type, using black abrasive filler.
 3. Provide anchors for embedding in concrete, either integral or applied to treads, as standard with manufacturer.
- D. Manhole Steps:
 1. Provide manhole steps as shown on the Drawings. Conform to requirements of 29 CFR 1910 and ANSI A14.3.
 2. Products and Manufacturers: Provide one of the following:
 - a. R-1982-W, manufactured by Neenah Foundry Company.
 - b. Or equal.

3. Vertical separation of steps shall be uniform at maximum of 12 inches on centers. Steps shall project evenly from manhole or chamber walls.
 4. Material: Extruded aluminum.
- E. Stainless Steel Bar Racks and Rakes:
1. Provide manually cleaned bar racks as shown on the Drawings.
 2. Fabricate of all-stainless steel welded construction in accordance with details on the Drawings.
 3. Bar size and spacing shall provide clear openings as shown.
 4. Provide plates, angles, bars, and fasteners as shown.
 5. Provide approved rake of suitable length and spacing to match rack dimensions.
- F. Bollards:
1. Provide Schedule 80 galvanized steel pipe filled with concrete as shown on the Drawings. Paint as required in accordance with Section 09900, Painting. Unless otherwise shown or specified, finish-paint bollard "Safety Yellow."
- G. Miscellaneous Framing and Supports:
1. Provide miscellaneous metal framing and supports that are not part of structural steel framework and are required to complete the Work.
 2. Fabricate miscellaneous units to sizes, shapes, and profiles shown on the Drawings or, if not shown, of required dimensions to receive adjacent grating, plates, tanks, doors, and other work to be retained by the framing.
 3. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all-welded construction using mitered corners, welded brackets, and splice plates and minimum number of joints for field connection.
 4. Cut, drill, and tap units to receive hardware and similar items to be anchored to the Work.
 5. Furnish units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units are to be installed after concrete is placed.
 - a. Except as otherwise shown, space anchors, 2.0 feet on centers, and provide units the equivalent of 1.25-inch by 1/4-inch by eight-inch strips.
 - b. Galvanize exterior miscellaneous frames and supports.
 - c. Where shown or indicated, galvanize miscellaneous frames and supports that are not to be installed outdoors.
 6. Miscellaneous steel framing and supports shall be hot-dip galvanized and finish-painted, unless otherwise shown or indicated.
 7. For railings, refer to Section 05522, Aluminum Handrails and Railing.
 8. For grating requirements refer to Section 05532, Aluminum Grating.
 9. Surface preparation and painting of galvanized surface shall conform to Section 09900, Painting
- H. Steel Raised-pattern Floor Plate:

1. Provide raised-pattern floor plate conforming to ASTM A786/A786M and manufacturer's standards. Plates shall be of thicknesses shown.
 2. Products and Manufacturers: Provide products of one of the following:
 - a. 4-Way Safety Steel Plate, by Ryerson Tull Company.
 - b. Raised Pattern Floor Steel Plate, by Central Steel and Wire Company.
 - c. Or equal.
 3. Provide removable plates at locations and sizes shown. Provide perforated plates where shown.
 4. Provide each plate section with four lifting handles as recommended by manufacturer. Lifting handles shall be recessed, drop-handle type. Maximum weight of checkered plate shall be 150 pounds.
 5. Finish: Hot-dip galvanize in accordance with ASTM A123/A123M.
- I. Aluminum Raised-pattern Floor Plate:
1. Provide raised-pattern floor plate conforming to ASTM B632/B632M and manufacturer's standards. Provide plates of thicknesses shown.
 2. Products and Manufacturers: Provide products of one of the following:
 - a. Aluminum Plate, by Ryerson.
 - b. Raised Pattern Floor Aluminum Plate, by Central Steel and Wire Company.
 - c. Or equal.
 3. Provide removable plates at locations and sizes shown. Provide perforated plates where shown.
 4. Provide each plate section with four lifting handles as recommended by manufacturer. Lifting handles shall be recessed, drop handle type. Maximum weight of checkered plate or plank section shall be 150 pounds.
 5. Finish: Anodized. Protect finish with factory-applied coating of manufacturer's standard lacquer coating, suitable for service on floor.
- J. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.
- K. Anchors and Expansion Anchors: Refer to Section 05051, Anchor Systems.

2.3 FINISHING

- A. Surface Preparation and Shop Priming: Perform surface preparation and apply primer coat to miscellaneous metal fabrications in the shop. Conform to surface preparation and shop priming requirements in Section 09900, Painting.
- B. Galvanizing:
1. Galvanizing of fabricated steel items shall comply with ASTM A123/A123M.
 2. Details of fabrication of steel items and assemblies to be hot-dip galvanized shall conform to recommendations of ASTM A384/A384M to minimize the potential for distortion.

- C. Aluminum Finish: Provide natural mill finish for aluminum Work unless otherwise shown or specified.

2.4 SOURCE QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures complying with the Contract Documents.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine conditions under which the Work is to be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install miscellaneous metal fabrications accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry, or other construction.
- B. Anchor securely as shown and as required for the intended use, using concealed anchors where possible.
- C. Fit exposed connections accurately together to form tight, hairline joints. Field-weld steel connections that are not to be exposed joints and cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1/D1.1M, D1.2/D1.2M and D1.6, as applicable to the material being welded. Grind steel joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- D. Protection of Aluminum from Dissimilar Materials:
 - 1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09900, Painting.

+ + END OF SECTION + +

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SECTION 05511

PRE-ENGINEERED ALUMINUM STAIRS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install pre-engineered aluminum stairs including surface preparation and shop priming.
2. The extent of pre-engineered aluminum stairs shall be as shown.
3. The Work also includes:
 - a. Providing openings in and attachments to pre-engineered aluminum stairs to accommodate the Work under this and other Sections and providing for the pre-engineered aluminum stairs all items such as anchor bolts, studs and all items required for which provision is not specifically included under other Sections.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the pre-engineered aluminum stairs Work.

C. Related Sections:

1. Section 05051, Anchor Systems.
2. Section 05130, Structural Aluminum Framing
3. Section 05522, Aluminum Handrails and Railings.
4. Section 05532, Aluminum Grating.
5. Section 09900, Painting.

1.2 REFERENCES

A. All pre-engineered aluminum stairs shall be in accordance with:

1. Aluminum Association (AA), Specification for Aluminum Structures.
2. ASTM B 209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM B 211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
4. ASTM B 221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
5. ASTM B 308/B 308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

6. ASTM B 429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
7. ASTM F 593, Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
8. ASTM F 594, Specification for Stainless Steel Nuts.
9. AWS D1.2/D1.2M, Structural Welding Code-Aluminum.
10. NAAMM, Metal Stairs Manual and Metal Finishes Manual.

1.3 SUBMITTALS

- A. Samples: Submit the following:
 1. Representative samples of materials including nosings, tread material, and other items as requested by the Engineer. Review will be for type only. Compliance with all other requirements is exclusive responsibility of Contractor.
- B. Shop Drawings and Calculations: Submit the following:
 1. Erection and detailed Shop Drawings, which show the plan location, elevation and details for the fabrication and erection of the pre-engineered aluminum stair Work. Show anchorage and accessory items. Include details of all connections between all materials.
 2. Provide signed and sealed Shop Drawings and calculations, which are prepared by a Registered Professional Engineer licensed in the State in which the pre-engineered aluminum stairs will be installed.

1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 1. Manufacturer shall have a minimum of five years of experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Component Supply and Compatibility:
 1. Obtain all products included in this Section regardless of the component manufacturer from a single pre-engineered aluminum stair manufacturer.
 2. The pre-engineered aluminum stair manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pre-engineered aluminum stair manufacturer.
- C. Codes: Comply with the applicable requirements of the New York State Building Codes.

- D. Source Quality Control: Contractor shall be responsible for entire design, fabrication and installation of pre-engineered aluminum stair Work.
- E. The Shop Drawings and calculations shall be prepared by a Registered Professional Engineer licensed in the State in which the pre-engineered aluminum stairs will be installed and is a recognized expert in the type of Work shown and specified.

1.5 JOB CONDITIONS

- A. Conform to applicable OSHA and the New York State Building Codes.

PART 2 – PRODUCTS

2.1 DESIGN CRITERIA

- A. Pre-engineered aluminum stairs shall comply with the requirements of the NAAMM, "Metal Stairs Manual".
- B. Sizes of miscellaneous items such as carrier angles and platform stiffeners, and design stresses shall be as recommended in Section 4 of the "Metal Stairs Manual", unless otherwise shown.
- C. All required stair loadings and other stair related requirements shall comply with the governing building code in which the pre-engineered aluminum stairs will be installed.

2.2 FABRICATION

- A. General:
 - 1. Use welding for joining pieces together, unless otherwise shown or specified. Welding to comply with the applicable provisions of AWS D1.2/D1.2M. Fabricate units so that bolts and other fastenings do not appear on finish surfaces. Make joints true and tight, and make connections between parts light proof tight. Provide continuous welds, ground smooth where exposed.
 - 2. Construct stair units to conform to sizes and arrangements as shown. Provide pre-engineered aluminum framing, hangers, columns, struts, clips, brackets, bearing plates and other components for the support of pre-engineered aluminum stairs and platforms. Erect pre-engineered aluminum stair Work to line, plumb, square, and true with runs registering level with floor and platform levels.
 - 3. Provide brackets and bearing surfaces as detailed and as required to anchor and contain the pre-engineered aluminum stairs on the supporting structure.

4. Where masonry walls support the pre-engineered aluminum stair Work, provide temporary supporting struts, designed for the erection of stair components before installation of masonry.
 5. Finish: Provide Architectural mill finish as specified in the NAAMM Manual.
 6. Protection of Aluminum from Dissimilar Materials: Coat all surfaces of aluminum in contact with dissimilar materials, such as concrete, masonry and steel as specified in Section 09900, Painting.
- B. Stair Framing:
1. Fabricate stringers of structural aluminum channels, or plates, or a combination thereof, as shown. Provide closures for exposed ends of stringers.
 2. Construct platforms of structural aluminum channel headers and miscellaneous framing members, as shown. Bolt or weld headers to stringers. Bolt or weld framing members to strings and headers. Refer to Section 05051, Anchor Systems.
- C. Aluminum Grating Treads and Platforms:
1. For aluminum grating, refer to Section 05532, Aluminum Grating. Fabricate grating treads with abrasive nosing on one edge and with aluminum angle or aluminum plate carrier at each end for stringer connections. Secure treads to stringers with bolts. Provide grating treads at the following stairs:
 - a. Open grated stair treads in exterior applications.
 - b. Open grated stair treads on unenclosed stairs within buildings.
 2. Fabricate grating platforms, with serrated nosing matching that on grating treads, at all landings. Provide toe plates at open sided edges of floor grating fastened to platform framing members.
 3. Provide platforms 3/8 inch minimum thick with solid abrasive surface matching that on treads. Secure platforms to platform framing members with bolts.
 4. Platform framing members shall conform to the requirements of Section 05130, Structural Aluminum Framing.
- D. Stair Aluminum Railing:
1. Aluminum railings shall conform to the requirements of Section 05522, Aluminum Handrails and Railings.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the conditions under which the Work is to be installed and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction.

3.3 INSTALLATION

- A. Fastening to In Place Construction:
 - 1. Provide anchorage devices and fasteners where necessary for securing pre-engineered aluminum stairs to in place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts and other connectors as required. The anchorage devices and fasteners shall be Type 316 stainless steel. Refer to Section 05051, Anchor systems.
- B. Cutting, Fitting and Placement:
 - 1. Perform cutting, drilling and fitting required for the installation of the pre-engineered aluminum stairs. Set the pre-engineered aluminum stairs accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry or similar construction.
 - 2. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units that have been hot dip galvanized after fabrication and are intended for bolted or screwed field connections.

+ + END OF SECTION + +

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SECTION 05522

ALUMINUM HANDRAILS AND RAILINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as specified, and required to furnish and install aluminum handrail and railing systems. The Work also includes:
 - a. Provide an aluminum two-rail system with toeboards at all required locations.
 - b. Providing openings in, and attachments to, aluminum handrail and railing systems to accommodate the Work under this and other Specification Sections. Provide all items for aluminum handrails and railings, including anchorages, fasteners, studs, and other items required for which provision for is not specifically included under other Sections.
2. Aluminum handrails and railings Work shall include components and features specified, and all components and features available from specified manufacturers required for providing complete aluminum handrail and railing system in accordance with the Contract Documents.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum handrails and railings Work.
2. Aluminum handrail and railing locations shall conform with Laws and Regulations.

C. Related Sections:

1. Section 03600, Grouting.
2. Section 05051, Anchor Systems.
3. Section 09900, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. Aluminum Association (AA), Aluminum Design Manual.
2. ASTM B26/B26M, Specification for Aluminum-Alloy Sand Castings.
3. ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

4. ASTM B136, Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum.
5. ASTM B137, Standard Test Method for Measurement of Coating Mass per Unit Area on Anodically Coated Aluminum.
6. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
7. ASTM B241/B241M, Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
8. ASTM B244, Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments.
9. ASTM B247, Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and rolled Ring Forgings.
10. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
11. ASTM E 935, Standard Test Methods for Permanent Metal Railing Systems and Rails for Buildings.
12. NAAMM/Architectural Metal Products Division (AMP), Pipe Railing Manual.
13. NAAMM/AMP AMP 501 Finishes for Aluminum.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Manufacturer shall be able to document at least five years successful experience in fabricating aluminum handrail and railing systems of scope and type similar to that required.
2. Professional Engineer:
 - a. Contractor or handrail and railing manufacturer shall retain a registered professional engineer legally qualified to practice in same state as the Site.
 - b. Responsibilities include:
 - 1) Reviewing aluminum handrail and railing system performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
 - 3) Preparing or supervising preparation of design calculations verifying compliance of aluminum handrail and railing system with requirements of the Contract Documents.
 - 4) Signing and sealing all calculations.
 - 5) Certifying that:

- a) Design of aluminum handrail and railing system was performed in accordance with performance and design criteria stated in the Contract Documents, and
 - b) Design conforms to all applicable local, state, and federal Laws and Regulations, and to prevailing standards of practice.
- 3. Installer Qualifications:
 - a. Retain a single installer trained and with record of successful experience in installing aluminum handrail and railing systems.
 - b. Installer shall have record of successfully installing aluminum handrail and railing systems in accordance with recommendations and requirements of manufacturer, or shall provide evidence of being acceptable to the manufacturer.
 - c. Installer shall employ only tradesmen with specific skill and successful experience in the type of Work required.
 - d. When requested by Engineer, submit name and qualifications of installer with the following information for at least three successful, completed projects:
 - 1) Names and telephone numbers of owner and architect or engineer responsible for each project.
 - 2) Approximate contract cost of the aluminum handrail and railing systems for which installer was responsible.
 - 3) Amount (linear feet) of aluminum handrail and railing installed.
- B. Component Supply and Compatibility:
 - 1. Obtain all products included in this Section regardless of component manufacturer, from a single aluminum handrail and railing system manufacturer.
 - 2. Aluminum handrail and railing system manufacturer shall review and approve or prepare all Shop Drawings and other submittals (except for delegated design submittals, when professional engineer is retained by other than handrail and railing manufacturer) for all components furnished under this Section.
 - 3. Components shall be specifically constructed for specified service conditions and shall be integrated into overall assembly by aluminum handrails and railings manufacturer.
- C. Regulatory Requirements: Conform to Laws and Regulations including:
 - 1. OSHA Part 1910.28, Duty to have fall protection and falling object protection.
 - 2. OSHA Part 1910.29, Fall protection systems and falling object protection-criteria and practices.
 - 3. New York State Building Codes.

D. Certifications:

1. Furnish certification, signed by authorized officer of manufacturer and notarized, stating that handrail and railing systems conform to the design prepared by the professional engineer.
2. Furnish certification, signed by authorized officer of Contractor and notarized, stating that all components and fittings are furnished by the same manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings for fabrication and installation of aluminum handrail and railing systems with sizes of members, pipe wall thickness, information on components, and anchorage devices. Show all anchorages. Provide details drawn at scale of 1.5-inch equal to one foot.
 - b. Indicate required location of posts.
 - c. Indicate locations and details of all expansion joints, if any.
 - d. Indicate locations and details of gaps across seismic joints, if any.
 - e. Profile drawings of aluminum handrail and railing system components.
 - f. Custom detail drawings. Details of forming, jointing, sections, connections, internal supports, trim and accessories. Provide details drawn at scale of 1.5-inch equal to one foot.
2. Product Data:
 - a. Manufacturer's specifications, standard detail drawings, and installation instructions for aluminum handrail and railing systems.
 - b. Manufacturer's catalogs showing complete selection of standard and custom components and miscellaneous accessories for selection by Engineer.
3. Delegated Design Submittals:
 - a. Design Data:
 - 1) Design computations or complete structural analysis and shop drawings of handrail and railing systems, signed and sealed by professional engineer. Professional engineer's seal shall be clearly legible, including state of registration, registration number, and name on seal.
 - 2) Certification by professional engineer that professional engineer has performed design of aluminum handrail and railing systems in accordance with performance and design criteria stated in the Contract Documents, and that design conforms to all local, state, and federal Laws and Regulations, and to prevailing standards of practice.
4. Samples:

- a. Full-size Sample, 2.0 feet long, of assembled railing system at post and rail intersections. Sample shall have all associated components including typical connections, mounted toeboard and sleeve, and handrail at wall return, complete with mounting brackets, all with specified controlled uniform metal finish.
 - b. Color Samples: Maximum range of clear anodized aluminum that shall appear in finished Work. Prepare range Samples, to show highest level of color control feasible for actual handrail and railing systems, as determined by licensor of finishing process specified, on actual extrusions and castings of the Work.
 - c. Samples will be reviewed for finish, color, joint tolerances, workmanship, and general component assembly only. Compliance with other requirements is the responsibility of the Contractor.
- 5. Test Procedure: Submit detailed description of proposed shop testing procedures. Do not perform shop testing until Engineer approves shop test procedure:
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Certification on source of supply, as specified in Article 1.3 of this Section.
 - b. Manufacturer certification specified in Article 1.3 of this Section.
 - 2. Source Quality Control Submittals:
 - a. Manufacturer's load testing report in accordance with ASTM E935 for completed aluminum handrail and railing systems, demonstrating compliance with applicable requirements of building codes, safety codes, and other Laws and Regulations.
 - 3. Qualifications Statements: Submit qualifications for the following:
 - a. Manufacturer, when requested by Engineer.
 - b. Professional engineer.
 - c. Installer, when requested by Engineer. Qualifications statement shall include record of experience with references specified.
- C. Closeout Submittals: Submit the following:
 - 1. Maintenance Manuals: Furnish detailed maintenance manuals that include the following:
 - a. Product name and number.
 - b. Detailed procedures for routine maintenance and cleaning, including cleaning materials, application methods and precautions in use of products that may be detrimental to finish when improperly applied.
 - c. Handrail and railings systems manufacturer's current catalog including individual parts.
 - d. Conform to Section 01781, Operations and Maintenance Data.
 - 2. Guarantee: Provide in maintenance manual the guarantee specified.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, and Unloading:

1. Prior to shipping, completely inspect products to assure that components are complete and comply with requirements of Contract Documents and recommendations of manufacturer. Box or crate products as required to prevent damage during shipment.
2. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
3. Inspect all boxes, crates, and packages upon delivery to Site and notify Engineer in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
4. Conform to Section 01610, Transportation and Handling of Materials and Equipment.

B. Storage and Protection:

1. Keep products off ground using pallets, platforms, or other supports. Protect products from corrosion and deterioration.
2. Conform to Section 01610, Transportation and Handling of Materials and Equipment.

C. Handling of Products:

1. Do not subject handrail and railing products to bending or stress.
2. Do not damage edges or handle products in a manner that will cause scratches, warping, or dents.
3. Protect handrails and railings by paper or coating as acceptable to handrail and railing manufacturer, against scratching, splashes of mortar, paint, and other marring during transportation, handling, and erection. Protect until completion of adjacent work.

1.6 GUARANTEE

- A. Guarantee: Manufacturer shall provide written guarantee of availability of replacement parts and components for period of at least five years after completion of the Project.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. System Description: Aluminum handrail and railing system shall consist of equally spaced horizontal rails with totally concealed mechanical fasteners, internally threaded tubular rivets and components fastened to posts spaced no more than 5.0 feet on centers and system of handrails supported from adjacent construction by mounting brackets spaced at no more than 5.0 feet on centers.
- B. Design Criteria and Performance Criteria:
1. Design, fabricate, and install aluminum handrail and railing systems to withstand the most critical effects resulting from the following loads (loads listed below do not act concurrently):
 - a. Uniform Load: 50 pounds per foot, applied at top in any direction.
 - b. Concentrated Load: 200 pounds single load, applied at any point along the top in any direction.
 - c. Components: Intermediate rails (all rails except the handrail), balusters, and panel fillers, if any, shall withstand horizontally-applied normal load of 50 pounds on an area equal to one square foot, including openings and space between rails. Reactions due to this loading are not required to be superimposed to loading specified for main supporting members of handrails and railings.
 - d. Conform to requirements of AA Aluminum Design Manual for determining allowable stresses and safety factors for aluminum structural components.
 - e. Limit deflection in each single span of railing and handrail to 1.5-inch maximum, and to 1.4-inch maximum on railing posts. Applied loads shall not produce permanent deflection in the completed Work when loads are removed.
 2. Thermal Control: Provide adequate expansion within fabricated systems that allows for thermal expansion and contraction caused by material temperature change of 140 degrees F to -20 degrees F without warp or bow of system components. Distance between expansion joints shall be based on providing 1/4-inch wide joint at 70 degrees F, which accommodates movement of 150 percent of calculated amount of movement for specified temperature range.
 3. Where handrail and railing systems cross expansion joints in the building or structure, provide expansion joints in handrail and railings systems.
 4. For posts located at or near end of runs as shown, uniformly space intermediate posts as required to conform to loading and deflection criteria specified, at intervals no greater than maximum post spacing specified. Where posts are shown for handrails along both sides of walkways and other similar locations, locate posts opposite each other; do not stagger post locations.

2.2 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:

Long Beach WPCP Consolidation
Pump Station Conversion

05522-7

1. Custom Fabricated Connectorail System by Julius Blum & Company, Inc.
2. Custom Fabricated Series 500 Non-Welded Aluminum Pipe Aluminum handrails and railing systems by Superior Aluminum Products, Inc.
3. Or Equal.

2.3 MATERIALS

- A. Extruded Aluminum Architectural and Ornamental Shapes: ASTM B221, Alloy 6063-T52.
- B. Aluminum Forgings: ASTM B247.
- C. Extruded or Drawn Aluminum Pipe and Tube:
 1. ASTM B429 or ASTM B241/B241M, Alloy 6063-T5, 6063-T52, or 6063-T832 as required by loadings, deflections, and post spacing specified.
 2. Provide Schedule 40 pipe, minimum, unless conditions of detail and fabrication require extra-heavy pipe to comply with Specifications. Rails and posts shall have minimum outside diameter of 1.90 inches.
- D. Reinforcing Bars: Solid, circular profile, 24 inches long, 6061-T6 aluminum reinforcing bars with same outside diameter as inside diameter of post.
- E. Anchors and Fastenings:
 1. For anchors and fasteners, use Type 316 stainless steel; minimum 0.5-inch diameter.
 2. Provide minimum of four bolt fasteners per post where surface-mounted posts are shown. Components shall be in accordance with manufacturer's recommendations and as approved or accepted (as applicable) by Engineer on submittals.
 3. Anchors: As specified in Section 05051, Anchor Bolts, Toggle Bolts, and Concrete Inserts.
- F. Castings:
 1. Provide high-strength aluminum alloy brackets, flanges, and fittings suitable for anodizing as specified.
 2. Aluminum alloy sand castings: ASTM B26/B26M.
- G. Connector Sleeves: Schedule 40, 5.0-inch long by 1.610-inch diameter.
- H. Sockets: Provide six-inch deep by 2.5-inch outside diameter aluminum sockets with 3.5-inch wide socket cover on bottom of each socket and on top and bottom of removable post sockets.
- I Custom Cover Flanges: 1/4-inch high by 4.0-inch diameter, aluminum.

- J. Adhesive: Two-part waterproof epoxy-type as recommended by handrail and railing systems manufacturer.
- K. Non-shrink Grout: Refer to Section 03600, Grout.
- L. Toeboards:
 - 1. Provide extruded Alloy 6063-T5 or T52 aluminum alloy toeboards, unless railing is mounted on curbs or other construction of sufficient height and type to conform to OSHA 1910.23. Bars or plates are not acceptable.
 - 2. Unless otherwise specified, toeboards shall conform to requirements of OSHA 1910.23, Section (e).
- M. System Components and Miscellaneous Accessories: Provide complete selection of manufacturer's standard and custom aluminum handrail and railing systems components and miscellaneous accessories required. Show type and location of all such items on Shop Drawings and other submittals as applicable.

2.4 FABRICATION

- A. General: Unless otherwise shown or specified, provide typical non-welded construction details and fabrication techniques recommended in NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501.
- B. Fabricate handrail and railing systems true to line and level, with accurate angles surfaces and straight edges. Fabricate corners without using fittings. Provide bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends. Provide not less than four-inch outside radius.
- C. Provide chains across openings in railings where shown. Attach one end of each chain to an eyebolt in post and other end attached by means of swivel eye snap hook to similar eyebolt in opposite post.
- D. Remove burrs from exposed edges.
- E. Close aluminum pipe ends by using prefabricated fittings.
- F. Weep Holes:
 - 1. Fabricate joints that will be exposed to weather to exclude water.
 - 2. Provide 15/64-inch diameter weep holes at lowest possible point on each post in handrail and railing systems.
 - 3. Provide pressure relief holes at closed ends of handrail and railing systems.
- G. Toeboards:

1. Provide manufacturer's standard toeboard, which accommodates movement caused by thermal change specified without warping or bowing toeboards.
 2. Provide manufacturer's standard toeboard, which accommodates storage for removable socket covers.
 3. Coordinate and cope toeboard as required to accommodate cover flanges at posts.
 4. Toeboards shall follow curvature of railing. Where railing is shown to have curved contours at corners, or other locations, toeboard shall likewise be curved to follow line of railing system.
- H. Reinforcing Bars: Provide reinforcing bar friction-fitted at each post in railing system. Extend reinforcing bars of tubes six inches into cast-in-place sleeves or other types of supporting brackets.
- I. Mechanically Fitted Component Pipe Handrail and Railing System:
1. Use non-welded pipe handrail and railing system with posts, top and intermediate rail(s), and flush joints.
 2. Provide top and one intermediate horizontal rail, equally spaced.
 3. Do not use blind rivets, pop rivets, or other exposed fastening devices in the Work. Fasteners used for side-mounting fascia flanges where shown or specified may be exposed in the Work. Provide internal threaded aluminum rivets, stainless steel through-bolts with lock nuts, stainless steel sheet metal screws with lock washers, and epoxy adhesive for fastening components of the Work.

2.5 FINISHES

- A. General:
1. Prepare surfaces for finishing in accordance with recommendation of aluminum producer and the finisher or processor.
 2. Adjust and control direction of mechanical finishes specified to achieve best overall visual effect in the Work.
 3. Color and Texture Tolerance: Provide uniform color and continuous mechanical texture for aluminum components. Engineer reserves the right to reject aluminum materials because of color or texture variations that are visually objectionable, but only where variation exceed range of variations established by manufacturer prior to fabrication, by means of range of Samples approved by Engineer.
 4. Anodize aluminum components.
 5. Provide the following railing finishes:
 - a. Railing finish shall be clear anodized finish.
- B. Mechanically finish aluminum by wheel or belt polishing with aluminum oxide grit of 180 to 220 size, using peripheral wheel speed of 6,000 feet per minute; AA Designation - M32 Medium Satin Directional Texture.

1. Hand Rubbed Finish: Where required to complete the Work and provide uniform, continuous texture, provide hand-rubbed finish to match medium satin directional texture specified to even out and blend satin finishes produced by other means.
- C. Provide non-etching chemical cleaning by immersing aluminum in inhibited chemical solution, as recommended by coating applicator, to remove lard oil, fats, mineral grease, and other contamination detrimental to providing specified finishes.
 1. Clean and rinse with water between steps as recommended by aluminum manufacturer.
- D. Exposed Aluminum Anodic Coating: Provide anodic coatings as specified that do not depend on dyes, organic or inorganic pigments, or impregnation processes to obtain color. Apply coatings using only the alloy, temperature, current density, and acid electrolytes to obtain specified colors in compliance with designation system and requirements of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501. Comply with the following:
 1. Provide Architectural Class I high density anodic treatment by immersing the components in tank containing solution of 15 percent sulfuric acid at 70 degrees F with 12 amperes per square foot of direct current for minimum of sixty minutes; AA Designation A41 Clear or AA Designation A42 Bronze as indicated above.
 2. Physical Properties:
 - a. Anodic Coating Thickness, ASTM B244: Minimum of 0.7-mils thick.
 - b. Anodic Coating Weight, ASTM B137: Minimum of 32 mg/sq. in.
 - c. Resistance to Staining, ASTM B136: No stain after five minutes dye solution exposure.
 - d. Salt Spray, ASTM B117: 30,000 hours exposure with no corrosion or shade change.
 3. Seal finished anodized coatings using deionized boiling water to seal pores and prevent further absorption.
 4. Products and Manufacturers: Provide one of the following:
 - a. Alumilite 215 Clear or Duranodic 313 by Aluminum Company of America, Inc.
 - b. Or equal.

2.6 SOURCE QUALITY CONTROL

- A. Allowable Tolerances:
 1. Limit variation of cast-in-place inserts, sleeves and field-drilled anchor and fastener holes to the following:
 - a. Spacing: Plus-or-minus 3/8-inch.
 - b. Alignment: Plus-or-minus 1/4-inch.
 - c. Plumbness: Plus-or-minus 1/8-inch.

2. Minimum Handrails and Railings Systems Plumb Criteria:
 - a. Limit variation of completed handrail and railing system alignment to 1/4-inch in 12.0 feet with posts set plumb to within 1/16-inch in 3.0 feet.
 - b. Align rails so variations from level for horizontal members and from parallel with rake of stairs and ramps for sloping members do not exceed 1/4-inch in 12.0 feet.
 3. Provide “pencil-line” thin butt joints.
- B. Factory Testing:
1. Perform load test on completed handrail and railing systems. Extent of handrail and railing systems to be factory-tested shall be as shown and specified.
 2. Load test completed handrail and railing systems in accordance with requirements of ASTM E935. Provide written report to Engineer identifying and documenting testing methods used, magnitude and location of loads superimposed, and results of such tests on actual completed handrail and railing systems, including all anchors and fasteners to be used in the Work. Testing setup shall simulate actual conditions of installation to be used in the Work.
 3. Do not ship products from factory until Engineer accepts load testing report.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which Work is to be performed and notify Engineer, in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. Verify to Engineer gauge of aluminum pipe railing posts and rails brought to the Site by actual measurement of on-Site material in presence of Engineer.

3.2 INSTALLATION

- A. General:
 1. Do not erect components that have become scarred, dented, chipped, discolored, otherwise damaged or defaced. Remove from Site railing and handrail system components that have holes, cuts, gouges, deep scratches, or dents of any kind. Repairs to correct such Work will not be accepted. Remove and replace with new material.
 2. Comply with installation and anchorage recommendations of NAAMM/AMP Pipe Railing Manual and NAAMM/AMP AMP 501 in

addition to requirements specified and approved or accepted (as applicable) submittals.

B. Fastening to In-Place Construction:

1. Remove protective plastic immediately before installing.
2. Adjust handrails and railings prior to securing in place, to ensure proper matching at butting joints and correct alignment throughout their length. Plumb posts in each direction. Secure posts and rail ends to building or structure as follows:
 - a. Anchor posts in concrete by means of sockets set and anchored into concrete floor slab. Provide closure secured to bottom of sleeve. Before installing posts, remove debris and water from sleeves. Verify that reinforcing bars or tubes have been inserted into posts before installation. Do not install posts without reinforcing bar. For all non-removable handrail and railing systems sections, after posts have been inserted into sockets, fill annular space between posts and sockets solid with grout as specified in Section 03600, Grouting. Crown the grout and slope grout to drain away from posts.
 - b. Side-mount posts by fastening them securely in brackets attached to steel in accordance with approved or accepted (as applicable) submittals.
 - c. Posts set in concrete shall be provided with an aluminum floor cover flange.
3. Use devices and fasteners recommended by handrail and railing systems manufacturer and as shown on approved or accepted (as applicable) submittals.

C. Cutting, Fitting and Placement:

1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels.
2. Fit exposed connections accurately together to form tight hairline joints. Do not cut or abrade surfaces of units that have been finished after fabrication, and are intended for field connections.
3. Make permanent field splice connections using manufacturer's recommended epoxy adhesive and 5.0-inch minimum length connector sleeves. Tight press-fit field splice connectors and install in accordance with manufacturer's written instructions. Follow epoxy manufacturer's recommendations for requirements of installation and conditions of use.
4. Make splices as near as possible to posts, but not exceeding 12.0 inches from nearest post.
5. Field welding is not allowed. Make splices using pipe splice lock employing a single allen screw to lock joint.
6. Securely fasten toeboards in place with not more than 1/4-inch clearance above floor level.

7. Drill one 15/64-inch diameter weep hole not more than 1/4-inch above top of location of solid reinforcing bar or tube in each post.
8. Space between post attached to existing rail at tanks and post attached to sluice gate platform rail shall be 2-inches.

D. Protection from Dissimilar Materials:

1. Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, and steel, in accordance with Section 09900, Painting.
2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.3 CLEANING AND REPAIRING

- A. Cleaning: Installer shall clean exposed surfaces of handrail and railing systems after completing installation. Comply with recommendations of both handrail and railing system manufacturer and finish manufacturer. Do not use abrasives or unacceptable solvent cleaners. Test cleaning techniques on an unused section of railing before employing cleaning technique.
1. Remove stains, dirt, grease, and other substances by washing handrails and railings systems thoroughly using clean water and soap; rinse with clean water.
 2. Do not use acid solution, steel wool, or other harsh abrasives.
 3. If stain remains after washing, remove defective sections and replace with new material meeting requirements of this Section.
- B. Handrails and railings shall be free from dents, burrs, scratches, holes, and other blemishes. Replace damaged or otherwise defective Work with new material that conforms with this Section at no additional cost to Owner.
- C. At Substantial Completion, replace adjacent work marred by the Work of this Section.

+ + END OF SECTION + +

SECTION 05532

ALUMINUM GRATING

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install aluminum grating and frames.
 - 2. The Work includes:
 - a. Providing grating, frames, and appurtenances.
 - b. Providing openings in aluminum grating to accommodate the Work under this and other Sections, and attaching to aluminum grating all items such as sleeves, bands, studs, fasteners, and items required for which provision is not specifically included under other Sections.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before aluminum grating Work.
- C. Related Sections:
 - 1. Section 09900, Painting.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. A A and Aluminum Design Manual.
 - 2. ASTM B210, Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
 - 4. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 5. NAAMM MBG 531, Metal Bar Grating Manual.
 - 6. NAAMM MBG 533, Welding Specifications for Fabrication of Steel, Aluminum and Stainless Steel Bar Grating.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Shall have at least five years experience manufacturing products substantially similar to those required and shall be able to submit

documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products and materials included in this Section regardless of component manufacturer from a single aluminum-grating manufacturer.
2. Aluminum grating manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all products and materials furnished under this Section.
3. Components shall be suitable for the specified service conditions and be integrated into overall assembly by aluminum grating manufacturer.
4. Provide only one type of aluminum grating exclusively throughout the Project.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Fabrication and erection of all Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
 - b. Setting drawings and templates for location and installation of anchorage devices.
2. Product Data:
 - a. Manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions.
3. Samples:
 - a. Representative Samples of grating, appurtenances and other finished products requested by Engineer.
 - b. Engineer's review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of Contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.

B. Storage and Protection:

1. Protect materials from corrosion and deterioration.
2. Do not store materials in contact with concrete or other materials that might cause corrosion, staining, scratching, or damage materials or finish.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Aluminum Grating: Provide aluminum grating complying with the following:
1. Grating Design Loads: Uniform live load shall be as shown or indicated in the Contract Documents. Where live load is not shown or indicated, uniform live and concentrated loads shall be as indicated in the table below, whichever results in the greater design stresses.

	Live Load	Concentrated Load
a.	100 psf	500 lbs. per foot of grating width at center of span
b.	150 psf	750 lbs. per foot of grating width at center of span
c.	200 psf	1,000 lbs. per foot of grating width at center of span
d.	300 psf	1,500 lbs. per foot of grating width at center of span

2. Maximum Clear Span Deflection for Uniform Live Loads: 1/120 of span, but not more than 1/4-inch.
 3. Maximum Fiber Stress: 12,000 psi.
 4. Do not install aluminum grating in areas subject to vehicular traffic.
 5. Minimum Size of Members:
 - a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable loading and deflection requirements.
 - b. Minimum dimensions of cross bars shall be as indicated in tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.
 6. Banding bar shall be 1/4-inch thick minimum. Top of banding bar shall be flush with top of grating, unless otherwise shown or indicated. Banding bar shall be 1/4-inch shorter than the bearing bar height.
 7. Comply with requirements of AA Aluminum Design Manual.
- B. Stair Treads: Provide stair treads complying with the following:
1. Stair Tread Design Loads: Concentrated live load shall be:
 - a. 300 pounds on front-most five inches of tread at center of tread of span up to 5.5 feet.
 - b. 300 pounds on front-most five inches of tread at the one-third points of tread of span greater than 5.5 feet.
 2. Maximum Clear Span Deflection for Concentrated Live Loads: 1/240 of span, but not more than 1/4-inch.
 3. Maximum Fiber Stress: 12,000 psi.
 4. Minimum Size of Members:
 - a. Minimum size of bearing bars shall be within standard mill tolerance as indicated in load tables in NAAMM MBG 531 for applicable

- loading and deflection requirements.
- b. Minimum dimensions of cross bars shall be as indicated in tables of Minimum Standard Cross Bars and Connecting Bars in NAAMM MBG 531.
- 5. Carrier plate shall be 1/4-inch thick minimum. Top of carrier plate shall be flush with top of tread, unless otherwise shown or indicated. Provide carrier plate with hole and slot for attachment to stringer.
- 6. Comply with requirements of AA Aluminum Design Manual.

2.2 MANUFACTURERS

- A. Grating, Products and Manufacturers: Provide one of the following:
 - 1. Swage-Locked I-Bar Grating, by IKG Industries.
 - 2. Swage-Locked I-Bar Grating, by AMICO.
 - 3. Or equal.
- B. Stair Treads, Products and Manufacturers: Provide one of the following:
 - 1. I-Bar Treads, by IKG Industries.
 - 2. I-Bar Treads, by AMICO.
 - 3. Or equal.

2.3 MATERIALS

- A. Bearing Bars: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with ASTM B221.
- B. Cross Bars or Bent Connecting Bars: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with either ASTM B221 or ASTM B210.
- C. Frames: Aluminum alloy 6061-T6 or alloy 6063-T6, complying with ASTM B221.
- D. Stud anchors welded to steel supports and other fasteners shall be Type 316 stainless steel.

2.4 FABRICATION

- A. Use materials of minimum depth and thickness specified and required to comply with performance criteria in the Contract Documents.
- B. Provide grating as follows:
 - 1. Grating Type: Aluminum I-bar with swage-locked cross bars at right angles to bearing bars.
 - 2. Depth: One-inch minimum.

3. Bearing Bars: Aluminum I-bar minimum of one-inch spaced at 1-3/16-inch on centers.
 4. Cross-Bars: Swage-locked to bearing bars at maximum spacing of four inches on centers.
 5. Surface: Grooved.
 6. Finish: Mill.
- C. Provide stair treads as follows:
1. Tread Type: Aluminum I-bar with swage-locked cross bars at right angles to bearing bars.
 2. Depth: One-inch minimum.
 3. Bearing Bars: Aluminum I-bar minimum one-inch spaced at 1-3/16-inch on centers.
 4. Cross Bars: Swage-locked to bearing bars at maximum spacing of four inches on centers.
 5. Surface: Grooved.
 6. Nosing: Cast aluminum abrasive nosing.
 7. Finish: Mill.
- D. Provide cutouts in grating for passage of piping, electrical conduit, valve stems, columns, ducts, and similar work. Where more than two bearings bars are included in a cut out, provide banding bars of same dimensions as bearing bars around opening welded to grating component parts.
- E. Gratings shall be accurately fabricated, free from warps, twists, and other defects that would affect grating appearance and grating serviceability.
- F. Welding shall conform to requirements of NAAMM MBG 533. Welds shall be ground smooth at top surfaces and bearing surfaces.
- G. Openings in and edges of gratings sections shall be banded with banding bars. Weld bands to intersecting members.
- H. Size each section of grating to weigh not more than 100 pounds, unless otherwise indicated in the Contract Documents.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine conditions under which Work is to be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

- B. Check all dimensions at the Site after piping and equipment are in place and determine exact locations of openings and cutouts.

3.2 INSTALLATION

- A. Fastening to In-Place Construction:
 - 1. Use anchorage devices and fasteners to secure aluminum grating to supporting members or prepared openings, as recommended by manufacturer.
 - 2. Weld Type 316 stainless steel stud bolts to receive saddle clip or flange block anchors to supporting steel members. Drill for machine bolts when supports are aluminum.
- B. Cutting, Fitting, and Placing:
 - 1. Perform cutting, drilling and fitting required for installation. Set the Work accurately in location, alignment and elevation, plumb, level, true, and free of rack. Do not use wedges or shimming devices.
 - 2. Where gratings are penetrated by piping, electrical conduit, ducts, structural members, or similar protrusions, cut openings neatly and accurately to size and attach banding bar as specified.
 - 3. Divide panels into sections only to extent required for installation where aluminum grating is to be installed around previously installed piping, electrical conduit, ducts, structural members, or similar protrusions.
- C. Aluminum gratings in concrete floors shall be removable and arranged in sizes to be readily lifted. Provide aluminum gratings in concrete with aluminum angle frames with mitered corners and welded joints. Grind exposed joints smooth. Frames shall have welded anchors set into concrete. Angle size shall match grating depth selected for flush fit.
- D. Clearance at ends or between sections of grating shall be a maximum of 1/4-inch.
- E. Tops of aluminum gratings shall be set flush with surrounding construction.
- F. Aluminum gratings shall be set with full and uniform end bearing on frames to preclude rocking movement; do not use wedges or similar shimming devices.
- G. Protection of Aluminum from Dissimilar Materials: Coat aluminum surfaces in contact with dissimilar materials such as concrete, masonry, steel, or other metals, in accordance with Section 09900, Painting.

+ + END OF SECTION + +

SECTION 05542

FLOOR ACCESS HATCH COVERS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install floor access hatch covers.
2. The Work also includes:
 - a. Providing openings in and attachments to floor access hatch covers to accommodate the Work under this and other Sections, and providing for floor access hatch covers items such as anchorage devices, and all items required for which provision is not specifically included under other Sections.
3. The types of floor access hatch covers include the following:
 - a. Aluminum Floor Access Hatch Covers - Channel Frame Type.
 - b. Aluminum Floor Access Hatch Covers (H-20 Loading) - Channel Frame Type.
 - c. Aluminum Floor Access Hatch Covers - Angle Frame Type.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items to be installed with or before floor access hatch covers Work.

C. Related Sections:

1. Section 09900, Painting.

1.2 REFERENCES

A. Standards referenced in this Section:

1. AASHTO Standard Specifications for Highway Bridges.
2. MIL-P-21035B, Military Specification, Paint, High Zinc Dust Content Galvanizing Repair.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Manufacturer shall have not less than five years experience producing products substantially similar to those specified and, shall be able to show

evidence of at least five satisfactory installations in place for not less than five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of the component manufacturer from a single floor access hatch covers manufacturer. Furnishing covers from more than one manufacturer is unacceptable.
2. Floor access hatch covers manufacturer shall prepare, or shall review and approve, all Shop Drawings and other submittals for all components furnished under this Section.
3. Components shall be suitable for specified service conditions and shall be integrated into the overall assembly by the floor access hatch covers manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Detailed plans and other drawings showing location of products and direction of door swing; floor access hatch cover schedules indicating cover location, material, type, loading capacity, and other information; and fabrication details for the access hatch covers Work, including materials, thickness of metals, finishes, latching or locking provisions, type of anchorages, and accessory items.
2. Product Data:
 - a. Copies of manufacturer's literature and specifications for each type of floor access hatch incorporated in the Work.

1.4 DELIVERY, STORAGE AND HANDLING

A. Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
2. Protect mill finish and other finish during shipping and installation by an attached, adhesive-backed vinyl material that is removable during and after installation of the access hatch cover.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.5 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents. The obligations of Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.
- B. Special Warranty:
 1. Provide manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove or replace structural components of the products specified in this Section found to have defect in material and workmanship during a period of five years after the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 GENERAL

- A. General:
 1. Provide manufacturer's standard fabricated access hatch cover units, modified when necessary to comply with the Contract Documents. Where standard units are not available for the sizes and types required, provide custom-fabricated units of the same quality as manufacturer's similar standard-sized units.
 2. Fabricate each access hatch cover unit in the shop, complete with anchors, gaskets, hardware, and accessory items, as required.
- B. Provide floor access hatch covers in accordance with Table 05542-A, Floor Access Hatch Covers Schedule, located after "End of Section" designation.

2.2 CHANNEL-FRAME TYPE ACCESS HATCH COVERS

- A. Aluminum Floor Access Hatch Covers – Channel Frame Type:
 1. Design Live Load: 300 pounds per square foot.
 2. Products and Manufacturers: Provide one of the following:
 - a. Single-Leaf Door Aluminum Access Hatch Cover:
 - 1) Model TPS, by U.S.F Fabrication, Inc,
 - 2) Type J-AL, by The Bilco Company,

- 3) Type BFDDPA_SAL, by Babcock-Davis,
 - 4) Type W1R, by Halliday Products, Inc.,
 - 5) Or equal.
 - b. Double-Leaf Door Stainless Steel Access Hatch Cover:
 - 1) Model APD300, by U.S.F. Fabrication, Inc.
 - 2) B-FHA Series Double Leaf, by Babcock Davis Associates, Inc.
 - 3) Or equal.
 3. Cover: Not less than 1/4-inch thick, aluminum diamond-pattern plate cover. Provide flush drop-handle for lifting the cover.
 4. Frame: Extruded aluminum channel frame with manufacturer's standard anchor tabs or continuous anchor flange around perimeter for anchorage to concrete.
 5. Drain Coupling: 1.5-inch diameter NPT threaded drain coupling welded under the channel frame for connection of a drain pipe.
 6. Gasket: EPDM gasket mechanically attached to the channel frame.
 7. Hinges: Type 316 stainless steel, heavy-duty butt hinges with Type 316 stainless steel pin fastened to door with Type 316 stainless steel tamper-resistant bolts.
 8. Latch: Type 316 stainless steel, watertight, slam-type latch with inside lever handle and outside removable exterior turn/lift handle fastened to leaf (door) with tamper-resistant Type 316 stainless steel bolts. Latch release shall be protected by a flush, gasketed, removable screw plug.
 9. Lift Assistance: Open-style stainless steel compression springs with Type 316 stainless steel guide tubes. Automatic Type 316 stainless steel hold-open arm with grip handle release.
 10. Fall-Through Prevention System: Provide access hatch cover manufacturer's standard safety grating of aluminum, constructed for live load capacity of not less than 300 psf. Provide hinges and lift-assist to allow grating sections to automatically lock in place in full-open 90-degree position. Provide hold-open arm and release assembly of aluminum or Type 316 stainless steel. Grating shall be colored OSHA "Safety Yellow" or "Safety Orange".
 11. Finish: Mill finish.
- B. Aluminum Floor Access Hatch Covers (H-20 Loading) – Channel Frame Type:
1. Design Live Load: H-20 truck loading in accordance with AASHTO Standard Specifications for Highway Bridges, intended for use in off-street locations that may occasionally be subject to H-20 wheel loads.
 2. Products and Manufacturers: Provide one of the following:
 - a. Single-Leaf Door Aluminum Access Hatch Cover:
 - 1) Model THS, by U.S.F Fabrication,
 - 2) Type J-AL H-20, by The Bilco Company,
 - 3) Type BFDDHA_SAL, by Babcock-Davis,
 - 4) Type H1R, by Halliday Products, Inc.,
 - 5) Or equal.
 3. Cover: Not less than 1/4-inch thick, aluminum diamond-pattern plate cover with stiffener plates, as required. Provide flush drop-handle for lifting the cover.

4. Frame: Extruded aluminum channel frame with manufacturer's standard anchor tabs or continuous anchor flange around the perimeter for anchorage to concrete.
5. Drain Coupling: 1.5-inch diameter NPT threaded drain coupling welded under the channel frame for connection of a drain pipe.
6. Gasket: EPDM gasket mechanically attached to the channel frame.
7. Hinges: Type 316 stainless steel, heavy-duty butt hinges with Type 316 stainless steel pin fastened to door with Type 316 stainless steel tamper resistant bolts.
8. Latch: Type 316 stainless steel, watertight, slam-type latch with inside lever handle and outside removable exterior turn/lift handle fastened to leaf (door) with tamper-resistant Type 316 stainless steel bolts. Latch release shall be protected by a flush, gasketed, removable screw plug.
9. Lift Assistance: Open-style stainless steel compression springs with Type 316 stainless steel guide tubes. Automatic Type 316 stainless steel hold-open arm with grip handle release.
10. Fall-Through Prevention System: Provide access hatch cover manufacturer's standard safety grating of FRP or aluminum, constructed for live load capacity of not less than 300 psf. Provide hinges and lift-assist to allow grating sections to automatically lock in place in full-open 90-degree position. Provide hold-open arm and release assembly of aluminum or Type 316 stainless steel. Grating shall be colored OSHA "Safety Yellow" or "Safety Orange".
11. Finish: Mill finish.

- C. Provide Schedule 40 PVC drain piping from the floor access hatch cover channel frame routed as indicated in the Contract Documents.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install floor access hatch covers in accordance with the manufacturer's instructions and recommendations and the approved Shop Drawings.
- B. Set floor access hatch covers level and true to line or grade, without warp or rack.
- C. Drain Piping for Channel Frames:
 1. Provide drain piping from the floor access hatch cover channel frame routed as shown or indicated on the Drawings.

2. After installation, fill drain piping with water. Drain piping shall be free of visible leaks.

- D. Protection of Aluminum from Dissimilar Materials: Coat surfaces of aluminum in contact with dissimilar materials such as concrete, masonry, steel, and other metals in accordance with Section 09900, Painting.

3.3 ADJUSTING AND CLEANING

- A. Adjust leafs of floor access hatch covers as necessary to provide proper operations.
- B. Remove stains, concrete splatter, oils, grease, and other foreign materials necessary and provide clean, finished surfaces.

3.4 SCHEDULE

- A. Schedules listed below, following the “End of Section” designation, are part of this Specification section.
 1. Table 05542-A, Floor Access Hatch Schedule

+ + END OF SECTION + +

TABLE 05542-A, FLOOR ACCESS HATCH SCHEDULE

HATCH ID	BUILDING	FLOOR ELEVATION	CLEAR OPENING		MATERIAL	WITH RAILINGS OR CHAIN	LOADING	SINGLE LEAF/DOUBLE LEAF	REMARKS
			WIDTH	LENGTH					
EQH-1, 2, 3	Grinder Chamber	9.89'	3'-0"	4'-6"	AL	(C)	300 PSF	Single	Grinder Equipment Access
EQH-4, 7, 8	Wet Well	9.89'	8'-0"	5'-6"	AL	(C)	300 PSF	Single	Equipment Access
EQH-5, 6, 9	Wet Well	9.89'	5'-0"	4'-0"	AL	(C)	300 PSF	Single	Equipment Access
EQH-10, 13, 14	Valve Pit	9.89'	8'-0"	4'-0"	AL	(C)	300 PSF	Double	Valve Access
EQH-11, 12, 15	Valve Pit	9.89'	5'-7"	3'-0"	AL	(C)	300 PSF	Single	Valve Access
EQH-16	Valve Pit	9.89'	8'-6"	6'-0"	AL	(C)	300 PSF	Single	Stair Access
EQH-17	Pigging Station	9.00	4'-0"	6'-0"	AL	(C)	H-20	Single	Equipment Access
EQH-18	Grinder Chamber	9.89'	8'-0"	4'-0"	AL	(C)	300 PSF	Double	Cleaning Access

EQH-19	Equalization Tank Forebay	9.89'	4'-0"	4'-0"	AL	(C)	300 PSF	Single	Cleaning Access
EQH-20, 21	Equalization Tank	9.89'	8'-0"	4'-0"	AL	(C)	300 PSF	Double	Cleaning Access
EQH-22, 23	Equalization Tank	9.89'	4'-0"	4'-0"	AL	(C)	300 PSF	Single	Cleaning Access
EQH-24, 25	Wet Well	9.89'	4'-0"	4'-0"	AL	(C)	300 PSF	Single	Pump/Cable Removal
EQH-26, 27	Wet Well	9.89'	4'-0"	4'-0"	AL	(C)	300 PSF	Single	Equipment/Inspection/Cleaning Access
EQH-28	Flowmeter Vault	9.89'	5'-0"	5'-0"	AL	(C)	300 PSF	Single	Equipment Access
EQH-29	Flowmeter Vault	9.89'	4'-0"	4'-0"	AL	(C)	300 PSF	Single	Personnel Access

SECTION 05561

METAL CASTINGS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install metal castings.
 - 2. Castings include metal items that are not part of miscellaneous metal fabrications or metal systems in other Specifications Sections.
 - 3. Castings for electrical manholes are specified in Section 16134, Electric Manholes.
- B. Castings shall be for the following types of construction:
 - 1. Manhole frames with covers.
 - 2. Trench frames with grated lids.
- C. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items to be installed with, or before, the metal castings Work.
- D. Related Sections:
 - 1. Section 05501, Miscellaneous Metal Fabrications.
 - 2. Section 16134, Electric Manholes.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ASTM A48/A48M, Standard Specification for Gray Iron Castings.
 - 2. AASHTO M105, Standard Specification for Gray Iron Castings.
 - 3. AASHTO M306, Standard Specification for Drainage, Sewer, Utility, and Related Castings.
 - 4. Iron Casting Handbook, American Foundry Society, Inc.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Shall have at least five years experience manufacturing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

- B. Shop Assembly:
 - 1. Preassemble items in the shop to the greatest extent possible, to minimize field splicing and assembly of units at the Site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of component manufacturer, from a single castings manufacturer.
 - 2. Obtain all hydrostatic pressure relief valve products included in this Section regardless of component manufacturer, from a single castings manufacturer.
 - 3. Castings manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 4. Components shall be constructed for specified service conditions and shall be integrated into overall assembly by castings manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Fabrication and installation of all casting assemblies. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.
 - 2. Product Data:
 - a. Copies of manufacturer's catalog information for the products proposed for use, specifications, load tables, dimension diagrams, anchor details, and installation instructions.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Furnish certification, signed by authorized officer of Contractor and notarized, stating that all components are furnished by the same manufacturer.
 - b. Manufacturer's certification that the casting or lot of castings was made, sampled, tested and inspected in accordance with ASTM A48, AASHTO M105, and conforms to AASHTO M306.
 - 2. Qualifications Statements: Submit qualifications for the following:
 - a. Manufacturer, when required by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:

1. Deliver products to the Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
- B. Storage and Protection:
 1. Protect materials from corrosion and deterioration.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Material: ASTM A 48/A 48M, Class 35B.
- B. Type-1 Casting: Raised Round Sanitary Manhole Frame with Vented Lid:
 1. Products and Manufacturers: Provide one of the following:
 - a. R-1697, manufactured by Neenah Foundry Company.
 - b. 00220513 with 00220523, manufactured by EJ USA, Inc.
 - c. Or equal.
- C. Type-2 Casting: Raised Round Storm Manhole Frame with Vented Lid:
 1. Products and Manufacturers: Provide one of the following:
 - a. R-1697, manufactured by Neenah Foundry Company.
 - b. 00220513 with 00220527, manufactured by EJ USA, Inc.
 - c. Or equal.
- D. Round Slab-Type Manhole Frame with Vented Lid – Flush Top:
 1. Type-3 Casting
 - a. Products and Manufacturers: Provide one of the following with venting:
 - 1) R-6060, manufactured by Neenah Foundry Company.
 - 2) 00162521, manufactured by EJ USA, Inc.
 - 3) Or equal.
 2. Type-4 Casting
 - a. Products and Manufacturers: Provide one of the following with venting:
 - 1) R-6095, manufactured by Neenah Foundry Company.
 - 2) 00158260, manufactured by EJ USA, Inc.
 - 3) Or equal.

- E. Heavy-Duty H-20 Trench Frame with Grated Lid:
 - 1. Type-5 Casting
 - a. Products and Manufacturers: Provide one of the following:
 - 1) 6" Wide NDS Dura Slope Grate, manufactured by NDS.
 - 2) 00695541, manufactured by EJ USA, Inc.
 - 3) Or equal.

2.2 MANUFACTURE

- A. Manufacture, General:
 - 1. Castings shall be of uniform quality, free from sand holes, gas holes, shrinkage cracks, and other surface defects.
 - 2. Repairs by welding or plugging are not allowed. Castings shall be ground smooth and well-cleaned by shot blasting.
 - 3. Traffic bearing round covers, grates and frames shall be provided with machined bearing surfaces with such precision to prevent rocking.
 - 4. As-cast dimensions may vary within accepted foundry tolerances as outlined in the Iron Casting Handbook published by the American Foundry Society, Inc. Nominally, casting dimensional tolerances shall be +/- 1/16" per foot.
 - 5. All published castings weights may vary +/- 5%. Castings shall be provided without coatings, unless otherwise specified.
 - 6. All covers shall have text permanently cast onto the product, Frames and covers shall have the producing foundry's name, ASTM material designation, individual part number, country of origin preceded by "Made in" (example: MADE IN USA) and production date. Castings shall include all lettering shown or indicated on the Drawings.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which Work is to be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Comply with casting manufacturer's printed instructions and the Contract Documents. Where castings are installed on precast concrete, fabricated fiberglass, or other fabricated products, install casting in accordance with requirements of manufacturer of product on which casting will be installed.
- B. Set castings accurately to required location, alignment, and elevation, plumb, level, true and free of rack, measured from established lines and levels. Where applicable, brace temporarily or anchor temporarily in formwork.

++ END OF SECTION ++

NO TEXT ON THIS PAGE

SECTION 05601

ALUMINUM STOP LOGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, material, equipment and incidentals as shown, specified and required to furnish and install aluminum stop log planks with appurtenant seals, guides, frame, lifting lugs and accessories in accordance with the details shown, and as specified herein.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the aluminum stop logs Work.
2. Notify other contractors in advance of the installation of the aluminum stop logs to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the aluminum stop logs Work.

C. Related Sections:

1. Section 03300, Cast-In-Place Concrete.
2. Section 05501, Miscellaneous Metal Fabrications.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 276, Specification for Stainless Steel Bars and Shapes.
 - b. ASTM B 308/B 308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
 - c. ASTM D 2000, Classification System for Rubber Products in Automotive Applications.
2. American Welding Society, (AWS).
 - a. AWS D1.2/D1.2M, Structural Welding Code - Aluminum.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of five years experience producing substantially similar products and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of the component manufacturer from a single aluminum stop logs manufacturer.
2. The aluminum stop logs manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the aluminum stop logs manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following

1. Shop Drawings:
 - a. Detailed dimensional drawings, including calculations for sizing guides.
 - b. Assembly and installation drawings.
 - c. Location and details of stop log plank storage facilities.
2. Product Data:
 - a. Design calculations and supporting data for all log planks showing stresses, loads and deflection for critical parts under design head conditions.
 - b. Material certification and specifications.

B. Informational Submittals: Submit the following

1. Site Quality Control Submittals:
 - a. Submit a written report giving the results of the field tests required.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 JOB CONDITIONS

- A. CONTRACTOR shall examine the locations of the stop log planks to verify all pertinent dimensions prior to fabrication of the stop log planks.
- B. CONTRACTOR shall have full responsibility for the proper fit of the furnished stop log planks at the locations designated on the Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. The stop log planks shall not deflect more than 1/360 of the span of the plank under the design head shown or specified.
- B. The stop log planks shall be designed for flow in either direction and seals shall be provided for this condition.
- C. Manufacturer maximum guaranteed leakage shall be 0.05 gallons per minute per linear foot of wetted seal length.
- D. All component parts shall be protected from dissimilar metals.

2.2 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:
 - 1. Aluminum Stop Log, as manufactured by Rodney Hunt Company.
 - 2. Aluminum Stop Log, as manufactured by Whipps, Inc.
 - 3. Or equal.

2.3 MATERIALS OF CONSTRUCTION

- A. Stop log planks, lifting lugs, frame and appurtenances shall conform to the requirements of ASTM B 308/B 308M and to aluminum alloy and temper AA-6061-T6 provided with a mill finish.
- B. Lip type seals shall be extruded neoprene conforming to ASTM D 2000, Grade 2BC515, Durometer 50±5. Bottom seals shall be extruded neoprene conforming to ASTM D 2000, Grade AA625.
- C. Guides, anchor bolts and miscellaneous hardware and lifting devices shall be of Type 316 stainless steel conforming to ASTM A 276.

2.4 STOP LOG PLANKS

- A. Stop log planks shall be fabricated of aluminum plate reinforced with extruded or structural aluminum horizontal and vertical members.
- B. End caps will not be allowed on the stop log planks. Planks shall be of sufficient weight to be submerged under their own weight.
- C. Provide two lifting lugs for each stop log plank. Lifting lugs shall be capable of withstanding the lifting load necessary to remove the stop log plank under the design head.

2.5 LIP TYPE SEALS

- A. Each stop log plank shall be provided with uninterrupted seals along the bottom of the plank and up both sides. The seals shall be attached to the plank with Type 316 stainless steel bars and fasteners.
- B. The shape of the seal shall provide a seating surface having a minimum width of 1-inch. The vertical face of the seal shall be in contact with the seating surface of the guide or seal located on the frame to provide a proper seal at the corners.
- C. The bottom of the plank shall seal flush with the invert of the finished concrete channel or the stainless steel guide, as shown.

2.6 GUIDES

- A. Guides and all necessary attaching bolts and anchor bolts shall be furnished by the stop log plank manufacturer.
- B. Guides shall not be less than 1/4-inch thick.

2.7 LIFTING DEVICE

- A. Provide lifting devices to remove and install the stop log planks as specified herein. One lifting device shall be provided for each stop log width. The lifting devices shall be extendible so that they will function with different stop log plank lengths.
- B. The lifting device shall be equipped with a suitable eyebolt for portable crane operation. The device shall be oriented in its position by the stop log plank guides and shall be capable of securing and releasing the stop logs with the use of a lanyard from the operating floor.

2.8 WELDING

- A. All welding shall be performed in accordance with AWS D1.2/D1.2M for aluminum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide number, size and location of stop log planks, guides and lifting devices as shown or specified.
- B. Guides shall not be installed in the formwork and cast in the concrete. A groove shall be formed in the concrete and the guide shall be grouted into the groove.
- C. Protection from Dissimilar Materials:
 - 1. Coat all surfaces of aluminum in contact with dissimilar materials, such as concrete, masonry and steel, as specified in Section 09900.01, Painting.
 - 2. Do not extend coating beyond contact surfaces. Remove coating where exposed-to-view in the finished Work.

3.2 TESTING OF STOP LOG PLANKS

- A. CONTRACTOR shall demonstrate, using a stop log puller and lifting device, the ease of installation, removal and the proper fit of the stop log planks at the locations of use in the presence of and to the satisfaction of ENGINEER.
- B. Each stop log plank installation shall be tested for conformance to manufacturer's maximum guaranteed leakage.
- C. Any stop log planks that bind, do not fit or do not meet leakage limits shall be repaired and retested, at no additional cost to the OWNER.

3.3 STOP LOG PLANK STORAGE

- A. CONTRACTOR shall fabricate and install brackets, chains, angles, etc., on handrail or exterior/interior walls, as shown or as directed and approved by ENGINEER for storage of the planks.
- B. Storage brackets and stop log planks shall not overstress the structure to which they are attached.
- C. Bracket, chain, angles and hardware shall be of Type 316 stainless steel.

+ + END OF SECTION + +

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SECTION 07191

SILANE WATER REPELLENTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install silane water repellents.
2. Extent of surface-applied silane water repellents includes all exterior concrete.
3. Types of silane water repellents required include:
 - a. Liquid, colorless, non-gloss-producing, VOC-compliant, applied water repellent.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before silane water repellants Work.
2. Coordinate water repellent provided with sealant. Water repellent and sealant shall be compatible with each other.

C. Related Sections:

1. Section 03300 – Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Water repellent applicator shall be acceptable to or licensed by water repellent manufacturer and shall be regularly-engaged in installing water repellent products and work similar to the Work required under this Section.

B. Component Supply and Compatibility:

1. Provide all water repellents of each type required produced by one manufacturer.

C. Regulatory Requirements:

1. VOC emissions from water repellent materials shall not exceed 400 g/l.

D. Mock-up:

1. Prior to installing materials required under this Section, apply silane water repellent to area acceptable to ENGINEER.
2. Mock-up shall indicate, relative to silane water repellents, proposed range of color change, surface sheen, and workmanship to be expected in the completed

- Work. Obtain ENGINEER's approval of visual qualities of mock-up before starting unit masonry construction and silane water repellants Work.
3. Provide as many mock-up panels as required to obtain ENGINEER's approval.
 4. Water repellent application that does not comply with standards approved on mock-up panels shall be removed and reapplied to comply with the Contract Documents.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Product Data:
 - a. Manufacturer's literature and specifications on products proposed for use. Indicate VOC emissions of materials.
 - b. Detailed chemical analysis and test results of previously-performed tests of materials required under this Section applied to surfaces identical to, or similar to, those to which silane water repellants will be applied for the Project.
- B. Informational Submittals: Submit the following:
1. Certificates:
 - a. Manufacturer's certification indicating silane water repellent complies with or exceeds requirements of the Contract Documents.
 2. Supplier's Instructions:
 - a. Manufacturer's instructions for handling, storing, and shelf-life.
 - b. Manufacturer's instructions for methods and application procedures.
 3. Qualifications Statements:
 - a. Installer: Submit copy of manufacturer's acceptance of installer and installer's record of experience in work similar to that required under this Section.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions for handling, storing, and shelf-life.

1.5 SITE CONDITIONS

- A. Environmental Conditions for Installation:
1. Comply with manufacturer's installation instructions regarding required temperature of surface to which material is applied.
 2. Do not apply water repellent when ambient air temperature is lower than 50 degrees F.
 3. Do apply materials when ice or frost covers the substrate.
 4. Do apply materials when ambient temperature of surface exceeds 100 degrees F.
 5. Do apply materials in rainy conditions or when heavy rain is expected with four hours after application.

6. Maintain ambient temperature above 20 degrees F during 24 hours after installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:
 1. Protectosil Chem-Trete BSM 400, by Evonik Degussa Corporation.
 2. Prime-A-Pell Plus Series V662, by Tnemec Company, Inc.
 3. Or equal.

2.2 MATERIALS

- A. Chemical Bonding Water Repellants Without Silicone Resin:
 1. Provide silane solution, with or without diffused quartz carbide; colorless, and VOC-compliant.
 2. When dry, water repellant shall be colorless and without gloss.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine under which the Work will be performed. Notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Verify that surfaces to receive water-repellent are clean, and free of efflorescence, stains, oil, grease, and other foreign matter detrimental to application.
- C. Verify that required sealants have been installed in areas to receive water repellant.

3.2 PREPARATION

- A. Protection of Adjacent Surfaces:
 1. Protect adjacent surfaces that will not receive silane water repellents. When applied or splashed onto surfaces not required to receive water repellents, remove immediately, using method recommended by water repellant manufacturer. Maintain cleaning materials available at the Site for immediate use.
- B. Surface Preparation:
 1. Remove loose particles and foreign matter. Remove grease and oil using solvent, effective alkaline cleaner, or detergent as instructed by water repellant manufacturer. Scrub surfaces with water.

2. Surfaces shall be dry prior to applying water repellant.

3.3 APPLICATION

- A. Provide water repellants in accordance with water repellant manufacturer's instructions and recommendations.
- B. Apply in two continuous, uniform coats as recommended by water repellant manufacturer. Allow to dry between coats as recommended by water repellant manufacturer.
- C. Protect materials in vicinity of application. During windy conditions, do not apply water repellant by spraying. When plants and other flora receive water repellant coating, immediately remove water repellant from plants and flora by washing.

3.4 FIELD QUALITY CONTROL

- A. Site Tests:
 1. Spray Test: After water repellent has dried, spray with water the surfaces to which water repellant was applied. After surfaces have adequately dried, inspect for signs of water adsorption in presents of ENGINEER, and reapply water repellant to areas that indicate water absorption.

3.5 SCHEDULE

- A. Apply silane repellant where indicated. Coordinate with section 03300, Cast-In-Place Concrete.
 1. New Concrete Surfaces:
 - a. Valve Pit, Wet Wells, Equalization Tanks, Grinder Chamber – All new, exterior, exposed concrete surfaces, except for the undersides of slabs.
 - b. Electrical Building Platform – All new, exterior, exposed concrete surfaces, except for the undersides of slabs and beams.
 - c. Generator Platform – All new exposed concrete surfaces, except for the undersides of slabs and beams.

+ + END OF SECTION + +

SECTION 07421

METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install metal wall panel. The Work also includes:
 - a. Provide structural metal framing supporting metal wall panels and accessories. Provide structural metal framing design by a licensed Structural Engineer in the State of New York.
 - b. Providing openings in preformed metal panels to accommodate the Work under this and other Sections and building into the preformed metal panels all items such as sleeves, inserts and all other items to be embedded in metal wall panel for which placement is not specifically provided under other Sections.
 - 2. Extent of each type of metal wall panel is shown.
 - a. Scope includes 2" insulated metal wall panels underneath the slab and beams of the Electrical Building Platform.
 - b. Scope of this specification does not include the insulated metal wall panels and the insulated, standing-seam, metal roof panels on the exterior of the Electrical Building.
 - 3. Types of products required include the following:
 - a. Insulated metal wall panels with structural framing.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or embedded in, the metal wall panel.
 - 2. Notify other trades in advance of the installation of the metal wall panel to provide them with sufficient time for the installation of their work that must be installed with, or before, the metal wall panel.
- C. Related Sections:
 - 1. Section 07920 – Joint Sealants.

1.2 REFERENCES

- A. American society of Civil Engineers, (ASCE).
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

- B. American Society for Testing and Materials, (ASTM).
 - 1. ASTM A 653, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 666, Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
 - 3. ASTM B 117, Practice for Operating Salt Spray (FOG) Apparatus.
 - 4. ASTM B 633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 5. ASTM C 36, Specification for Gypsum Wallboard.
 - 6. ASTM C 423, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 7. ASTM C 442, Specification for Gypsum Backing Board and Coreboard.
 - 8. ASTM C 518, Test Method for Steady-State Thermal Transmission Properties by Means of Heat Flow Meter Apparatus.
 - 9. ASTM C 991, Specification for Flexible Fibrous Glass Insulation for Metal Buildings.
 - 10. ASTM D 522, Test Methods for Mandrel Bend Test of Attached Organic Coatings.
 - 11. ASTM D 523, Test Method for Specular Gloss.
 - 12. ASTM D 968, Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
 - 13. ASTM D 1308, Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
 - 14. ASTM D 2244, Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
 - 15. ASTM D 2247, Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - 16. ASTM D 3363, Test Method for Film Hardness by Pencil Test.
 - 17. ASTM D 4213, Test Method for Scrub Resistance of Paints by Abrasion Weight Loss.
 - 18. ASTM E 72, Test Methods of Conducting Strength Tests of Panels for Building Construction.
 - 19. ASTM E 84, Method for Surface Burning Characteristics of Building Materials.
 - 20. ASTM E 96, Test Methods for Water Vapor Transmission of Materials.
 - 21. ASTM E 119, Test Methods for Fire Tests of Building Construction and Materials.
 - 22. ASTM E 283, Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure

- Differences Across the Specimen.
 - 23. ASTM E 488, Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 - 24. ASTM F 593, Specification of Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 25. ASTM F 594, Specification for Stainless Steel Nuts.
- C. Underwriters Laboratories, Incorporated, (UL).
- 1. UL, Fire Resistance Index.

1.3 SUBMITTALS

- A. Samples: Submit the following:
- 1. Samples of each type of metal wall panels and trim complete with factory-applied finish, two foot long by full-width. Samples will be reviewed by Engineer for pattern, texture and color only. Compliance with other requirements is the exclusive responsibility of Contractor.
 - 2. One of each type fastener employed, with statement of intended use. Samples will be reviewed by Engineer for material and color only. Compliance with other requirements is the exclusive responsibility of Contractor.
 - 3. Complete selection of manufacturer's standard and custom colors matching Owner's sample.
- B. Shop Drawings: Submit the following:
- 1. Copies of manufacturer's specifications, standard and custom detail drawings and installation instructions for preformed prefinished metal panels, supports and trim. Submit manufacturer's standard fifteen warranty on factory-applied finish of preformed metal roofing panel.
 - 2. Profiles of preformed prefinished roofing panel units, and the details of forming, jointing, gaskets (if any), supports, anchorages, trim, flashing, and accessories. Show details of weatherproofing at edges, terminations and penetrations of the preformed prefinished roof panel Work. Show 1/4-inch to the foot scale layout and elevations of entire Work. Show all details at 3-inch to the foot scale, indicating all internal components and intersection members, details and special fabrication techniques.
 - 3. Complete selection of manufacturer's standard and custom colors.
 - 4. Installer's qualifications.
- C. Submit design computations signed and sealed by a Registered Professional Structural Engineer licensed in the State of New York to verify structural adequacy of members, support framing and connections, for review with Shop Drawings.

- D. Test Reports: Submit for approval certified laboratory tests reports for required performance tests:
1. Air Infiltration: ASTM E 283.
 2. Water Infiltration: ASTM E 331.
 3. Wind Uplift: UL-90 rated wind up-lift resistance requirement specified in UL 580 test.
 4. Formability: ASTM D 522.
 5. Weathering: ASTM G 152, ASTM G 153, and ASTM G 155.
 6. Chalking Resistance: ASTM D 4214.
 7. Color Change: ASTM D 2244.
 8. Salt Spray: ASTM B 117.
 9. Abrasion: ASTM D 968.
 10. Humidity: ASTM D 2247.
- E. Certification: Submit for approval written certification prepared, signed and sealed by a Registered Professional Structural Engineer, licensed in the State of New York, verifying that the design meets indicated loading requirements and codes of authorities having jurisdiction.
1. Provide written certification to the Engineer from the coil manufacturer verifying that the coil to be used for on-site roll forming is compatible with the roll forming machinery that will be used.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide coil finish applicator experienced in the handling and application of polyvinylidene coatings acceptable to the manufacturer of the coating.
- B. Installer Qualifications: Engage a single installer regularly engaged in metal wall panel installation and with successful and documented experience in the erection of metal wall panel of the scope and type of Work required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
1. Names and telephone numbers of owners, architects or engineers responsible for projects.
 2. Approximate contract cost of the metal wall panel.
 3. Amount of area installed.
- C. Testing Agency Qualifications: To qualify for approval, an independent testing agency shall demonstrate to Engineer's satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

- D. Mock-ups:
1. Prior to the installation of metal wall panels and accessories, but after Engineer's approval of samples, install sample of each type of metal wall panels in areas selected by Engineer to show a representative installation of the metal wall panels. Obtain Engineer's acceptance of visual qualities of the mock-up before start of metal wall panel Work. Retain and protect mock-up during construction as a standard for judging completed metal wall panel Work. Do not alter mock-ups.
 2. Metal wall panel Work that does not meet the standard approved on the mock-up areas shall be removed and replaced with new material.
- E. Source Quality Control: Obtain all metal wall panel and accessories from the same manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials:
1. Deliver metal wall panels and all accessories dry and undamaged, with manufacturer's protective coating intact.
 2. Deliver metal wall panel in bundles with banded wood surrounds and end caps intact.
- B. Storage of Materials:
1. Store metal wall panel and accessory materials in a manner that will protect strippable coating from exposure to sun and condensation; with good air circulation around each piece.
 2. Store metal wall panel and accessory materials in an area protected from dirt, damage and weather.
 3. Do not store in contact with concrete or other materials that might cause corrosion.
- C. Handling of Materials:
1. Do not subject metal wall panel and accessory materials to bending or stress.
 2. Do not damage edges or handle material in a manner that will cause scratches, warps or dents.

1.6 JOB CONDITIONS

- A. Conform to applicable OSHA and the New York State Building Codes.

1.7 WARRANTY

- A. The manufacturer shall warranty for a period of one year that the wall system

materials will be free from defects.

- B. Provide manufacturer's twenty-year warranty on the coil coated polyvinylidene fluoride based coating specified.
- C. Guarantee that the polyvinylidene fluoride based coating meets all criteria specified and will not spall, check, craze, peel or otherwise lose adhesion for a period of twenty years from the date of installation, to the extent that such shall create unsightly conditions or otherwise impair the intended architectural qualities of the building.
- D. In the event that the coil coated polyvinylidene fluoride based coating fails to meet the specified requirements the manufacturer shall, at their own expense, replace or field paint, at the direction of Engineer, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.
- E. The warranty specified shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- F. The warranty does not apply where failure is caused by accidents, or external conditions or forces beyond the control of the manufacturer.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. System Description:
 - 1. Metal wall panel shall include a complete system of field-assembled components including exterior wall panels, structural framing, and subgirts finished as specified and capable of structurally spanning between support framing or girts shown. The complete system shall also include all fascias, spandrel panels, soffits, cap flashings, custom transition flashings and similar custom flashings, fasteners, extensions of the Work for interior uses, and all associated trim, closures and accessories.
 - 2. The complete system shall provide all system performance criteria specified.
- B. Performance Criteria:
 - 1. Panels and secondary support systems shall be designed for component and cladding wind loads determined in accordance with the more stringent

of the 2020 IBC, local building code or ASCE 7, latest edition, for the parameters specified.

- a. Building Category, III,
 - b. Wind Importance Factor, $I=1.00$.
 - c. Wind Exposure Category, C.
 - d. Wind Speed = 134 MPH.
 - e. Wind Pressure = 50 PSF.
 - f. Internal Pressure Coefficient, $GC_{pi} = \pm 0.18$
2. Secondary supports for the wall system shall be designed in accordance with AISC or Aluminum Association design procedures. Through-tube support systems shall be designed and installed only by the manufacturer and certified wall systems contractor.
- a. Secondary supports shall not vary from the theoretical plane by more than the specified tolerances. (Note: These are more stringent than AISC or ACI tolerances to ensure optimal appearance and performance of the wall system.)
 - 1) 1/4 inch in any 20-foot length vertically or horizontally.
 - 2) 1/2 inch in any building elevation.
 - 3) 1/8 inch within 5 feet of any change in plane such as corners.
 - 4) soffits.
3. The wall system or secondary supports shall be designed to allow differential movement of the buildings roof and floor structures. (Note: Movement of roof and/or floor systems exceeding 1/4" shall require the use of thru tube supports with sliding connections.)
4. Performance of the wall system shall be verifiable with tests witnessed or conducted by independent agencies.
- a. Structural performance of the wall panels shall be derived from ASTM E72 Chamber Method with a deflection limit of $L/180$ applied to positive load. Ultimate structural values shall be achieved without the use of backside mechanical attachments to the structure.
 - b. There shall be no evidence of delamination of the wall panels after two million cycles of positive and negative $L/180$ deflection.
 - c. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction.
 - d. Pressure Equalized Rain Screen Performance Water Penetration: PASS AAMA 508 with a 15 psf pressure difference with a imperfect air and water barrier, in accordance with the following:
 - 1) Test rain screen performance utilizing ventilation areas of minimum 7 square inch per 10 feet of horizontal joint, with a cavity volume to vent area ratio of between 10 and 50,

- with sealed vertical joints in the rain screen panel.
- 2) Install test air/moisture barrier meeting air infiltration performances of 0.04 cfm per square foot at a pressure differential of 1.57 psf when tested per ASTM E283. Locate test air/moisture barrier maximum 3-inches behind rain screen.
- e. Fire Rating, ASTM E 119: Non-combustible.

2.2 MATERIALS

- A. Aluminum Sheet: Smooth surface coil-coated sheet, ASTM B209, 5052 H2 Aluminum alloy.
- B. Aluminum Extrusions: ASTM B221, 6063 TS Aluminum.
- C. Panel Core: Thermo-set polymeric core, fire retardant per ASTM E84, with plane-spread index of 25 or less and smoke develop index at 450 or less.
- D. Secondary Metal Framing:
 - 1. Miscellaneous Framing Components, General: Cold-formed metallic coated steel sheet, ASTM C645, Grade 50, with ASTM A 653/A 653M, G90 hot-dip galvanized zinc coating.
 - a. 0.053-inch/16 ga. Minimum.
 - b. Sill Channels: 0.053-inch/16 ga. Minimum.
- E. Flashing and Trim: Provide flashings and sheet metal contour closure trim components, indicated as part of the metal wall panel Work, including cap flashings, fascias, sills, corner units, surrounds at openings, soffits, jamb trim, seam covers, battens, gutters, accent/shadow/graphic bars, and similar components of the Work. Except as otherwise shown or specified, match the material, gage, and finish of the exterior panels.
- F. Miscellaneous Materials:
 - 1. Provide manufacturer's standard 1/4-inch diameter, stainless steel, self-tapping concealed fasteners and stainless steel brackets, clips, anchoring devices and other components needed for a complete, permanently weatherproof installation. Provide stainless steel complying with ASTM A 666.
 - 2. Provide manufacturer's standard exposed 1/4-inch diameter, stainless steel, self-tapping fasteners, and other components needed for a complete, permanently weatherproof installation, finished to match the color of the substrate. Provide stainless steel complying with ASTM A 666.
 - 3. Sealant: Provide manufacturer's standard elastomeric sealant for use within this Section of the Work.

2.3 METAL WALL PANEL FABRICATION

- A. General:
 - 1. Comply with the dimensions, profile limitations, gages and fabrication details shown.
 - 2. Prefabricate all components of the system at the factory, ready for field assembly of exterior panels, liner panels, trim and accessories.
 - 3. Fabricate components and assemble units to comply with the system performance requirements specified for the completed installation of the Work.
 - 4. Products and Manufacturers: Provide one of the following:
 - a. 2" Thick, 24" wide, Smooth, Formawall Dimension Series FWDS by Centria.
 - b. 2" Thick, 24" wide, Smooth, CF Architectural - Horizontal by MBCI.
 - c. Or Approved Equal.
- B. Composite Metal Panels: Factory-formed, aluminum-faced composite panels fabricated from two sheets of 0.032-inch thick aluminum facing sheets with metal facings bonded to reaction injected polymeric core, with integral reveal and rout and return joinery.
 - 1. Thickness: 6 mm. nominal.
 - 2. Panel Flatness: Maximum allowable distortion: 1/32-inch in 24-inches in any direction.
 - 3. Horizontal Joints: Pressure-equalized.
 - a. Horizontal joints shall be 24-inches on center unless otherwise noted.
 - 4. Vertical Joints: Preformed returns with gasket and aluminum extrusions receptors and seal plates.
 - 5. Stiffeners: Manufacturer's standard stiffener as required to meet performance requirements.
 - 6. Face sheet surface: smooth
 - 7. Unexposed Surface Finish: Manufacturer's standard primer.
 - 8. Exposed Trim and Fastener Finish: match panel finish, refer to Section 2.5.

2.4 TRIM

- A. Extruded trim shall be furnished by the metal wall panel manufacturer. Installation shall be by the certified wall systems contractor except for those that require completion of work by roofing trades such as gravel stops.
 - 1. Provide base trim, coping, Panel installation perimeter, and opening perimeter necessities.

2. Gaskets: Panel manufacturer's EPDM or neoprene, fire retardant-treated.
 3. Flashing Tape: 4-inch wide self-adhering butyl flashing tape.
 4. Sealants: Refer to Section 07920.
- B. Extrusion material shall be 6063-T5 aluminum.
- C. All exposed extrusion areas shall be finished. Finish shall match metal wall panel.

2.5 METAL WALL PANEL COATINGS

- A. Concealed Aluminum Coating: On internal surfaces of metal wall panel, where coatings will be concealed from either exterior or interior view, provide metal siding manufacturer's standard rust-inhibitive coating. After proper cleaning, pretreatment and conversion coating, apply one coat of rust-inhibitive metal primer and one coat of metal enamel, 1.0 mil dry film thickness.
- B. Exposed Aluminum Coating (Exposed to either interior or exterior view): Apply full strength polyvinylidene fluoride based coatings at the factory by coil coating for sheet material and spray coating for extruded or factory-fabricated material. Provide the following four coat finish system complying with the following:
1. Alkali clean and hot water rinse all surfaces to receive polyvinylidene fluoride based finish.
 2. Prepare a chemical conversion coating on the surface, using phosphates or chromates followed by a cold water rinse. Seal with a chromic acid rinse and dry, except where manufacturer recommends another method to achieve greater coating reliability.
 3. Apply a base prime coat of epoxy paint to the prepared surface in its coil form, by reverse roller coating. Fully cure in a gas-fired oven to a dry film thickness of 0.2 to 0.4-mils. Follow with a barrier coat, 0.75 to 1.0-mil thick.
 4. Apply color coat containing mica pearlescent or metallic flakes over the barrier coat by roller coating for coil material and airless or Ransburg Elastostatic Hand Spray for extrusions and fuse at a peak metal temperature of 440°F. Apply to a dry film thickness of 0.7 mils for coil coating and 1.2 mils for spray coating so that the total dry film is approximately 1.0 mil thick for coil material and 1.5 mils thick for extruded material.
 5. Apply clear fluoropolymer top coat to provide a dry film thickness of 0.4 to 0.8 mils. The entire four coat system shall have a dry film thickness of 2.6 mils, minimum.
 6. Provide the following physical properties, as proven by the following laboratory test methods acceptable to Engineer:
 - a. Weathering, ASTM D 4214: Chalking, not more than No. 8, after exposure for 5000 hours in Sunshine Arc Weatherometer XWR

- using 60/60 cycle.
 - b. Color Change, ASTM D 2244: No greater than 5 N.B.S. units after removal of external deposits and after exposure for 5000 hours in Sunshine Arc Weatherometer XWR using 60/60 cycle.
 - c. Humidity Resistance, ASTM D 2247: No blisters after 3000 hours.
 - d. Salt Spray, ASTM B 117: Few scattered blisters no larger than ASTM No. 4, and no more than 1/16-inch creep from areas scribed to bare metal after 3000 hours.
 - e. Dry Adhesion: No pick-off when tape tested over 1/16-inch cross hatch.
 - f. Wet Adhesion: No pick-off when tape tested over 1/16-inch cross hatch; extruded material only.
 - g. Boiling Water Adhesion: No pick-off when tape tested over cross hatch area after one hour immersion in distilled boiling water.
 - h. Water Immersion: No pick-off when tape tested over cross hatch area after immersion in aerated distilled water $80 \pm 10^{\circ}\text{F}$ after 500 hours.
 - i. Abrasion Resistance, ASTM D 968: Coefficient of abrasion of 67, minimum.
 - j. Gloss, ASTM D 523: 30 ± 5 reflectivity at 60°F .
 - k. Pencil Hardness, ASTM D 3363: HB-H minimum.
 - l. Dry Film Thickness, ASTM D 3363: Primer, 0.2 to 0.4 mils; barrier coat, 1.0 mils; color coating, 0.7 to 1.5 mils; clear topcoat, 0.4 to 0.8 mils.
 - m. Solvent Resistance: 100 Double MEK rubs minimum.
 - n. Flexibility, ASTM D 522: No cracking prior to metal fracture.
 - o. Acid Resistance, ASTM D 1308: 16 hour spot test with 5 percent hydrochloric acid - no effect.
 - p. Alkali Resistance, ASTM D 1308: 16 hour spot test with 5 percent sodium hydroxide - no effect.
- C. Colors: Provide the following:
- 1. Full selection of manufacturer's standard, custom and premium colors for final selection by Engineer.
 - 2. Color coating of panels already fabricated into panel profiles shall not be permitted.
- D. Protective Coating: Immediately upon completion of the metal wall panel finish, apply a transparent, color-coded, strippable-film coating, not less than 1.0 mil dry film thickness, suitable for protection of the finish through completion of erection.
- E. Products and Manufacturers: Provide one of the following:
- 1. Duranar Metallic XL Specialty Color 4-Coat System by PPG Industries

- Coatings and Resins Division, Incorporated.
2. Or Approved Equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor and installer shall examine the alignment of the structural steel before erection of the metal wall panel begins and notify Engineer, in writing, of unsatisfactory conditions. Do not proceed with the metal wall panel Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 PREPARATION

- A. Take field measurements, prior to submission of Shop Drawings. Do not delay Project progress. Allow for trimming where final dimensions cannot be established before fabrication. Identify all such areas to Engineer on Shop Drawings.

3.3 INSTALLATION

- A. Comply with metal wall panel manufacturer's instructions for assembly, installation and erection of metal wall panel.
- B. Install metal wall panel with the longitudinal configuration and joints in the vertical position.
- C. Where metal wall panels are to be replaced, inspect existing support framing. Replace corroded and damaged sections, allow for 50% replacement. Provide new fasteners, washers and gaskets.
- D. Anchor component parts of metal wall panel securely in place at each girt or framing member providing for necessary thermal and structural movement, and meeting wind loads specified.
- E. Do not exceed fastener spacing recommended by the metal wall panel manufacturer or approved structural framing submittal.
- F. Locate metal wall panel joints as shown.
- G. Install corner metal wall panels as performed corner units with a minimum of 12-inches at each leg. Locate end joints at structural supports.

- H. All fasteners must be long enough to penetrate through the entire wall panel assembly and penetrate into the structural support a minimum of 1/2-inch.
- I. Fasten flashings and accessories 12 inches on center.
- J. Use exposed fasteners, on non insulated panels only, which have been prefinished to match finish of panels and trim. Limit exposure of fasteners to extent indicated in manufacturer's data and instructions.
- K. Do not use exposed fasteners either on the exterior panel faces.
- L. Drive all fasteners normal to the surface and to a uniform depth.
- M. Install sealants for the metal wall panel Work as specified, and as required for watertight performance. Comply with sealant manufacturer's instructions for installation and curing.
- N. Minimize field cutting of metal wall panel and associated Work as far as practicable. Perform necessary field cutting using skilled workmen with proper tools.
- O. Do not fabricate flashings, closures and associated trim at the connection of metal wall panel adjacent materials.
- P. Install all special flashing and trim shapes, contour closure strips and calking compounds required to maintain complete weathertightness wherever pipes, ducts or other mechanical appurtenances penetrate metal wall panel.
- Q. Install insulation between exterior and masonry wall at non insulated metal wall panels.
- R. Remove strippable protection coating immediately after completion of erection and completion of adjoining construction Work which might damage panel finish. In any case, do not leave strippable coating on faces of preformed metal panels beyond the amount of exposure time recommended by the metal wall panel manufacturer.
- S. Comply with panel manufacturer's instructions and recommendations.

3.4 DAMAGED MATERIAL

- A. Damage caused by the manufacturer or contractors shall be replaced or repaired to as new condition at no cost to Owner.

3.5 FIELD QUALITY CONTROL

- A. Determine conformity of metal wall panel finish to this Section as follows:
 - 1. Manufacturer of the metal wall panel shall set aside a labeled sample of the metal wall panel from each production lot of panels for the Project. Protect sample metal wall panel from weather.
 - 2. Make sample metal wall panel available at all times, for comparison with installed metal wall panel, as requested by Owner, for the full time of the warranty.
 - 3. Make color comparison measurements with a Hunter Tristimulus Color Difference Meter employing methods of computation in use at the National Bureau of Standards conforming to ASTM D 2224.

3.6 ADJUSTMENT AND CLEANING

- A. Set metal wall panel plumb, level, and true to line, without warp or rack.
- B. Clean exterior and interior exposed surfaces of metal wall panel Work promptly after completion of installation, including removal of strippable coating. Comply with recommendations of both the metal wall panel and coating manufacturer.
- C. Leave metal wall panel and flashing perfectly flat, free from dents, burrs, scratches, holes or other blemishes. Paint all scratches, on the finish of the panels, flashing and all associated material, to be indistinguishable from adjacent un-scarred areas.
- D. Do not erect components which have become scarred, chipped or otherwise damaged or defaced.
- E. Remove and replace with new material metal wall panel and component parts of the Work, including finish, which have been damaged beyond successful repair, as directed by the Engineer, in writing. Repair minor damage.
- F. Do not use exterior sheets, trim members, and flashing sheets, in which holes have been made in locations where fasteners are not required.
- G. At the completion of the Work, clean or replace adjacent work, marred by the Work of this Section.

– END OF SECTION –

SECTION 07920

JOINT SEALANTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install calking and sealants.
2. Extent of each type of calking and sealant is shown or indicated and includes the following:
 - a. Interior and exterior joints in equipment and construction systems not filled by another material, and that are not required to be open for operation.
 - b. Exposed-to-view joints of all fire-rated sealants.
 - c. Joints specified to be recalked.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items to be installed with or before calking and sealants.
2. Coordinate final selection of calking and sealants so that materials are compatible with all calking and sealant substrates specified.

C. Related Sections:

1. Section 03251, Concrete Accessories.
2. Section 04090, Masonry Anchorage and Reinforcing.
3. Section 04201, Unit Masonry Construction.
4. Section 13122, Metal Building Systems.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM C510, Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
2. ASTM C661, Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
3. ASTM C793, Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
4. ASTM C794, Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
5. ASTM C920, Specification for Elastomeric Joint Sealants.

6. ASTM C1021, Practice for Laboratories Engaged in Testing Building Sealants.
7. ASTM C1087, Test method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
8. ASTM C1193, Guide for Use of Joint Sealants.
9. ASTM C1247, Practice for Durability of Sealants Exposed to Continuous Immersion in Liquids.
10. BAAQMD Regulation 8, Rule 51.
11. FS TT-S-00227, Sealing Compound: Elastomeric Type, Multi-component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
12. 12. NSF/ANSI Standard 61, Drinking Water System Components - Health Effects.
13. SCAQMD Rule 1168.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Installer:
 - a. Engage a single installer, approved by product manufacturer, regularly engaged in calking and sealant installation and with successful experience in applying types of products required, and who employs only tradesmen with specific skill and successful experience in the type of Work required.
2. Testing Laboratory:
 - a. Furnish services of independent testing laboratory qualified according to ASTM C1021, for conducting testing required.

B. Component Supply and Compatibility:

1. Obtain materials only from manufacturers who will, if required:
 - a. Test calking and sealants for compatibility with substrates for conformance with FS-TT-S-00227, and recommend remedial procedures as required.
2. Before purchasing each sealant, investigate its compatibility with joint surfaces, joint fillers, and other materials in joint system. Provide products that are fully compatible with actual installation condition, verified by manufacturer's published data or certification, and as shown on approved Shop Drawings and other approved submittals.

C. Product Testing: Provide test results of laboratory pre-construction compatibility and adhesion testing, as specified in Article 3.1 of this Section, by qualified testing laboratory, based on testing of current sealant formulations within a 36-month period preceding the Notice to Proceed for the Work.

1. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920 and, where applicable, to other standard test methods.

2. Test other joint sealants for compliance using specified post-construction field adhesion test.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Schedule of calking and sealants installation, indication each specific surface where calking or sealants are to be provided and the material proposed for each application.
2. Product Data:
 - a. Copies of manufacturer's data sheets including color charts, specifications, recommendations, and installation instructions for each type of sealant, caulking compound, and associated miscellaneous material required. Include manufacturer's published data, indicating that each product complies with the Contract Documents and is intended for the applications shown or indicated.
 - b. Product test reports.
3. Samples:
 - a. Each type of actual cured material of each calking and sealant specified, in each of manufacturer's standard colors.
 - b. Samples will be reviewed by Engineer for color and texture only. Compliance with other requirements is responsibility of Contractor.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Certify that materials are suitable for intended use and materials meet or exceed requirements of the Contract Documents.
 - b. Certification from manufacturer that products furnished are appropriate for surfaces and conditions to which they will be applied.
 - c. Certify that applicator is approved by manufacturer.
2. Field Quality Control Submittals:
 - a. Pre-construction and post-construction field test reports.
 - b. Compatibility and adhesion test reports.
 - c. Contractor's Field Test Report Logs:
 - 1) Indicate time present at the Site.
 - 2) Include observations and results of field tests, and document compliance with manufacturer's installation instructions and supplemental instructions provided to installers.
3. Qualifications: Submit qualifications for:
 - a. Installer.
 - b. Testing laboratory.

C. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data:

- a. Recommended inspection intervals.
 - b. Instructions for repairing and replacing failed sealant joints.
2. Warranty: Submit written warranties as specified in this Section.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery of Products:
 1. Deliver products in calking and sealant manufacturer's original unopened, undamaged containers, indicating compliance with approved Shop Drawings and approved Sample color selections.
 2. Include the following information on label:
 - 1) Name of material and Supplier.
 - 2) Formula or Specification Section number, lot number, color and date of manufacture.
 - 3) Mixing instructions, shelf life, and curing time, when applicable.
- B. Storage of Products:
 1. Do not store or expose materials to temperature above 90 degrees F or store in direct sunlight.
 2. Do not use materials that are outdated as indicated by shelf life.
 3. Store sealant tape in manner that will not deform tape.
 4. In cool or cold weather, store containers for sixteen hours before using in temperature of approximately 75 degrees F.
 5. When high temperatures prevail, store mixed sealants in a cool place.
- C. Handling:
 1. Do not open containers or mix components until necessary preparatory Work and priming are complete.

1.6 JOB CONDITIONS

- A. Environmental Conditions:
 1. Do not install calking and sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
 2. Proceed with the Work when forecasted weather conditions are favorable for proper cure and development of high-early bond strength.
 3. Where joint width is affected by ambient temperature variations, install elastomeric sealants when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
 4. When high temperatures prevail, avoid mixing sealants in direct sunlight.
 5. Supplemental heat sources required to maintain both ambient and surface temperatures within the range recommended by manufacturer for material applications are not available at the Site.

6. Provide supplemental heat and energy sources, power, equipment, and operating, maintenance, and temperature monitoring personnel.
7. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas of calking, sealants, and painting Work, and areas where Owner's personnel or construction personnel may work. Properly locate and vent such heat sources to outdoors so that calking and sealants and other Work are unaffected by exhaust.

1.7 WARRANTY

- A. Provide written warranty, signed by manufacturer and Contractor, agreeing to repair or replace sealants that fail to perform as air-tight and watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified in approved Shop Drawings and other submittals, as an inherent quality of material for exposure indicated.
 1. Provide manufacturer warranty for period of one year from date of Substantial Completion of calking and sealants Work.
 2. Provide installer warranty for period of two years from date of Substantial Completion of calking and sealants Work.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Provide elastomeric joint sealants for interior and exterior joint applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. VOC Performance Criteria:
 1. VOC content of sealants used shall comply with current VOC content limits of SCAQMD Rule 1168. Sealants used as fillers shall comply with or exceed requirements of BAAQMD Regulation 8, Rule 51.
 - a. Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.
- C. Provide colors selected by Engineer from calking and sealant manufacturer's standard and custom color charts. "Or equal" manufacturers shall provide same generic products and colors as available from manufacturers specified.

2.2 MATERIALS

A. Exterior and Interior Horizontal and Vertical Joints; Submerged and Intermittently Submerged in Wastewater:

1. Two-component Polyurethane Sealant:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Sikaflex- 2c NS by Sika Corporation.
 - 2) Vulkem 227 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
 - 3) Or equal.
 - b. Polyurethane based, two-component elastomeric sealant complying with:
 - 1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
 - 2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 18 lbs.
 - 3) Hardness (Standard Conditions), ASTM C661: 25 (Shore A).
 - 4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
 - 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
 - 6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
 - 7) VOC Content: 220 grams per liter, maximum.

B. Exterior and Interior Vertical Joints; Non-submerged:

1. Two-component Polyurethane Sealant:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Sikaflex- 2c NS by Sika Corporation.
 - 2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.
 - 3) Or equal.
 - b. Polyurethane based, two-component elastomeric sealant complying with:
 - 1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
 - 2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 10 pounds.
 - 3) Hardness (Standard Conditions), ASTM C661: 25 to 35 (Shore A).
 - 4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
 - 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
 - 6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.

7) VOC Content: 100 g/L, maximum.

C. Exterior and Interior Horizontal Joints; Non-submerged:

1. Two-component Polyurethane Sealant:
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Sikaflex- 2c SL by Sika Corporation.
 - 2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
 - 3) Or equal.
 - b. Polyurethane based, two-component elastomeric, self-leveling sealant complying with the following:
 - 1) FS TT-S-00227E, Type I (self-leveling) Class A. and ASTM C920, Type M, Grade P, Class 25
 - 2) Water Immersion Bond, FS TT-S-00227E: Elongation of 50 percent with no adhesive failure.
 - 3) Hardness (Standard Conditions), ASTM C661: 35 to 45.
 - 4) Stain and Color Change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
 - 5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
 - 6) VOC Content: 165 g/L, maximum.

D. Miscellaneous Materials:

1. Joint Cleaner: As recommended by calking and sealant manufacturer.
2. Joint Primer and Sealer: As recommended for compatibility with calking and sealant by calking and sealant manufacturer.
3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with calking and sealant by calking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of calking and sealant. Provide self-adhesive tape where applicable.
4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended for compatibility with calking and sealant by calking and sealant manufacturer. Provide size and shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.
5. Low-temperature Catalyst: As recommended by calking and sealant manufacturer.

E. Products for Other Applications:

1. Compressible Filler: Refer to Section 04090, Masonry Anchorage and Reinforcing.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine joint surfaces, substrates, backing, and anchorage of units forming sealant rabbet, and conditions under which calking and sealant Work will be performed, and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work and performance of sealants. Do not proceed with calking and sealant Work until unsatisfactory conditions are corrected.
- B. Laboratory Pre-construction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers for testing indicated below samples of materials that will contact or affect joint sealants.
 1. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 2. Submit at least eight pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 4. For products that fail tests, obtain joint-sealant manufacturer's written instructions for corrective measures including using specially formulated primers.
 5. Immersion Testing: ASTM C1247 for potable water and wastewater.
 6. Testing will not be required if joint sealant manufacturers submit joint preparation data based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted and mock-up field testing is acceptable.

3.2 PREPARATION

- A. Protection: Do not allow calking and sealants to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough textured materials. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or calking and sealant materials.
- B. Joint Surface Preparation:
 1. Clean joint surfaces immediately before installing sealant compound. Remove dirt, weakly adhering coatings, moisture and other substances that would interfere with bonds of sealant compound as recommended in sealant manufacturer's written instructions as shown on approved Shop Drawings.

2. If necessary, clean porous materials by grinding, sandblasting, or mechanical abrading. Blow out joints with oil-free compressed air or by vacuuming joints prior to applying primer or sealant.
 3. Roughen joint surfaces on vitreous coated and similar non-porous materials, when sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or steel wool to produce a dull sheen.
 4. Concrete Joint Preparation: Refer to Section 03251, Concrete Accessories
- C. Mixing:
1. Comply with sealant manufacturer's written instructions for mixing multi-component sealants.
 2. Thoroughly mix components before use.
 3. Add entire contents of activator can to base container. Do not mix partial units.
 4. Mix contents for minimum of five minutes or as recommended by sealant manufacturer, until color and consistency are uniform.

3.3 INSTALLATION

- A. Install calking and sealants after adjacent areas have been cleaned and before joint has been cleaned and primed, to ensure calking and sealant joints will not be soiled. Replace calking and sealant joints soiled after installation.
- B. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or indicated in the Contract Documents, only as acceptable to Engineer.
- C. Prime or seal joint surfaces as shown on approved Shop Drawings and approved other submittals. Do not allow primer or sealer to spill or migrate onto adjoining surfaces. Allow primer to dry prior to applying sealants.
- D. Apply masking tape before installing primer, in continuous strips in alignment with joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.
- E. Confirm that compressible filler is installed before installing sealants. Refer to Section 04201, Unit Masonry Construction, for locations.
- F. Do not install sealants without backer rods and bond breaker tape.
- G. Roll back-up rod stock into joint to avoid lengthwise stretching. Do not twist, braid, puncture, or prime backer rods.

- H. Employ only proven installation techniques that will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete “wetting” of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
- I. Install sealants to depths recommended by sealant manufacturer but within the following general limitations, measured at the center (thin) section of bead.
 - 1. For horizontal joints in sidewalks, pavements, and similar locations sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8-inch deep or less than 3/8-inch deep.
 - 2. For vertical joints subjected to normal movement and sealed with elastomeric sealants and not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2-inch deep or less than 1/4-inch deep.
- J. Remove excess and spillage of compounds promptly as the Work progresses.
- K. Cure calking and sealant compounds in compliance with manufacturer’s instructions and recommendations, to obtain high-early bond strength, internal cohesive strength, and surface durability.

3.4 FIELD QUALITY CONTROL

- A. Post-construction Field Adhesion Testing: Before installing elastomeric sealants, field-test joint sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform ten tests for the first 1,000 feet of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform one test for each 1,000 feet of joint length thereafter, and minimum of one test per each floor per elevation.
 - c. Test Method: Test joint sealants according to Method A, Field-applied Sealant Joint Hand Pull Tab, and Method D, Water Immersion in Appendix X1 of ASTM C1193. For joints with dissimilar substrates, verify adhesion to each substrate separately by extending cut along one side and verifying adhesion to opposite side. Repeat procedure for opposite side.
 - d. Inspect joints for complete fill, absence of voids, and joint configuration complying with specified requirements. Record results in a log of field adhesion tests.
 - e. Inspect tested joints and report on whether:

- 1) Sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - 2) Sealants filled the joint cavities and are free of voids.
 - 3) Sealant dimensions and configurations comply with specified requirements.
- f. Record test results in a log of field adhesion tests. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 - g. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
 - h. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other requirements will be satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
 - i. Do not proceed with installation of elastomeric sealants over joint surfaces that have been painted, lacquered, waterproofed, or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with FS TT-S-00227, has successfully demonstrated that sealant bond is not impaired by the coating or treatment. If laboratory test has not been performed or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

B. Water Leak Testing: Field test for water leaks as follows:

1. Flood the joint exposure with water directed from a 3/4-inch diameter garden hose, without nozzle, held perpendicular to wall face, two feet from joint and connected to water system with 30 psi minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 feet per minute.
2. Test approximately five percent of total joint system, in locations that are typical of every joint condition, and that can be inspected easily for leakage on opposite face. Conduct test in presence of Engineer, who will determine actual percentage of joints to be tested and actual period of exposure to water from hose, based on extent of observed leakage or lack of observed leakage.

3. Where nature of observed leaks indicates potential of inadequate joint bond strength, Engineer may direct that additional testing be performed at a time when joints are fully cured, and before Substantial Completion.

3.5 ADJUSTING AND CLEANING

- A. Where leaks and lack of adhesion are evident, replace sealant.
- B. Clean adjacent surfaces of sealant and soiling resulting from the Work. Use solvent or cleaning agent recommended by sealant manufacturer. Leave all finish Work in neat, clean condition.
- C. Protect sealants during construction so that they will be without deterioration, soiling, or damage at time of readiness for final payment of the Contract.

3.6 PROTECTION

- A. During and after curing period, protect joint sealants from contact with contaminating substances and from damage resulting from construction operations or other causes, so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

+ + END OF SECTION + +

SECTION 08120

ALUMINUM DOORS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all aluminum doors and frames Work.
2. The extent of aluminum doors and frames Work is shown.
3. The types of aluminum doors and frames Work required includes, but is not necessarily limited to, the following:
 - a. Flush doors and frames.
 - b. Removable insulated transom panel and removable transom bar.
 - c. Miscellaneous accessories and fasteners.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the aluminum doors and frames Work.

C. Related Sections:

1. Section 07920, Joint Sealants.
2. Section 08710, Door Hardware.
3. Section 13122, Metal Building Systems.

1.2 REFERENCES

A. Standards referenced in this Section or referenced in Product Performance Standard are listed below:

1. AA DAF 45, Designation System for Aluminum Finishes.
2. AAMA 701.1, Standard for Sliding Weatherstripping.
3. ASTM D 522, Test Methods for Mandrel Bend Test of Attached Organic Coatings.
4. ASTM D 523, Test Method for Specular Gloss.
5. ASTM D 968, Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive.
6. ASTM D 2244, Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
7. National Association of Architectural Metal Manufacturers, (NAAMM), Hardware Location for Custom Hollow Metal Doors.

8. National Association of Architectural Metal Manufacturers, NAAMM, NAAMM, Metal Finishes Manual.
9. The Society for Protective Coatings, (SSPC), Paint 12 Cold Applied Asphalt Mastic (Extra Thick Film).

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Provide aluminum doors, transom and frames manufactured by a single firm specializing in the production of this type of Work. Manufacturer shall have a minimum of five years of experience in the production of aluminum doors and frames, and shall be able to show evidence of satisfactory operation in at least five installations.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section regardless of the component manufacturer from a single aluminum doors and frames manufacturer.
2. The aluminum doors and frames manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the aluminum doors and frames manufacturer.

1.4 SUBMITTALS

A. Samples: Submit the following:

1. Samples of each required aluminum finish, on 12-inch long extrusions or 6-inch square sheets, of the alloys to be used for the Work. Where normal color and texture variations are to be expected, include two or more units in each sample, to show the range of such variations.
2. Samples shall be reviewed by Engineer for color and texture only. Compliance with other requirements is the exclusive responsibility of Contractor.

B. Shop Drawings: Submit the following:

1. Copies of manufacturer's fabrication and installation drawings of aluminum doors and frames. Include details of each frame type, elevations of each door type, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, details of joints and connections. Show all door and frame reinforcements.
2. Provide a schedule of doors and frames using same reference numbers for details and openings as those shown.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
2. Deliver aluminum doors and frames cartoned or crated to provide protection during transit and job storage.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store doors and frames at the Site under cover. Place units up off the floors in a manner that will prevent corrosion and damage. Avoid the use of non-vented plastic or canvas shelters, which could create a humidity chamber. If the cardboard wrapper on the door becomes wet, remove the carton immediately. Provide a 1/4-inch space between stacked doors to promote air circulation.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- #### A. Aluminum Extrusions:
- Provide aluminum Alloy 6063-T5 or equal for properties of strength (not less than 22,000 pounds per square inch ultimate tensile strength), corrosion resistance, abrasion resistance, application of required finish, and control of color.

B. Aluminum Sheets:

1. Provide aluminum Alloy 5005-H14, or equal, for properties of strength corrosion resistance, abrasion resistance, application of required finish, and control of color.
2. Provide smooth sheet to match existing for exposed faces of doors and panels, except as otherwise specified.

- #### C. Fasteners:
- Aluminum, non-magnetic stainless steel or other non-corrosive metal

fasteners guaranteed by the manufacturer to be compatible with the doors, frames, stops, panels, hardware, anchors and other items being fastened.

1. For exposed fasteners (if any), provide Phillips flat-head screws with finish matching the item fastened.
 2. Do not use exposed fasteners, except where unavoidable for the assembly of units, and unavoidable for the application of hardware. Provide only concealed screws in glazing stops.
- D. Reinforcement and Brackets: Manufacturer's standard formed or fabricated aluminum units, of shapes, plates or bars.
- E. Inserts: For required anchorage into concrete or masonry work, furnish inserts of 12- gauge steel stainless steel after fabrication.
- F. Expansion Anchor Devices: Stainless steel, drilled-in, expansion bolt anchors.
- G. Bituminous Coatings: Cold-applied asphalt mastic complying with SSPC Paint 12, compounded for 30-mil thickness per coat.

2.2 FABRICATION

A. General:

1. Sizes and Profiles: The required sizes for door and frame units and the profile requirements are shown. Variable dimensions for profiles (if any) are shown along with maximum and minimum dimensions as required to achieve design requirements and coordination with other work.
2. The details shown are based upon standard details by one or more manufacturers. Similar details by other manufacturers will be acceptable, provided they comply with the size requirements, and with minimum/maximum profile requirements as shown.

B. Flush Type Aluminum Doors:

1. Provide tubular frames members with minimum wall thickness of 1/8-inch, fabricated with reinforced mechanical or welded joints in accordance with manufacturer's standard fabrication methods. Limit edge exposure and face molding exposure to 0.50-inch maximum width.
2. Fabricate flush doors with cores laminated between two sheets of 0.040-inch thick aluminum laminated to 1/8-inch thick oil-tempered hardboard with epoxy adhesive to form a door thickness of 1-3/4-inch and of a true 5-ply construction.
3. Provide cores of 20 percent phenolic resin-impregnated honeycomb material 80 lbs. per 3,000 sq. ft. ream, (7/16-inch cells) laminated with an epoxy adhesive between two sheets of 1/8-inch thick tempered hardboard.
4. Products and Manufacturers: Provide one of the following:
 - a. Series 100BE Door and frame by Cline Aluminum Doors

- Incorporated.
- b. Model SL-16 Door and Frame by Special-Lite Incorporated.
- c. Or equal.

2.3 HARDWARE

- A. Flush Doors: Refer to Section 08710, Door Hardware, and to the frame, door and hardware schedules and details, for the furnishing and installing of hardware items. Hardware templates only will be furnished to the manufacturer for the fabrication of door and frames to receive hardware not supplied by door manufacturer.
- B. Hardware Installation: Cut, reinforce, drill and tap frames and doors as required to receive hardware, except do not drill and tap for surface-mounted items until the time of installation. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners, wherever possible.

2.4 ALUMINUM FINISHES

- A. General:
 - 1. Preparation: After fabrication of doors and frames, but before lamination of panels, prepare the aluminum surfaces for finishing in accordance with the aluminum producer's recommendations and standards of the finisher or processor. Process all components of each assembly simultaneously to attain complete uniformity of color.
 - 2. Samples:
 - a. Comply with industry standard colors and texture samples. Establish Samples of the required finish, for Engineer's acceptance, prior to fabrication of the Work. Engineer reserves the right to reject material finishes with objectionable variations from the established samples.
 - b. Prepare samples on extrusions and sheets of the exact alloys to be used for the Work, and show range of natural variations to be expected in finished Work, by duplicate samples of varying color and texture.
- B. Anodized Finishes: NAAMM AA-M10-C22-A42, (minimum thickness of 0.7-mils), Clear.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the substrate and conditions under which aluminum doors and frames Work are to be installed and notify Engineer, in writing, of any conditions detrimental to the proper and timely completion of the Work. Do not

proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 INSTALLATION

- A. Comply with manufacturer's specifications and recommendations for the installation of aluminum doors and frames.
- B. Set units plumb, level and true to line, without warp or rack of frames, doors or panels. Anchor securely in place. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTMENT AND CLEANING

- A. Clean aluminum surfaces promptly after installation of frames and doors. Remove excess glazing and sealant compounds, dirt and other substances.
- B. Where protective coating has been supplied, remove coating completely as soon as the completion of construction activities no longer requires its retention.
- C. Contractor shall provide protective treatment and other precautions required as recommended by manufacturer, through the remainder of the construction period, to ensure that doors and frames will be without damage or deterioration (other than normal weathering) at the time of Final Acceptance.

++ END OF SECTION ++

SECTION 08710

DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install finish hardware
2. Extent of door hardware is specified. Door finish hardware is defined to include all items known commercially as finish hardware, except special types of unique and non-matching hardware specified in the same Section as the door and door frame.
3. Types of finish hardware required include the following:
 - a. Mortise hinges.
 - b. High-security mortise locksets.
 - c. Panic exit devices.
 - d. Heavy-duty, overhead, surface-mounted, door closers.
 - e. Cylinders for doors specified in other Sections.
 - f. Astragals.
 - g. Stripping and seals.
 - h. Thresholds.
 - i. Silencers.
 - j. Floor stops.
 - k. Flush bolts.
 - l. Dust-proof strikes.
 - m. Door contact switches.
 - n. Miscellaneous items and accessories for a complete installation functioning in compliance with the requirements of governing authorities having jurisdiction at the Site.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the finish hardware.
2. Coordinate the Work of other Sections to provide clearances and accurate positioning of recessed or cast-in-place items.

C. Related Sections:

1. Section 08120, Aluminum Doors and Frames.
2. Section 13122, Metal Building systems.

1.2 REFERENCES

A. Standards referenced in this Section or referenced in Product Performance Standard are listed below:

1. ANSI A117.1, Accessible and Usable Buildings and Facilities.
2. ANSI/BHMA A156.1, Butts and Hinges.
3. ANSI/BHMA A156.3, Exit Devices.
4. ANSI/BHMA A156.4, Door Controls - Closers.
5. ANSI/BHMA A156.5, Auxiliary Locks and Associated Products.
6. ANSI/BHMA A156.6, Architectural Door Trim.
7. ANSI/BHMA A156.7, Template Hinge Dimensions.
8. ANSI/BHMA A156.8, Door Controls - Overhead Stops and Holders.
9. ANSI/BHMA A156.13, Mortise Locks and Latches, Series 1000.
10. ANSI/BHMA A156.16, American National Standard for Auxiliary Hardware.
11. ANSI/BHMA A156.18, Hardware - Materials and Finishes.
12. ANSI/BHMA A156.21, Thresholds.
13. ANSI/BHMA A156.22, Door Gasketing and Edge Seal Systems.
14. ANSI/BHMA A156.24, Delayed Egress Locks.
15. ANSI/DHI A115.1, Preparation of Mortise Locks in 1-3/8-inch and 1-3/4-inch Standard Steel Doors and Frames.
16. ANSI/NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
17. ASTM E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
18. FF-TT-S-00227.
19. NIST, U. S. Standard.
20. NFPA 70, National Electric Code.
21. NFPA 101, Life Safety Code.
22. SDI 109, Hardware for Standard Steel Doors and Frames.
23. UL 305, Panic Hardware.
24. UL, Building Materials Directory.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Provide finish hardware and accessories manufactured by firms specializing in the production of this type of Work and complying with specified standards of ANSI, BHMA, DHI, NFPA, HMMA, SDI and UL.
2. Provide finish hardware from manufacturers who are members of BHMA and participate in BHMA certification programs.

B. Installer's Qualifications:

1. The finish hardware installer shall have in his employ an architectural hardware consultant. The architectural hardware consultant shall be a member of the Door and Hardware Institute, (DHI), who has passed the DHI certification examine and successfully completed an apprenticeship program. The architectural hardware consultant shall be responsible for preparing finish hardware schedules and Shop Drawings and be present at the Site for the purpose of checking and supervising the Work of the installer during the time of installation and adjustment of the finish hardware Work, and shall prepare a written field report on status of completed finish hardware installation as specified.
2. Submit name and qualifications of the installer and hardware consultant to Engineer.

C. Architectural Hardware Consultant Qualifications:

1. A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

D. Component Supply and Compatibility:

1. Finish hardware equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the finish hardware manufacturer.

E. Testing Agency Qualifications: The independent testing agency shall demonstrate to Engineer's satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated in accordance with ASTM E 329, without delaying the Work.

F. Source Quality Control:

1. Obtain each type of finish hardware item from only one manufacturer.
2. Provide finish hardware schedule, for submission to, and for approval by, Engineer, prepared in compliance with specified DHI standards.
3. Comply with specified BHMA standards.

G. Requirements of Regulatory Agencies:

1. Provide door finish hardware for fire-resistance-rated openings in compliance with NFPA 80.
2. Provide only finish hardware that has been tested, listed and labeled by UL for the types and sizes of doors required, and complies with the requirements of the door and door frame labels.

3. Modify features of finish hardware items specified, and provide additional accessories and features as required to meet UL and NFPA 80 requirements, at no additional cost to the Owner.
 4. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches or less above the sill.
- H. Preconstruction and Keying Conference: Conduct conference at Project site to comply with requirements in Section 01210, Preconstruction Conference. In addition to OWNER, CONTRACTOR, and Engineer, conference participants shall also include Architectural Hardware Consultant and Owner's security consultant.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review required testing, inspecting, and certifying procedures.
 3. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Address for delivery of keys.

1.4 SUBMITTALS

A. Action Submittals

1. Shop Drawings: Submit the following:
 - a. Copies of manufacturer's data for each item of finish hardware. Include whatever information may be required to show compliance with specified requirements, and include instructions for installation and for maintenance of operating parts and exposed finishes. Include mounting heights and locations for each item of finish hardware. Provide Engineer with latest complete technical catalogue of all available finish hardware manufactured by proposed manufacturers, even if manufacturer specified by Engineer is submitted by Contractor to perform the Work. Furnish templates to fabricators of other Work, which is to receive finish hardware.
 - b. Copies of the Door Finish Hardware Schedule, prepared by the Architectural Hardware Consultant, in the manner and format specified, complying with the actual construction Progress Schedule requirements (for each draft). Include explanation of abbreviations, symbols, and codes used to present scheduled information.
 - 1) Prepare and submit Door Finish Hardware Schedule in compliance with DHI standards.

- c. Based on the finish hardware requirements specified, organize the final Door Finish Hardware Schedule into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other Work which may be critical in the Project Schedule. Furnish final draft of schedule after Samples, manufacturer's data sheets, coordination with Shop Drawings for other Work, delivery schedules and similar information have been completed and accepted.
- d. Include a separate key schedule, showing clearly how Owner's final instructions on keying of locks have been fulfilled.
- e. Door Finish Hardware Schedules are intended for coordination of the Work. Review and acceptance by Engineer does not relieve Contractor of responsibility to fulfill the requirements as shown and specified.
- f. Field Report: Architectural Hardware Consultant's Report.
- g. Maintenance Manual: Upon completion of the Work, furnish five copies of detailed maintenance manuals, including the following information:
 - 1) Product name and manufacturer.
 - 2) Name, address, e-mail address and telephone number of manufacturer and local distributor.
 - 3) Detailed procedure for routine maintenance and cleaning.
 - 4) Detailed procedures for repairs such as dents, scratches and staining.
 - 5) Parts identification manual and maintenance manuals for each piece of finish hardware.

B. Informational Submittals

- 1. Test Reports: Submit for approval certified independent laboratory test reports for BHMA certification program and certification tests for each type of product specified.
- 2. Qualification Data:
 - a. Installer.
 - b. Architectural Hardware Consultant.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

- 1. Deliver all items of finish hardware in manufacturer's original, undamaged packages, bearing accurate representation of the item within each package.
- 2. Pack each piece of finish hardware separately, complete with screws, keying, instructions and templates, tagged to correspond with items submitted on approved Shop Drawings and as specified.

B. Storage and Protection:

- 1. Store materials to permit easy access for inspection and identification. Keep

all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

2. Provide secure storage area for finish hardware items, secured by locks and accessible only to finish hardware installer, Engineer and Contractor.
3. Store finish hardware in manufacturers' original packages.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Items that arrive in a damaged condition shall be removed from the Site and not offered again for acceptance. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: 3 years from date of Substantial Completion, except as follows:
 - a. Exit Devices: 2 years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

1.8 MAINTENANCE

- A. Maintenance Service
 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
 2. Maintenance Service: Beginning at Substantial Completion, provide 6 months' full maintenance by skilled employees of door hardware Installer.

Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Design Criteria:

1. Where the finish, shape, size, fire-resistance-rating, frequency of use, or function of a member receiving finish hardware is such as to prevent, or make unsuitable, the types of finish hardware specified, furnish similar types having as nearly as practicable the same operation but of type or kind more appropriate to the design intension and requirements of governing authorities having jurisdiction at the Site. Clearly identify and highlight to Engineer all such required modifications on Shop Drawings submitted for approval.
2. If finish hardware for any location is not specified, provide finish hardware equal in design and quality to adjacent finish hardware specified for comparable openings at no additional cost to Owner.
3. Furnish finish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements, as necessary for proper installation and function.
4. Unless otherwise specified, comply with DHI, Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames and Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames.

2.2 DETAILS OF CONSTRUCTION

A. General:

1. Hand of Door: The Drawings show the swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish each item of finish hardware for proper installation and operation of the door swing as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with labels required by governing authorities having jurisdiction at the Site.
3. Base Metals: Produce finish hardware units of the basic metal and forming method specified, using the manufacturer's standard metal alloy, composition, temper and hardness. Do not substitute materials or forming methods for those specified.
4. Fasteners: Manufacture door finish hardware to conform to published templates, generally prepared for machine screw installation. Do not provide

finish hardware, which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

5. Furnish screws for installation, with each finish hardware item. Provide Phillips flat-head screws except as otherwise specified. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces on other Work, to match the finish of such other Work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
6. Provide fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of finish hardware, base material or fastener.
7. Provide concealed fasteners for finish hardware units, which are not exposed when the door is closed, except to the extent no standard manufacturer units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other Work under any condition, except where it is not possible to adequately reinforce the Work and use machine screws or concealed fasteners of another standard type to satisfactorily avoid the use of through bolts.
8. Tools for Maintenance: Furnish two complete sets of specialized tools as required for Owner's continued adjustment, maintenance, removal and replacement of finish hardware.

2.3 HARDWARE TYPES

A. Mortise Hinges:

1. Templates and Screws: Provide only template-produced units.
2. Base Metal: Except as otherwise specified, fabricate hinges from stainless steel and finish to match the latch and lock set.
3. Number of Hinges: Provide three hinges on each door leaf of less than 60-inches in height; provide one additional hinge for next 30-inches of door height or fraction thereof; provide two additional hinges for each 30-inches, or fraction thereof, for doors above 90-inches tall.
4. Hinge Size: Except as otherwise specified or as required to comply with UL and NFPA, provide hinges of the following sizes:
 - a. Exterior Doors, Maximum 36-Inches Wide: 4-1/2-inch heavy-weight (0.180-inch).
5. Types of Hinges: Provide full-mortise type, ball-bearing hinges, swaged for mortise applications, inner leaf beveled, square cornered, unless manufacturer's recommendations indicate that half-mortise, half-surface, full-surface or other type should be used for the frame and door type or condition.
6. Hinge Pins: Except as otherwise specified, provide hinge pins as follows:
 - a. Pins: Stainless steel.

- b. Exterior Doors: Non-removable pins. Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed.
 - c. Tips: Slope ends of hinge barrel.
 - 7. Conform to ANSI/BHMA A156.7.
 - 8. Comply with UL, List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
 - 9. Products and Manufacturers: Provide one of the following:
 - a. FBB 199 and FBB 191 by Stanley Commercial Hardware, Division of The Stanley Works.
 - b. T4B3386 and TB3313 by McKinney Products Company, an ASSA ABLOY Group company.
- B. High-Security Mortise Locks:
- 1. Strikes: Provide manufacturer's standard wrought box strike, for each location and use shown. Provide stainless steel curved lip strikes, unless otherwise recommended by manufacturer, finished to match lock or latch set trim.
 - 2. Lock Throw: Provide minimum of 3/4-inch anti-friction latch bolt and 1-inch dead bolt throw. Comply with UL requirements for throw of latch bolts and deadbolts on fire-resistance-rated openings.
 - 3. Materials: Provide the following features and materials:
 - a. Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
 - b. Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
 - c. Case: Wrought steel, zinc dichromatized.
 - d. Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
 - e. Armor Front: 8-inches by 1-1/4-inches wide, minimum; steel.
 - f. Escutcheon: 8-inches by 2-1/2-inches wide by 3/16-inches thick, minimum; stainless steel, US 32D.
 - g. Hubs: Sintered steel, copper infiltrated.
 - h. Lever with Stop Pin: Brass, plated to match stainless steel, with additional built-in stop to prevent over-torquing of lever.
 - i. All components shall be of marine quality, wherever possible.
 - 4. Backset: 2-3/4-inches.
 - 5. Modify specified locks and latches to comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
 - 6. Latches and Locks for Means of Egress Doors: Comply with NFPA 101.
 - 7. Finish: US 32D satin.
 - 8. Conform to ANSI/BHMA A156.13, Series 1000, Security Grade 1.
- C. Panic Exit Devices:

1. Strikes: Provide manufacturer's standard wrought stainless steel jamb-mounted top latch bolt and bottom latch bolt for each location and use shown to allow independent opening and closing of each leaf of double doors with panic exit devices; complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
2. Lock Throws: Provide minimum of 3/4-inch latch bolt throw complying with UL List of Inspected Fire Protection Equipment and Materials and NFPA 80 requirements.
3. Provide concealed vertical rod type exit device and mortise type exit devices as specified.
4. Provide the following features and materials:
 - a. Latch Bolt: Two-piece; mechanical; anti-friction, stainless steel.
 - b. Dead Bolt: One-piece, stainless steel with two enclosed hardened-steel roller armor pins.
 - c. Case: Wrought steel, zinc dichromatized.
 - d. Cylinders: High-security; brass; pick- and drill-resistant; ANSI/BHMA A156.5 - E09211A.
 - e. Armor Front: 8-inches by 1-1/4-inches wide, minimum; steel.
 - f. Escutcheon: 8-inches by 2-1/2-inches wide by 3/16-inches thick, minimum; stainless steel, US 32D.
 - g. Hubs: Sintered steel, copper infiltrated.
 - h. Crossbar: Oval, seamless with interlocking expansion collets and roll pins; knurled, satin stainless steel, 0.062-inches minimum thickness, with steel reinforcing tube.
 - i. Concealed bolts: Minimum 1/2-inch diameter, stainless steel.
5. Backset: Provide minimum backset of 2-3/4-inches.
6. Finish: US 32D satin.
7. ANSI/BHMA: A156.3, Type 3 and Type 8, Grade 1; F08, entrance by lever, key locks or unlocks lever for entrances shown as accessible to people with disabilities as required by ADAAG; and F05, entrance by thumb piece, key locks or unlocks thumb piece.
8. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
9. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
10. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
11. Products and Manufacturers: Provide one of the following:
 - a. 1530-L8 (F) and -T8 (F) Series Mortise Exit Devices and 1520(F) CVR Concealed Vertical Rod Exit Devices; with Escutcheon Trim and Augusta - ASL Lever Handles and Thumbpiece/Handle/Cylinder Unit

by Yale Commercial Locks and Hardware, an ASSA ABLOY Group company.

- b. ED6600Series Mortise Exit Devices and ED 6800 Concealed Vertical Rod Exit Devices; with Escutcheon Trim and Newport – N4M Lever Handles and D Grip T7M Thumb piece/Handle/Cylinder Unit by Corbin Russwin Architectural Hardware, an ASSA ABLOY Group company.
- c. Or equal.

D. Cylinders and Keying System:

- 1. Review the keying system with Owner's and provide the type required to integrate with Owner's existing system.
- 2. Furnish all locks with manufacturer's cylinders for interchangeable-core pin tumbler inserts. Furnish only temporary inserts for the construction period, and remove these before Substantial Completion. Construction control keys and cores shall not be part of Owner's permanent keying system. Permanent cores and keys shall be furnished to Owner prior to Substantial Completion.
- 3. Comply with the Owner's instructions for master keying and, except as otherwise specified, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
- 4. Permanent keys and cores shall be stamped with the applicable key mark for identification. These visual key control marks or codes shall not include the actual key cuts. Permanent keys shall also be stamped "DO NOT DUPLICATE".
- 5. Cylinder Material: Brass, bronze or Series 300 stainless steel.
- 6. Cylinder Features: Seven-pin, high-security, removable core.
- 7. Key Material: Nickel silver.
- 8. Key Quantity: Furnish three keys for each lock and five keys for each master and grandmaster system. Provide one extra key blank for each lock.

E. Overhead, Surface-Mounted, Door Closers:

- 1. Provide all doors, unless specially shown or specified as being provided with floor-mounted or concealed overhead closers, with surface-mounted overhead door closers. Provide both active and inactive door leafs with closers.
- 2. Size of Units: Except as otherwise specified, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, and anticipated frequency of use.
- 3. Where parallel arms are specified, and for closers on exterior doors, provide closer unit one size larger than recommended for use with standard arms.
- 4. Use parallel arm arrangement for doors that would otherwise have the door closer appearing in finished corridors or entries.
- 5. Comply with UL, Building Materials Directory, and List of Inspected Fire Protection Equipment and Materials, and NFPA 80. Modify closers specified as required. UL 10C and UBC 7-2c positive pressure requirements for fire-rated openings.

6. Provide hold open feature for all non-fire-resistant-rated doors, unless otherwise specified.
7. Provide offset bracket mounting on exterior doors. Select all arms to clear weather-stripping, and overhead door holders.
8. Provide long arm to allow door to swing 180 degrees where long arm will eliminate floor-mounted stops.
9. Provide closers with spring power adjustment feature capable of increasing spring power 15 percent minimum in all closer sizes.
10. Provide individual regulating valves for closing and latching speeds, and separate adjustable back check valve.
11. Provide delayed closing action feature on all door closers. Position valve at top of closure.
12. Provide the following materials and features:
 - a. Full Metal Cover: Aluminum.
 - b. Case: Cast-iron.
 - c. Arms: Plated to match full metal covers.
 - d. Other Parts: Steel.
 - e. Extreme temperature fluid.
 - f. Security torx machine screws.
 - g. Ten-year warranty.
 - h. Provide manufacturer's optional corrosion protection.
13. Finishes: US 26D satin chrome. Color coordinate all arms and other accessories.
14. Highly Corrosive Atmospheres: Provide all closers with specified manufacturer's optional corrosion protection.
15. ANSI/BHMA: A156.4, Grade 1.
16. Products and Manufacturers: Provide one of the following:
 - a. DC8000 Series by Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - b. 4040 Series by LCN Closers, an Ingersoll Rand Company.
 - c. Or equal.

F. Flush Bolts:

1. Provide flush bolts on the inactive leaf of all pairs of doors, unless otherwise specified.
2. Provide flush bolts at the top and bottom of door.
3. Provide downset of 12-inches for all automatic flush bolts, and manufacturers' automatic flush bolt strikes, for the locations specified in List of Door Hardware Items at end of Part 3.
4. Comply with UL, Hardware, Automatic or Surface Bolts, and NFPA 80, for automatic flush bolt requirements.
5. Provide the following features and materials:
 - a. Flush Bolt Levers: Forged Brass.
 - b. Flush Bolt Plate: Forge Brass.
 - c. Flush Bolt Guide and Strike: Wrought Brass.

- d. Flush Bolt Rods: 1/2-inch round rods, bronze, 12-inches minimum length.
 - e. Bolt Head: Brass.
 - 6. Provide extension flush bolts with 3/4-inch throws and with top bolt not over 6 foot-0 inches above finished floor. Provide bottom flush bolt 12-inches long.
 - 7. ANSI/BHMA: A156.16: L14081, L14251 and L14091.
 - 8. Products and Manufacturers: Provide one of the following:
 - a. FB458 Extension Flush Bolts by IVES Hardware, an Ingersoll-Rand Corporation.
 - b. Trimco 3917 Series Manual Exterior Flush Bolts by Triangle Brass Manufacturing Company.
 - c. Or equal.
 - 9. Where required by governing authorities having jurisdiction at the Site, provide cast bronze automatic flush bolts bearing the UL label.
- G. Astragals:
- 1. Provide metal split-astragal bars, not less than 1/8-inch by 2-inches, for exposed flathead screw mounting on both leafs of all pairs of doors. Comply with UL and NFPA requirements for types and locations of astragals.
 - 2. Provide astragal of extruded aluminum with clear anodized finish.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. No. 351 Series by Pemko Manufacturing Company.
 - b. No. McK297 by McKinney, an ASSA ABLOY Group company.
 - b. Or equal.
- H Dust-Proof Strikes:
- 1. Provide brass dust-proof strikes, which incorporate a slotted plunger raised to flush position by spring tension for all flush bolts.
 - 2. Provide 5/8-inch inside diameter dust-proof strikes; threshold mounted and surface mounted.
 - 3. Finish: US 26D satin chrome.
 - 4. ANSI/BHMA: A156.16, L14011-L14012.
 - 5. Products and Manufacturers: Provide one of the following:
 - a. DP-1 and DP-2 by IVES Hardware, an Ingersoll-Rand Company.
 - b. Trimco Series 3910 and 3910N Dustproof Strikes by Triangle Brass Manufacturing Company.
 - c. Or equal.
- I. Weatherstrip Gasketing:
- 1. Provide perimeter weatherstrip at all exterior doors. Provide stripping and seals for interior doors where scheduled in the Finish Hardware Schedule, at end of Part 3.

2. Continuity of Gasketing: Except as otherwise specified, stripping at each opening shall be continuous and without unnecessary interruptions at door corners and hardware.
 3. Replaceable Seal Strips: Resilient or flexible seal strip of every unit shall be easily replaceable and readily available from stocks maintained by the manufacturer.
 4. Provide bumper-type weatherstrip at jambs and head, including a resilient insert and metal retainer strip, surface-applied, of the following metal, finish and resilient bumper material:
 - a. Housing: Extruded aluminum with dark bronze anodized finish; 0.062-inch minimum thickness of main walls and flanges.
 - b. Dimensions: 1-3/8-inches by 7/8-inches, stop-mounted.
 - c. Seals: Closed-cell extruded silicone.
 - d. ANSI/BHMA: A156.22, R3E264.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) No. 350DSPK and 2891 DPK (for parallel arms) by Pemko Manufacturing Company.
 - 2) No. 770D Compress-O-Matic and No. 429A (for parallel arms) by Zero International.
 - 3) Or equal.
 5. Provide heavy-duty, surface-mounted, automatic drop-seal door-bottom unit of manufacturer's standard design, with operating seal bar of the following material, retained in an extruded metal bar and capable of operating to close a 3/4-inch gap (from door bottom to floor or threshold). House mechanism and operating bar in the following metal housing, for mounting in doors as follows:
 - a. Housing: Extruded aluminum, 0.062-inch thick, with mill aluminum finish.
 - b. Seal: Neoprene.
 - c. Mounting: Surface-mounted.
 - d. ANSI/BHMA: A156.22, R3E344.
 - e. Products and Manufacturers: Provide one of the following:
 - a) No. 4301 DPKL by Pemko Manufacturing Company.
 - b) No. 367 D by Zero International.
 - c) Or equal.
- J. Thermal Barrier Thresholds:
1. All exterior doors shall be provided with thermal barrier thresholds.
 2. Metal: Extruded aluminum.
 3. Surface Pattern: Fluted tread, manufacturer's standard.
 4. Provide countersunk stainless steel screws and expansion shields.
 5. Width: 5 1/8-inches wide and of length sufficient to span full width of rough openings, coped and scribed neatly at and around door frames.
 6. Construction:

- a. Two-piece, with rigid vinyl key complying with manufacturer's recommendations.
 7. Profile: Provide manufacturer's unit, which conforms to the minimum size and profile requirements specified.
 - a. For doors equipped with panic hardware, including floor bolts, provide profile with stop bar of proper size and shape to function as the strike plate for the floor bolts.
 8. Thickness: 1/2-inch.
 9. ANSI/BHMA: A156.21, J12100.
 10. Products and Manufacturers: Provide one of the following:
 - a. 252X2AFG by Pemko Manufacturing Company.
 - b. 625 A by Zero International.
 - b. Or equal.
- K. Silencers:
1. Provide silencers for all door frames.
 2. Provide pneumatic design that, once installed, forms an air pocket to reduce noise.
 3. Provide minimum of three per strike side of door jambs.
 4. ANSI/BHMA: A156.16, BHMA 6.5, L03011.
 5. Products and Manufacturers: Provide one of the following:
 - a. SR64 by IVES Hardware, an Ingersoll-Rand Company.
 - b. Series 307D by Hager Companies.
 - c. Or equal.
- L. Floor Stops:
1. Dome-Type Floor Stops:
 - a. Cast bronze extra heavy-duty wall mounted door stop, one per leaf.
 - b. Coordinate height of dome-type floor mounted doors stops with threshold condition and undercut of door.
 - c. Finish: US 26D satin chrome.
 - d. ANSI/BHMA: A156.16, L12161.
 - e. Products and Manufacturers: Provide one of the following:
 - 1) FS13/ R14, FS17 by IVES Hardware, an Ingersoll-Rand Company.
 - 2) Trimco BL243F by Triangle Brass Manufacturing Company.
 - 3) Or equal.
- M. Door Contact Switches:
1. General: Door contacts shall be provided flush-mounted.
 2. Features: The contact contains a hermetically sealed magnetic reed switch. The reed shall be potted in the contact housing with a polyurethane based compound. Contact and magnetic housing shall snap-lock into a 15/16-inch diameter hole. Housing shall be molded of flame retardant ABS plastic. Color of housing shall be gray. The magnet, made of Alnico V. Rare Earth Magnet, shall be made of neodymium iron boron.

3. Products and Manufacturers: Provide one of the following:
 - 1) Model 1076W, by Sentrol.
 - 2) Or equal.
- N. Sealants: Provide elastomeric sealant complying with FS TT-S-00227, Type 2 (non-sag) Class A for use with thresholds.

2.4 HARDWARE FINISHES

- A. Provide matching finishes for finish hardware units at each door or opening, to the greatest extent possible in compliance with NIST U. S. Standards or ANSI/BHMA A156.18.
- B. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of finish hardware exposed at the same door or opening. In general, match all items to the manufacturer's standard finish for the latch and lock set for color and texture.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the substrate to receive finish hardware, and the conditions under which the Work will be performed, and notify Engineer, in writing, of unsatisfactory conditions. Do not proceed with the finish hardware Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 PREPARATION

- A. Templates: Furnish finish hardware templates to each fabricator of doors, frames and other Work to be factory-prepared for the installation of finish hardware. Check the Shop Drawings of such other Work, to confirm that adequate provisions are made for the proper installation of the finish hardware.
- B. Prepare Work to receive finish hardware Work in compliance with ANSI/DHI A115.1.
- C. Surface-Applied Door Hardware: NFPA 80: Drill and tap doors and frames according to ANSI A250.6.

3.3 INSTALLATION

- A. Installer shall check and approve the installation before operation. Installer shall

assure that the system operates to the Owner's satisfaction.

- B. Mount finish hardware units at heights recommended in, Door and Hardware Institute, "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames" and "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames", except as otherwise specified or required to comply with governing authorities having jurisdiction at the Site, HMMA 830 and ADAAG requirements.
- C. Install each finish hardware item in compliance with the manufacturer's instructions and recommendations and approved Shop Drawings. Wherever cutting and fitting is required to install finish hardware onto or into surfaces that are later to be painted or finished in another way, install each item completely, then remove, and store in a secure place during the finish application. After completion of the finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.
- G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel that will not corrode in contact with the threshold metal.
- H. Set thresholds in a bead of elastomeric sealant to completely fill concealed voids and exclude moisture from every source. Do not plug drainage holes or block weeps. Remove excess sealant before sealant cures to a firm set.
- I. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Lubricate moving parts with the type lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door

will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

- J. Final Adjustment: Where finish hardware installation is made more than one month prior to Substantial Completion, return to the Work during the week prior to acceptance or occupancy, and make a final check and adjustment of all finish hardware items in each space and area. Clean and re-lubricate operating items as necessary to restore proper function and finish of finish hardware and doors. Adjust door control devices to compensate for final operating of heating and ventilating equipment.
- K. Provide manufacturer's authorized representative to instruct and train Owner's personnel in proper adjustment and maintenance of finish hardware during the final adjustment of finish hardware.
- L. Finish hardware, which is blemished or defective, will be rejected even though it was set in place before defects were discovered. Remove and replace with new finish hardware. Repair all resultant damage to other Work.
- M. Continued Maintenance Service: Approximately six months after the acceptance of finish hardware in each area, the installer, accompanied by the representative of the latch and lock manufacturer and Architectural Hardware Consultant, shall return to the Project and re-adjust every item of hardware to restore proper function of doors and finish hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Clean and lubricate operational items wherever required. Replace finish hardware items that have deteriorated or failed due to faulty design, materials or installation of finish hardware units.

3.4 FIELD QUALITY CONTROL

- A. Provide a written field report, prepared by installer's Architectural Hardware Consultant, identifying actual condition, location, manufacturer, and product designation for each item of finish hardware actually present on each door at the Site, including whether finish hardware is adjusted and operating properly, compared with each item referenced to approved Shop Drawings and Contract requirements.
- B. Installer's Architectural Hardware Consultant shall provide opinions to, and assist Engineer in determining, acceptability of installation as Work proceeds. All comments and discussions, conversations and meetings with Engineer shall be included in written field report for submission to Engineer for review and approval at completion of finish hardware installation.

- C. As part of written field report to be submitted to Engineer for approval, recommend remedial actions for Work not in compliance with these Specifications. No payment for Work shall be made until remedial recommendations and actions have been approved by Engineer and incorporated into the Work.

3.5 DOOR FINISH HARDWARE SCHEDULE

- A. Scheduled items for each door are generic and rely on information specified above. The listing of hardware functions and types provided are only a general guideline for the final Door Finish Hardware Schedule. Contractor shall submit a Door Finish Hardware Schedule acceptable to all governing authorities having jurisdiction at the Site.
- B. Provide the following finish hardware items:
1. Exterior Single Egress Doors and Frames
 - a. Mortise hinges.
 - b. High-security mortise lockset.
 - c. High-security mortise panic exit device.
 - d. Cylinder.
 - e. Overhead, surface-mounted, door closers
 - f. Stripping and seals.
 - g. Threshold.
 - h. Silencers.
 - i. Floor stop.
 - j. Door contact switch.
 2. Exterior Pair Egress Doors and Frames
 - a. Mortise hinges.
 - b. High-security mortise lockset on active leaf.
 - c. High-security mortise panic exit devices on active leaf.
 - d. Cylinder on active leaf.
 - e. Overhead, surface-mounted, door closer on active leaf.
 - f. Flush bolts.
 - g. Dust-proof strike.
 - h. Astragals.
 - i. Stripping and seals.
 - j. Floor stops.
 - k. Threshold.
 - l. Door contact switches.
 - m. Silencers.

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SECTION 09611
CONCRETE HARDENER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all concrete hardener Work.
2. The extent of the concrete hardener includes all interior concrete floors not shown or scheduled to be finished with another material.
3. The types of concrete hardener Work required include, but are not necessarily limited to, silicate penetrant.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the concrete hardener Work.

C. Related Sections:

1. Section 03300, Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

- A. Installer's Qualifications: Engage a single installer regularly engaged in the installation of concrete hardeners with five years experience in the application of the types of materials required, and who agrees to employ only tradesmen with specific skills and experience in this type of Work. Installer shall meet the requirements of the concrete hardener manufacturer for providing guarantee coverage. Submit name and qualifications to Engineer.
- B. Source Quality Control: Obtain all material from only one manufacturer who will send a qualified technical representative to the Site for the purpose of advising the installer of proper procedures and precautions for the use of the material, at no additional cost to the Owner.

1.3 SUBMITTALS

- A. Shop Drawings: Submit the following:

1. Copies of manufacturer's specifications, recommendations and installation instructions. Include manufacturer's published data, indicating the material complies with the requirements and is intended for the application shown.
 2. Submit installer's qualifications in accordance with Article 1.2, above.
- B. Certificates: Submit a certificate of coverage signed by a duly authorized representative of the manufacturer.
- C. Maintenance Data: Upon completion of the Work, furnish five copies of detailed maintenance manual including the following information:
1. Product name and number.
 2. Name, address and telephone number of manufacturer and local distributor.
 3. Detailed procedures for routine maintenance and cleaning.
 4. Detailed procedure for light repair such as scratches and staining.
- D. Guarantee: Submit for approval written guarantee agreeing to replace the concrete hardener should it fail to perform as specified in Article 1.6, below.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded, in ample time to prevent delay of that Work.
 2. Deliver materials in concrete hardener manufacturer's original unopened containers.
 3. Include the following information on the label:
 - a. Name of material and supplier.
 - b. Formula or specification number, lot number and date of manufacturer.
 - c. Mixing instructions, shelf life and curing time when applicable.
 4. Failure to comply with these requirements shall be sufficient cause for the rejection of the material in question, by Engineer, and requiring its removal from the Site. In such a case, supply new material conforming to the specified requirements, at no additional cost to Owner.
 5. Handle materials carefully to prevent inclusion of foreign materials.
 6. Do not open containers or mix components until all necessary preparatory Work has been completed.
- B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 2. Store materials so as to preclude the inclusion of foreign material.
 3. Protect material from freezing.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.5 JOB CONDITIONS

A. Environmental Conditions:

1. Do not apply concrete hardener to uncured concrete. Comply with manufacturer's written instructions for minimum ten days of curing time.
2. Apply hardener only when temperature of concrete is 50°F or above.

B. Protection:

1. Do not allow concrete hardener to overflow or spill onto adjoining surfaces.
2. Remove concrete hardener that is splashed on surfaces not designated to receive concrete hardener immediately by flushing with water.

C. Sequencing:

1. Coordinate the Work so that the concrete hardener is installed when best results will be obtained, as recommended by the manufacturer's technical representative.

1.6 GUARANTEE

- A. Provide a five year written guarantee, signed by Contractor and installer, stating that should concrete floors show signs of dusting because of wear and abrasion they will be re-installed, in the manner specified herein, at no additional cost to Owner, from the date of Final Acceptance of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete Hardener: Provide a clear, colorless, aqueous solution of chemically active silicates and fluosilicates plus a wetting and penetrating agent, that reacts with the free lime and calcium carbonates to bind soft, loose particles together and form a hard dense vitreous surface which is resistant to chemical attack and the growth of mildew, fungi and other organisms. Use potable water only.

2.2 MANUFACTURERS

- A. Products and Manufacturers: Provide one of the following:
 - 1. Lapidolith by Sonneborn Division of Contech, Incorporated.
 - 2. Armortop by Anti-Hydro Waterproofing Company.
 - 3. Or equal.

2.3 MIXES

- A. Follow manufacturer's written instructions for the proper mixing, dilution and coverage of each coat.

2.4 FINISH

- A. The finished installation of the concrete hardener shall have a smooth, uniform even finish without discontinuities or discolorations.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the substrates and the conditions under which the concrete hardener Work is to be performed and notify Engineer, in writing, of any conditions detrimental to the proper and timely completion of the Work and performance of the concrete hardener. Do not proceed with the concrete hardener Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 SUBSTRATE PREPARATION

- A. Steel trowel concrete in strict accordance with printed directions supplied by the concrete hardener manufacturer.
- B. Provide concrete free of all honeycombing and fins.
- C. Do not use sealers, curing or parting compounds on the concrete.
- D. Provide wet curing only.
- E. Surfaces to receive concrete hardener shall be clean, dry and free of all loose dirt, oil, wax and other foreign matter.

3.3 INSTALLATION

- A. Provide the services of a manufacturer's technical representative for the purpose of advising the installer of proper procedures and precautions for the use of the material prior and during the installation of the concrete hardener.
- B. Apply concrete hardener using the coverage recommended by the manufacturer per coat.
- C. Apply a minimum of three separate coats.
- D. Apply a fourth coat using undiluted material should the manufacturer's technical representative recommend this procedure, based on field conditions, and as directed by Engineer.
- E. Apply each coat by spray.
- F. Mop up excess solution or puddles.
- G. After each of the first and second applications, allow the floor to dry until no longer visibly wet.
- H. To avoid the development of crystals, when applying the third coat, flush the surface liberally with clean, hot water. At the same time, brush the floor rapidly with a stiff-bristle broom. Mop up excess water.
- I. Follow manufacturer's written instructions should white crystals develop after the first or second coat. Consult manufacturer's technical representative.

3.4 ADJUSTMENT AND CLEANING

- A. Clean adjacent surfaces of concrete hardener resulting from the Work. Use solvent or cleaning agent recommended by the concrete hardener manufacturer. Leave all finished Work in a clean neat appearance.
- B. Protect the concrete hardener until fully cured.

++ END OF SECTION ++

++ NO TEXT ON THIS PAGE ++

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and apply paint systems.
 - a. Contractor is responsible for surface preparation and painting of all new and existing interior and exterior items and surfaces throughout the Project areas included under this and other Sections.
2. Extent of painting includes the Work specified below. Refer to Article 2.2 of this Section where all surfaces of generic types are specified for preparation and painting according to their status, intended function, and location, using the painting system for that surface, function, and location as specified, unless specifically identified on the Drawings as a surface not to receive specified painting system.
 - a. All new items except where the natural finish of the material is specified as a corrosion-resistant material not requiring paint; or is specifically indicated in the Contract Documents as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.
 - b. Mechanical and process items to be painted include:
 - 1) Piping, pipe insulation, pipe hangers, and supports, including electrical conduit.
 - 2) Ductwork and insulation.
 - 3) Motors, mechanical equipment, and structural supports.
 - 4) Odor Control and Foul Air Ductwork supports.
 - 5) Accessory items.
 - c. Surface preparation and painting of all new items, both interior and exterior, and other surfaces, including items furnished by Owner, are included in the Work, except as otherwise shown or specified.
 - d. Approved stepped-down mock-ups for all painting systems showing all components of the surface preparation and paint system application before start of Work. Check all dry film thicknesses; demonstrate methods of surface preparation, and methods of application, and obtain Engineer's approval of colors and textures to be used in the Work.

B. Coordination:

1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
 2. Coordinate painting of areas that will become inaccessible once equipment, and similar fixed items have been installed.
 3. Coordinate primers with finish paint materials to provide primers that are compatible with finish paint materials. Review other Sections where primed surfaces are provided, to ensure compatibility of total painting system for each surface. Contractor is responsible for coordinating compatibility of all shop primed and field painted items in other Sections.
 4. Furnish information to Engineer on characteristics of finish materials proposed for use and ensure compatibility with prime coats used. Provide barrier coats over incompatible primers or remove and repaint as required. Notify Engineer in writing of anticipated problems using specified painting systems with surfaces primed by others. Reprime equipment primed in factory and other factory-primed items that are damaged or scratched.
- C. Related Sections:
1. Section 07920, Joint Sealants.
 3. Section 15052, Exposed Pipe Installation.
 4. Section 15061, Ductile Iron Pipe.
- D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections:
1. Shop Priming: Shop priming of structural metal, miscellaneous metal fabrications, other metal items and fabricated components such as shop-fabricated or factory-painted process equipment, plumbing equipment, heating and ventilating equipment, electrical equipment, and accessories shall conform to applicable requirements of this Section but are included under other Sections.
 2. Pre-finished Items:
 - a. Items furnished with such finishes as baked-on enamel, porcelain, and polyvinylidene fluoride shall only be touched up at Site by Contractor using manufacturer's recommended compatible field-applied touchup paint.
 - b. Items furnished with finishes such as chrome plating or anodizing.
 3. Concealed Surfaces: Non-metallic wall or ceiling surfaces in areas not exposed to view, and generally inaccessible areas.
 4. Concrete floors, unless specifically shown as a surface to be painted.
 5. Face brick, and prefaced concrete unit masonry.
 6. Collector bearings, shafts and chains, wood flights, wood stop logs, and wood or fiberglass baffles.
 7. Corrosion-Resistant Metal Surfaces: Where the natural oxide of item forms a barrier to corrosion, whether factory- or Site-formed, including such materials as copper, bronze, muntz metal, terne metal, and stainless steel.
 8. Operating Parts and Labels:

- a. Do not paint moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sensing devices, interior of motors, and fan shafts.
 - b. Do not paint over labels required by governing authorities having jurisdiction at Site, or equipment identification, performance rating, nameplates, and nomenclature plates.
 - c. Cover moving parts and labels during the painting with protective masking. Remove all protective masking upon completion of Work. Remove all paint, coatings, and splatter that comes in contact with such labels.
- 10. Structural and miscellaneous metals covered with concrete need not receive primers, intermediate, or finish coats of paint, except in the case of dissimilar materials or otherwise noted.
 - 11. Existing structures, equipment, and other existing surfaces and items unless otherwise shown or specified.
- E. Description of Colors and Finishes:
- 1. Color Selection:
 - a. A maximum of ten different colors will be selected by Engineer in addition to color-coding of pipelines, valves, equipment, ducts, and electrical conduit.
 - 2. Color Coding of Pipelines, Valves, Equipment, and Ducts:
 - a. In general, color-coding of pipelines, valves, equipment and ducts shall comply with applicable standards of ANSI A13.1, ANSI Z535.1 and 40 CFR 1910.144. Specifically, provide color-coding for pipelines per Table 09900-B, Pipeline Color Table following below. Colors shall be brilliant, distinctive shades matching the existing colors. Paint colors are provided as a standard of quality; equivalent colors matching these colors will be acceptable to Engineer. Provide Engineer with direct color comparisons of colors available from Manufacturer submitted at time of Shop Drawing submission.
 - b. The color of the final coats shall match as closely as possible, without custom blending, the color of the specific pipeline service.
 - c. For equipment on roofs or exposed to view, the color shall be selected by Engineer.
 - 3. After approval by Engineer of colors and Shop Drawing submittals and prior to beginning painting Work, Engineer will furnish color schedules and samples for surfaces to be painted listed in Article 2.1, Painting Systems.

**TABLE 09900-A
TABLE OF STANDARD COLORS**

<u>Color</u>	<u>Designation*</u>
Aqua	Aqua Sky; 10GN
Black	Black; 35GR
Blue	True/Safety Blue; 11SF
Brown	Terra Cotta; 07RD
Charcoal	Deep Space; GR34
Dark Blue	Old Glory Blue; 78BL
Dark Brown	Medium Bronze; 85BR
Dark Gray	Blackthorn; GR31
Gray	Gray-ANSI 61; 33GR
Green	Spearmint/Safety Green; 09SF
Light Blue	Fontainebleau; 25BL
Light Brown	Twine; 68BR
Light Gray	Light Gray; 32GR
Light Green	Misty Jade; GB38
Olive	Clover; 110GN
Orange	Tangerine/Safety Orange; 04SF
Red	Candy Apple/Safety Red; 06SF
White	White; 11WH
Yellow	Lemon/Safety Yellow; 02SF

*Color designations are provided per Tnemec Company, Inc. paint color numbers and are provided as a standard of quality; equivalent colors matching these colors are acceptable. Provide with Shop Drawing submittal direct color comparisons of color numbers available from manufacturer submitted.

- b. General Color Code: Unless otherwise specified, use the following color code:

**TABLE 09900-B
PIPELINE COLOR TABLE**

<u>Pipeline</u>	<u>Color</u>
<u>WATER</u>	
City Water	Blue
Flushing Water	Blue
<u>FUELS AND LUBRICANTS</u>	
Diesel Fuel Oil	Brown

PROCESS

Floor Drains	Gray
Sewage	Dark Gray
Storm Drains	Gray
Sump Drains	Gray

- c. Color of final coats shall match as closely as possible, without custom blending, color tabulated for specific pipeline service.
4. After approval by Engineer of colors and Shop Drawings and prior to commencing painting Work, Engineer will furnish color schedules for surfaces to be painted.

F. Abbreviations and Symbols:

1. Abbreviations and symbols used in painting systems are explained in Article 2.2 of this Section and provide information on generic composition of required materials, manufacturers, number of coats and dry mil film thickness per coat (DMFTPC), and coverage for determining required number of gallons for the Work.

1.2 REFERENCES

- A. Referenced Standards: Standards referenced in this Section or referenced in Product Performance Standards are:
1. ANSI A13.1, Scheme for Identification of Piping Systems.
 2. ANSI Z535.1, Safety Color Code.
 3. ANSI/NSF Standard 60, Drinking Water Treatment Chemicals - Health Effects.
 4. ANSI/NSF Standard 61, Drinking Water System Components – Health Effects.
 5. ASTM D16, Terminology for Paint, Related Coatings, Materials and Applications.
 6. ASTM D2200, Pictorial Surface Preparation Standards for Painting Steel Surfaces.
 7. ASTM D4258, Practice for Surface Cleaning Concrete for Coating.
 8. ASTM D4259, Practice for Abrading Concrete.
 9. ASTM D4262, Testing Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 10. ASTM D4263, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 11. ASTM D4285, Test Method for Indicating Oil or Water in Compressed Air.
 12. ASTM D4417, Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.

13. ASTM D4541, Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion-Testers.
14. ASTM E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
15. Green Seal, Inc. Paint, (GS-11).
16. GLUMRB, Recommended Standards for Wastewater Facilities.
17. National Association of Piping Fabricators, NAPF 500-03, Surface Preparation Standard For Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings And/or Special Internal Linings.
18. Ozone Transport Commission, (OTC), OTC Model Rule for Architectural and Industrial Maintenance Coatings.
19. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
20. SSPC SP 1, Solvent Cleaning.
21. SSPC SP 3, Power Tool Cleaning.
22. SSPC SP 6, Commercial Blast Cleaning.
23. SSPC SP 10, Near-White Blast Cleaning.
24. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.
25. SSPC Volume 2, Systems and Specifications.

1.3 DEFINITIONS

- A. Standard coating terms defined in ASTM D16 apply to this Section, including:
 1. Paint: Pretreatment and all painting system materials, such as primer, emulsion, enamel, organic/inorganic polymer coating, stain sealer and filler, and other applied materials whether used as prime, filler, intermediate, or finish coats.
 2. Exposed: All items not covered with cement plaster, concrete, or fireproofing. Items covered with these materials shall be provided with specified primer only, except where specified as a surface not to be painted. Exposed-to-view surfaces include areas visible after permanent or built-in fixtures, convactor covers, ceiling tile, covers for finned tube radiation, grilles, and similar covering products are in areas scheduled to be painted.
 3. Low VOC: All interior and exterior field-applied coatings that have maximum VOC content as listed in OTC Model Rule for Architectural and Industrial Maintenance Coatings.
 4. OTC: Ozone Transport Commission, which recommends standard VOC content levels in several Northeastern and Mid-Atlantic states.

1.4 QUALITY ASSURANCE

- A. Applicator Qualifications:
 1. Engage a single applicator that regularly performs installation of paint materials, with documented skill and successful experience in installing types of products required and that agrees to employ only trained, skilled

- tradesmen who have successful experience in installing types of products specified.
2. Submit name and qualifications to Engineer along with following information for at least three successful, completed projects:
 - a. Names and telephone numbers of owner and design professional responsible for project.
 - b. Approximate contract cost of paint products.
 - c. Amount of area painted.
 3. Submit to Engineer proof of acceptability of applicator by manufacturer.
- B. Testing Agency Qualifications: Provide an independent testing agency for testing specified in this Section. Testing agency shall be selected by Owner and paid for by Contractor. To qualify for approval, submit documentation demonstrating to satisfaction of Engineer, that testing agency has experience and capability to satisfactorily conduct testing required without delaying the Work, in accordance with ASTM E329.
- C. Source Quality Control:
1. Obtain materials from manufacturers that will provide services of a qualified manufacturer's representative at Site at commencement of painting Work, to advise on products, mock-ups, installation, and finishing techniques and, at completion of Work, to advise Engineer on acceptability of completed Work and during the course of the Work as may be requested by Engineer.
 2. Certify long-term compatibility of all coatings with surfaces.
 3. Do not submit products that decrease number of coats, surface preparation, or generic type and formulation of coatings specified. Products exceeding VOC limits and chemical content specified will not be approved.
 4. Engineer may review manufacturers' recommendations concerning methods of installation and number of coats of paint for each painting system. Contractor shall prepare construction costs based on painting systems, number of coats, coverage's and installation methods specified.
 5. Submit "or equal" products, when proposed, with direct comparison to products specified, including information on durability, adhesion, color and gloss retention, percent solids, VOC's grams per liter, and recoatability after curing.
 6. "Or equal" manufacturers shall furnish same color selection as manufacturers specified, including intense chroma and custom pigmented colors in all painting systems.
 7. Color Pigments: Provide pure, non-fading, applicable types to suit surfaces and services to be painted. Comply with:
 - a. Lead and Chromate: Lead and chromate content shall not exceed amount permitted by authorities having jurisdiction.
 - b. Areas subject to hydrogen sulfide fume exposure will be identified by Engineer. Through Contractor, paint manufacturer shall notify

Engineer of colors that are not suitable for long-term color retention in such areas.

- c. Manufacturer shall identify colors that meet the requirements of authorities having jurisdiction at Site for use in locations subject to contact with potable water or water being prepared for use as potable water.
 - d. Comply with paint manufacturer's recommendations on preventing coating contact with levels of carbon dioxide and carbon monoxide that may cause yellowing during application and initial stages of curing of paint.
- 8. Obtain each product from one manufacturer. Multiple manufacturing sources for the same system component are unacceptable.
 - 9. Certify product shelf life history for each product source for materials manufactured by the same manufacturer, but purchased and stored at different locations or obtained from different sources.
 - 10. Constantly store materials to be used for painting Work between 60 degrees F and 90 degrees F, and per paint manufacturer's written recommendations, for not more than six months. Certify to Engineer that painting materials have been manufactured within six months of installation and have not, nor will be, subjected to freezing temperatures.

D. Regulatory Requirements:

- 1. Comply with VOC content limits of OTC Model Rule for Architectural and Industrial Maintenance Coatings:
 - a. Industrial Maintenance Coatings: 340 grams per liter.
 - b. Interior and Exterior Non-Flat Coatings: 250 grams per liter.
- 2. Comply with the following:
 - a. 29 CFR 1910.144, Safety Color Code for Marking Physical Hazards.
 - b. 40 CFR, Subpart D-2001, National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - c. Resource Conservation and Recovery Act of 1976 (RCRA).
 - d. SW-846, Toxic Characteristic Leaching Procedure (TCLP).
- 3. Comply with authorities having jurisdiction at Site for blast cleaning, confined space entry, and disposition of spent abrasive and debris.

1.5 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings: Submit the following:
 - a. Copies of manufacturer's technical information and test performance data, including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contract Documents, and application instructions for each product proposed for use.
 - b. Submit proof of acceptability of proposed application techniques by paint manufacturer selected.

- c. Copies of Contractor's proposed protection procedures in each area of the Work explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption, and for maintaining acceptable application, curing, and environmental conditions during and after painting systems application.
 - d. List each material and cross-reference to the specific painting system and application, including a list of site-specific surfaces to which painting system will be applied. Identify by manufacturer's catalog number and general classification. State number of gallons of each product being purchased for delivery to Site and square foot area calculated to be covered by each painting system specified based on theoretical loss of 20 percent. Where actual area to be covered by paint system exceeds area submitted to Engineer for that system, proof of additional material purchase shall be provided to Engineer. Calculated coverage shall be as specified for each component of each painting system specified. This requirement does not take precedence over Contractor's responsibility to provide dry film thickness required for each component of each painting system.
 - e. Identify maximum exposure times allowable for each paint system component before next coat of paint can be applied. Submit proposed methods for preparing surfaces for subsequent coats if maximum exposure times are exceeded.
 - f. Information on curing times and environmental conditions that affect curing time of each paint system component and proposed methods for accommodating variations in curing time. Identify this information for each painting system in the Work.
 - g. Specification for spray equipment with cross-reference to paint manufacturer's recommended equipment requirements.
2. Samples: Submit the following:
- a. Original copies of manufacturer's complete color charts for each coating system.
 - b. Mock-ups specified for the Site.

B. Informational Submittals:

- 1. Certificates: Submit the following:
 - a. Certificate from paint manufacturer stating that materials meet or exceed Contract Documents requirements.
 - b. Evidence of shelf life history for all products verifying compliance with the requirements of the Contract Documents.
 - c. Contractor shall provide notarized statement verifying that all painting systems are compatible with surfaces specified. All painting systems components shall be reviewed by an authorized technical representative of paint manufacturer for use as a compatible system.

Verify that all painting systems are acceptable for exposures specified and that paint manufacturer is in agreement that selected systems are proper, compatible, and are not in conflict with paint manufacturer's recommended specifications. Show by copy of transmittal form that a copy of letter has been transmitted to paint applicator.

2. Test Reports: Submit the following:
 - a. Certified laboratory test reports for required performance and analysis testing in compliance with ASTM E329.
 - b. Adhesion testing plan and procedures.
 - c. Results of adhesion testing on existing surfaces containing paints or other coatings to be topcoated with paint systems specified. Prior to adhesion testing, submit a testing plan establishing methods, procedures and number of tests in each area where existing coatings are to remain and become substrate for painting Work. Based on results of adhesion testing, recommend methods, procedures, and painting system modifications, if necessary, for proceeding with Work.
 - d. Locations of and test methods for soil sampling before beginning Work and after Substantial Completion.
 - e. Proposed methods for testing, handling, and disposal of waste generated during Work.
 - f. Results of alkalinity and moisture content tests performed in accordance with ASTM D4262 and ASTM D4263.
 - g. Results of tests of film thickness, holidays, and imperfections.
3. Manufacturer's Instructions: Provide paint manufacturer's storage, handling, and application instructions prior to commencing painting Work at Site.
4. Manufacturer's Site Reports: Provide report of paint manufacturer's representative for each visit to Site by paint manufacturer's representative.
5. Special Procedure Submittals: Submit the following:
 - a. Proposed protection procedures for each area of Work, explaining methods of protecting adjacent surfaces from splatter, for confining application procedures in a manner that allows other work adjacent to surface preparation and painting Work to proceed safely and without interruption.
 - b. Site-specific health and safety plan.
 - c. Procedures for maintaining acceptable application, curing and environmental conditions during and after painting systems application.
 - d. Procedures for providing adequate lighting, ventilation, and personal protection equipment relative to painting Work.
6. Qualifications: Submit qualifications data specified in Article 1.4 of this Section for the following:
 - a. Applicator.
 - b. Testing laboratory

C. Closeout Submittals:

1. Maintenance Manual: Upon completion of the painting Work, furnish Engineer five copies of detailed maintenance manual including the following information:
 - a. Complete and updated product catalog of paint manufacturer's currently available products including complete technical information on each product. Identify product names and numbers of each product used in the painting Work.
 - b. Name, address, e-mail address and telephone number of manufacturer, local distributor, applicator and technical representative.
 - c. Detailed procedures for routine maintenance and cleaning.
 - d. Detailed procedures for light repairs such as dents, scratches and staining.
2. Statement of Application: Upon completion of the painting Work, submit a notarized statement to Engineer signed by Contractor and painting applicator stating that Work complies with requirements of the Contract Documents and that application methods, equipment, and environmental conditions were proper and adequate for conditions of installation and use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Product Delivery Requirements: Deliver products to Site in original, new, and unopened packages and containers, accurately and legibly and accurately labeled with the following:
 1. Container contents, including name and generic description of product.
 2. Manufacturer's stock number and date of manufacture.
 3. Manufacturer's name.
 4. Contents by volume, for major pigment and vehicle constituents.
 5. Grams per liter of volatile organic compounds.
 6. Thinning instructions, where recommended.
 7. Application instructions.
 8. Color name and number.
- B. Product Storage Requirements:
 1. Store acceptable materials at Site.
 2. Store in an environmentally controlled location as recommended in paint manufacturer's written product information. Keep area clean and accessible. Prevent freezing of products.
 3. Store products that are not in actual use in tightly covered containers.
 4. Comply with health and fire regulations of authorities having jurisdiction at Site.
- C. Product Handling Requirements:
 1. Handle products in a manner that minimizes the potential for contamination, or incorrect product catalyzation.

2. Do not open containers or mix components until necessary preparatory work has been completed and approved by Engineer and painting Work will start immediately.
3. Maintain containers used in storing, mixing, and applying paint in a clean condition, free of foreign materials and residue.

1.7 SITE CONDITIONS

A. Site Facilities:

1. Supplemental heat sources, as required to maintain both ambient and surface temperatures within range recommended by paint manufacturer for paint system application, are not available at Site.
2. Provision of supplemental heat energy sources, power, equipment, and operating, maintenance and temperature monitoring personnel is responsibility of Contractor.
3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being painted. Properly locate and vent such heat sources to exterior such that paint systems are unaffected by exhaust.

B. Environmental Requirements:

1. Apply water-base paints when the temperature of surfaces to be painted and ambient air temperatures are between 55 degrees F and 90 degrees F, unless otherwise permitted by paint manufacturer's published instructions.
2. Surfaces to be painted shall be at least 5 degrees F above dew point temperature and be dry to the touch. Apply paint only when temperature of surfaces to be painted, paint products, and ambient air temperatures are between 65 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's published instructions.
3. Apply paint system within shortest possible time consistent with manufacturer's recommended curing instructions for each coat. If chemical, salt, or other contamination contacts paint film between coats, remove contamination per SSPC SP 1 and restore surface before applying paint.
4. Do not paint tanks or pipelines containing fluid without specific permission of Engineer and only under conditions where "sweating" of outside surface of vessel being painted is not likely to occur within 24 hours of paint application.
5. Do not apply epoxy paints if ambient temperature is expected to go below 50 degrees F within twelve hours of application. Follow manufacturer's instructions when manufacturer's published recommendations require a higher minimum ambient temperature.
6. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent. Do not apply paint to damp or wet surfaces or when surfaces will reach dew point due to falling or rising temperatures and humidity conditions during course of paint application, unless otherwise permitted by paint manufacturer's published instructions.

7. Do not paint unacceptably hot or cold surfaces until such surfaces can be maintained within temperature and dew point ranges acceptable to paint manufacturer. Arrange for surfaces to be brought within acceptable temperature and dew point ranges as part of painting Work.
8. Moisture content of surfaces shall be verified to Engineer as acceptable prior to commencement of painting using methods recommended by paint manufacturer.
9. Painting may be continued during inclement weather only if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer for application and drying.
10. Provide adequate illumination and ventilation where painting operations are in progress.

C. Protection:

1. Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently, or not to be painted.
2. During surface preparation and painting, facility shall remain in operation. Use procedures that prevent contamination of process or cause or require facility shutdown.
3. Coordinate and schedule surface preparation and painting to avoid exposing employees of Contractor, Owner, Engineer and others not involved with surface preparation and painting, to hazards associated with painting Work. Provide required personnel safety equipment per requirements of authorities having jurisdiction at Site.
4. Submit protection procedures to be employed by Contractor to Engineer. Do not begin surface preparation and painting Work in any area until Engineer accepts protection techniques proposed by Contractor.
5. When working with flammable materials, provide fire extinguishers and post caution signs warning against smoking and open flame.

1.8 MAINTENANCE

- A. Extra Materials: Furnish, tag, and store an additional one percent by volume of all coatings and colors installed. Provide a minimum of one gallon of each coating and color. Store in unopened containers as specified until turned over to Owner.

PART 2 - PRODUCTS

2.1 PAINTING SYSTEM MANUFACTURERS

- A. Products and Manufacturers: Where referenced under painting systems provide products manufactured by the following:
 1. Tnemec Company, Inc. (TCI).
 2. The Carboline Company, part of StonCor Group, an RMP Company (TCC).

3. PPG Protective & Marine Coatings (PPG PMC).
4. Pittsburgh Architectural Finishes (PPG PAF)
5. Benjamin Moore & Company (BMC).
6. ICI Paints (ICI).
7. Righter Group Inc. (RGI)
8. Duron Inc. (DI)
9. Or Equal.

2.2 PAINTING SYSTEMS

- A. New and Existing Cast-In-Place Concrete Walls (except walls within height of chemical containment wall areas), Columns, Underside of Roof Slabs and Beams; Moderate Corrosion and Abrasion-Resistant, Non-Submerged, Interior:
 1. Surface Preparation: Refer to Paragraphs 1.5.A.2, 3.2.A., 3.2.B.3., 3.2.B.5., 3.2.B.6., and 3.2.B.7 of this Section.
 2. Filler, Surfacer and Patching Compound:
 - a. Generic Components:
 - 1) Minimum 100 percent solids, epoxy modified cement; 40 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 218 MortarClad and Series 219 MortarCast (TCI); Carboguard 501/510 (TCC); Cor-Cote Epoxy Polymer Concrete or TPM 721 Repair and Leveling Mortar (SWC): One coat, hand troweled-in-place up to two inches deep for patching and applied 1/16-inch thick continuously over all surfaces specified to receive this painting system, 20 square feet per gallon (excluding patched areas); and provided in sufficient additional quantity to bring all surfaces to a smooth, uniform continuously coated plane, of thickness specified.
 3. Primer/Intermediate:
 - a. Generic Components:
 - 1) Minimum 42 percent solids, waterborne acrylic epoxy; 240 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 113 H.B. Tneme-Tufcoat (TCI); Sanitile 255 (TCC); Epo-Plex Multi-Mil (SWC): Two coats, 5.0 dry mils, per coat.
 4. Finish: Gloss:
 - a. Generic Components:
 - 1) Minimum 42 percent solids, waterborne acrylic or water-based epoxy; 285 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 114 Tneme-Tufcoat UR (TCI); Sanitile 255 (TCC); Waterborne Epoxy 3479 (SWC): One coat, 2.0 to 3.0 dry mils.

- B. New and Existing Cast-In-Place Concrete Associated Within All Influent Channels and the Influent Spaces; Non-submerged, Intermittently Submerged and Submerged, Interior and Exterior:
1. Provide painting system components specified for all cast-in-place concrete surfaces within the Grinder Chamber, the Equalization Tanks, and the Wet Wells, including troughs, walls, beams, columns, undersides of slabs, undersides of walkways, and other locations required.
 2. Surface Preparation: Refer to Paragraphs 1.5.A.2., 3.2.A., 3.2.B.3., 3.2.B.5., 3.2.B.6. and 3.2.B.7.
 3. Filler, Surfacer and Patching Compound:
 - a. Generic Components:
 - 1) Minimum 100 percent solids, epoxy modified cement; 40 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 215 Suirfacing Epoxy (TCI); Carboguard 510 (TCC); Dura-Plate 2300 (SWC): - patch and fill to original surface but no less than 1/32" to 1/8".
 4. Intermediate Filler, Surfacer and Patching Compound:
 - a. Generic Components:
 - 1) Minimum 100 percent solids, aliphatic amine or polyamine epoxy mortar; 95 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 434 Perma-Shield H₂S (TCI); Plasite 4500 S (TCC); Dura-Plate 6000 (SWC): 1/8-inch thick, minimum.
 5. Finish: Gloss:
 - a. Generic Components:
 - 1) Minimum 100 percent solids, modified polyamine epoxy; 119 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 435 Perma-Glaze (TCI); Plasite 4500 S (TCC); Dura-Plate 6000 (SWC): One coat, 10.0 to 15.0 dry mils.
- C. New and Existing Concrete Unit Masonry Walls; Moderate Corrosion and Abrasion Resistant, Non-submerged, Interior:
1. Surface Preparation: Refer to Paragraphs 1.5.A.2., 3.2.A., 3.2.B.1., 3.2.B.2. and 3.2.B.8.
 2. Filler, Surfacer and Patching Compound:
 - a. Generic Components:
 - 1) Minimum 68 percent volume solids, high-build, three-component, waterborne cementitious acrylic block filler; 75 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 130 Envirofill (TCI); Sanitile 600 TG (TCC); Cement-Plex 875 (SWC): One coat, 10 to 14 dry mils.
 3. Intermediate/Finish:

- a. Generic Components:
 - 1) Minimum 80 percent volume solids, high-build, chemical-resistant, high-gloss, modified, polyamine or polyamido-amine catalyzed epoxy finish; 180 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 280 Tneme-Glaze (TCI); Carboguard 890 LT (TCC); Cor-Cote HP (SWC):
 - a) Horizontal Surfaces: Two coats, 6.0 to 12.0 dry mils, per coat.
 - b) Vertical Surfaces: Two coats, 4.0 to 8.0 dry mils, per coat.
- D. New Ferrous Metals, Structural Steel, Miscellaneous Ferrous Metals, Exterior Surfaces of Valves, Exterior Surfaces of Ferrous Piping, and Exterior Surfaces of All Ferrous Metal; Non-submerged, Interior:
 - 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A., 3.2.C.1., 3.2.C.2.
 - 2. Shop Primer:
 - a. Generic Components:
 - 1) Minimum 66 percent volume solids, build, two-component, cycloaliphatic amine-catalyzed epoxy or polyamido-amine epoxy coating; 300 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Amercoat 370 (PPG PMC); Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC): One coat, 4.0 to 6.0 dry mils.
 - 3. Field Primer and Touch-Up:
 - a. Generic Components:
 - 1) Minimum 100 percent volume solids, high-build, two-component, polyamide-catalyzed epoxy; 8 grams per gallon VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Amerlock Sealer (PPG PMC); Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Cor-Cote HP (SWC): One coat.
 - 4. Finish: Gloss:
 - a. Generic Components:
 - 1) Minimum 80 percent volume solids, high-build, chemical-resistant, high-gloss, modified, polyamine- or polyamidoamine-catalyzed epoxy finish; 180 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Amerlock 2/400 Series (PPG PMC); Series 104 H.S. Epoxy (TCI); Carboguard 890 LT (TCC); Cor-Cote HP (SWC):
 - a) Horizontal Surfaces: One coat, 6.0 to 12.0 dry mils.
 - b) Vertical Surfaces: One coat, 4.0 to 8.0 dry mils.
- E. New Ferrous Metals, Non-Ferrous Metals and Exterior Surfaces of Piping; Submerged or Intermittently Submerged, including up to 4.0 above liquid surface; Interior and Exterior:
 - 1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A., 3.2.C.1., 3.2.C.2., and 3.2.E.

2. Factory Primer:
 - a. Generic Components:
 - 1) Minimum 66 percent solids, two-component, cycloaliphatic amine-catalyzed epoxy or polyamido-amine epoxy; 334 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Amercoat 370 (PPG PMC); Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Macropoxy HS Epoxy (SWC): One coat, 4.0 dry mils.
 3. Shop Prime/Touch-Up/Finish, Satin:
 - a. Generic Components:
 - 1) Minimum 80 percent volume solids, high-build, two-component, polyamide-catalyzed epoxy or polyamido-amine epoxy; 180 grams per gallon VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Amerlock 2/400 Series (PPG PMC); Series N69 Hi-Build Epoxoline (TCI); Carboguard 890 LT (TCC); Dura-Plate UHS (SWC): Three coats, 4.0 to 15.0 dry mils, per coat.
- F. New Galvanized Metal, and Fiberglass; Non-submerged, Interior:
1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A., 3.2.D., 3.2.E. and 3.2.F.
 2. Primer:
 - a. Generic Components:
 - 1) Minimum, 39 percent volume solids single-component, self-cross linking acrylic primer-sealer, 140 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Pitt Tech EDF 90-812 Series (PPG PMC); Series 115 Uni-Bond DF (TCI); Galoseal Wash Primer (TCC); One coat, 2.0 to 4.0 dry mils.
 3. Finish: Satin:
 - a. Generic Components:
 - 1) Minimum, 41 percent volume solids, single component, self-cross linking acrylic; 208 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Pitt Tech EDF 90-812 Series (PPG PMC); Series 116 Uni-Bond (TCI); Carbocrylic 3359 (TCC); One coat, 2.0 to 4.0 dry mils.
- G. New and Existing Aluminum in Contact with Dissimilar Materials:
1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A. and 3.2.D.
 2. Primer/Finish:
 - a. Generic Components:
 - 1) Minimum 80 percent volume solids, high-build, two-component, polyamido-amine or polyamine epoxy; 180 grams per gallon VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:

- 1) Amerlock 2/400 Series (PPG PMC); Series N69 Hi-Build Epoxoline 100 (TCI); Carboguard 954 HB (TCC); Dura-Plate UHS (SWC): Two coats, 4.0 to 15.0 dry mils, per coat.

H. New and Existing Exterior Surfaces of Ductile Iron Pipe; Buried Exterior:

1. Refer to Section 15061, Ductile Iron Pipe.

I. New Pipe and Duct Insulation, Cloth, Paper and Canvas Jacketed; Non-submerged, Interior:

1. Surface Preparation: Refer to Paragraphs 1.7.B., 3.2.A. and 3.2.G.
2. Primer:
 - a. Generic Components:
 - 1) Minimum 38 percent volume solids single-component, self-cross linking acrylic primer-sealer; 159 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 115 Uni-Bond DF (TCI); Sanitile 120 (TCC); (PPG PMC); One coat, 2.0 to 4.0 dry mils.
3. Finish: Satin:
 - a. Generic Components:
 - 1) Minimum 37 percent volume solids, single component, self-cross linking acrylic; 226 grams per liter VOC, maximum.
 - b. Products and Manufacturers: Provide one of the following:
 - 1) Series 1029 Enduratone (TCI); Carbocrylic 3358 (TCC); (PPG PMC); One coat, 2.0 to 4.0 dry mils.

2.3 JOINT SEALANTS

- A. Refer to Section 07920, Joint Sealants.

2.4 INSTRUMENTS

A. Instruments:

1. Contractor shall purchase for Owner two new dry-film thickness gauges for checking film thickness, and one set of visual standards to check surface preparation. Calibrate dry film thickness gauge at the Site using Bureau of Standards standard shim blocks. Provide one holiday detector for holiday testing. The holiday detector will remain the property of Contractor.
2. Products and Manufacturers: Provide the following:
 - a. Film Thickness Testers: Model FM-III manufactured by Mikrotest, or equal.
 - b. Holiday detector shall be Model M-1 as manufactured by Tinker & Rasor, or equal.
 - c. Visual Standards: ASTM D2200, Swedish Standards, SSPC VIS 1.

2.5 SNAP-ON PIPE MARKERS

- A. Snap-On Pipe Markers:
 - 1. Wrap around labels to attach to pipe with no string, straps or adhesives.
 - 2. Manufacturers:
 - a. Custom B-689 High Performance Pipe Markers by Brady USA, Incorporated – Signmark Division.
 - b. Brimar: System #1 Pipe Markers.
 - c. Or Equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine areas and conditions under which painting Work is to be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film capable of performing in accordance with claims made in paint manufacturer's product literature for surfaces and conditions encountered.

3.2 SURFACE PREPARATION

- A. General:
 - 1. Test for moisture content of surfaces before commencement of painting Work. Test for moisture in concrete in compliance with ASTM D4263. Report results to Engineer before commencing Work.
 - 2. Perform preparation and cleaning procedures as specified herein and in strict accordance with paint manufacturer's approved instructions for each surface and atmospheric condition.
 - 3. Contractor shall provide effective surface-applied protection for in place items that do not require painting prior to surface preparation and painting operations.
 - 4. Contractor shall remove as necessary items that must be field-painted where adjacent surfaces cannot be completely protected from splatter or overspray. Following completion of painting of each space or area, the removed items shall be reinstalled by workers skilled in the trades involved.
 - 5. Clean surfaces to be painted before applying painting system components. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning.
 - 6. Prepare surfaces that were improperly shop-painted and abraded or rusted shop-painted surfaces as specified.

B. Cast-In-Place Concrete:

1. Prepare surfaces of concrete unit masonry to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and other contamination using soap and water. Surfaces shall be clean and dry at time of paint system application.
2. Concrete unit masonry that cannot be adequately cleaned using soap and water shall be acid etched with a commercial solution of 15 percent muriatic acid.
3. Prepare and clean cast-in-place concrete and precast concrete surfaces per ASTM D4259 to provide a uniform and continuous anchor profile of approximately one mil. Provide mechanical abrading and abrasive blasting per ASTM D4259. Use 40 to 80-mesh abrasive and clean, dry, compressed air. Compressed air cleanliness shall be per ASTM D4285. Pressure at blasting nozzle shall not exceed 80 pounds per square inch. Do not concentrate blast on surface; instead, move at a fairly rapid rate to provide a surface free of laitants and contaminants. Provide post-surface preparation cleaning per ASTM D4258 to remove loose material. Surface preparation shall open all surface air holes by removing laitance shoulders surrounding air holes. Vacuum surfaces to remove dust and sand, and wash with potable water.
4. Where paint system is for chemical containment barrier protection, repair cracks and expansion joints in concrete and provide 2-inch radiused cove base fillets at equipment pads and containment walls as part of complete chemical containment paint system Work. Use materials and techniques recommended by manufacturers of the paint and concrete repair products.
5. Remove from cast-in-place concrete fins, projections, and other surface irregularities that would protrude above level of finished intermediate fillers and surfacers. Remove by chipping and scarification by mechanical abrasion.
6. Using specified filler and surfacer, patch cast-in-place concrete and precast concrete surfaces as required to completely fill surface air holes and honeycombing. Level all protrusions, grind filler and surfacing compounds smooth, and level with adjacent surfaces.
7. Perform tests per ASTM D4262 and ASTM D4263 to verify alkalinity and moisture content of surfaces to be painted, and report findings to Engineer. If, in Engineer's opinion, surfaces are sufficiently alkaline to cause blistering and burning of paint, correct the condition before applying paint. Provide suitable testing materials for alkalinity and moisture tests. Do not paint surfaces where the moisture content exceeds eight percent.
8. Where a concrete unit masonry block filler is specified, spot patch holes and cracks with a putty knife using specified block filler. Apply to large surfaces by airless spray and backroll uniformly using a roller with a synthetic nap cover. Follow with a rubber squeegee to provide a smooth finish.

C. Ferrous Metals:

1. Ferrous Metals except Ductile and Cast Iron:
 - a. Comply with paint manufacturer's recommendations for type and size of abrasive to provide a surface profile that meets manufacturer's painting system requirements for type, function, and location of surface. Verify that paint manufacturer-recommended profiles have been achieved on prepared surfaces. Report profiles to Engineer using Test Method C of ASTM D4417.
 - b. Clean non-submerged ferrous surfaces including structural steel and miscellaneous metal to be shop-primed, of all oil, grease, dirt, mill scale, and other contamination by commercial blast cleaning complying with SSPC SP 6 at time of paint system application, using SSPC VIS 1 as a standard of comparison.
 - c. Clean submerged ferrous surfaces including structural steel and miscellaneous metal to be shop-primed of all oil, grease, dirt, mill scale, and other contamination by near-white blasting complying with SSPC SP 10 at time of painting system application, using SSPC VIS 1 as a standard of comparison.
 - d. Clean non-submerged, ferrous surfaces that have not been shop-coated of all oil, grease, dirt, loose mill scale, and other contamination by commercial blasting complying with SSPC SP 6 at the time of painting system application, using SSPC VIS 1 as a standard of comparison.
 - e. Clean submerged ferrous surfaces that have not been shop-coated or that have been improperly shop-coated of all oil, grease, dirt, mill scale, and other contamination by near-white blasting complying with SSPC SP 10 at time of painting system application, using SSPC VIS 1 as a standard of comparison.
 - f. Touch-up shop-applied prime coats that have damaged or have bare areas with primer recommended by paint manufacturer after commercial blasting complying with SSPC SP 6 at the time of painting system application, using SSPC VIS 1 as a standard of comparison, to provide a surface profile of not less than one mil.
 - g. Power tool-clean per SSPC SP 3 to remove welding splatter and slag.
2. Ductile and Cast Iron:
 - a. Comply with paint manufacturer's recommendations and NAPF 500-03 for type and size of abrasive to provide a surface profile meeting paint manufacturer's requirements for type, function and location of surface. Verify that paint manufacturer-recommended profiles are achieved on prepared surfaces.
 - b. Clean submerged and non-submerged ductile and cast iron surfaces to be shop-primed of all oil, grease, dirt, mill scale, and other contamination by solvent cleaning and abrasive blasting complying with NAPF 500-03-01, NAPF 500-03-04, and NAPF 500-03-05 at time of paint system application.

- c. Clean submerged ductile and cast iron that have not been shop-coated or that have been improperly shop-coated of all oil, grease, dirt, mill scale, and other contamination by solvent cleaning and abrasive blasting complying with NAPF 500-03-01, NAPF 500-03-04, and NAPF 500-03-05 at time of paint system application.
 - f. Touch-up shop-applied prime coats that are damaged or have bare areas with primer recommended by paint manufacturer, after power tooling complying with NAPF 500-03 at the time of painting system application.
- D. Non-Ferrous Metal Surfaces: Prepare non-ferrous metal surfaces for painting by light whip blasting or by lightly sanding with 60- to 80-mesh sandpaper.
- E. Galvanized (Zinc-Coated) Surfaces: Prepare galvanized surfaces for painting by lightly sanding with 60- to 80-mesh sandpaper or by light whip blasting.
- F. PVC and CPVC Piping and Fiberglass: Lightly sand and clean surfaces to be painted. Fiberglass surfaces shall be prepared by solvent washing to remove wax and other contaminants, before abrading surfaces with 60- to 80-mesh sandpaper to provide an anchor pattern with scratches no further apart than 1/16-inch.
- G. Covering on Pipe Insulation:
 - 1. Remove all oil and surface contaminants as recommended by paint and insulation cover manufacturer for surface and application required.
 - 2. Do not cut or damage insulation and covering.

3.3 PROTECTION OF PROPERTY AND STRUCTURES

- A. Protect property and structures adjacent to the Work from waste residues resulting from cleaning, surface preparation and paint application.
- B. Use shrouding, vacuum blasting, or other approved methods for cleaning and surface preparation of exterior surfaces.
- C. During blast cleaning and surface preparation of interior and exterior surfaces, control discharge of dust and grit, using shrouding, negative-pressure containment/dust collection systems, or other means to protect adjacent property and structures and prevent dust/grit from escaping. Similarly control removal and temporary storage of residues to protect adjacent property and structures.
- D. For painting of exterior surfaces, use rollers, shrouding or other approved methods as required to protect adjacent property and structures from wind-blown paint residues.

- E. Submit proposed procedures for cleaning, surface preparation and paint application describing methods for protecting adjacent property and structures from residues. Do not proceed with cleaning, surface preparation or painting until proposed procedures are approved by Engineer.

3.4 MATERIALS PREPARATION

A. General:

- 1. Mix and prepare paint products in strict accordance with paint manufacturer's product literature.
- 2. Do not mix painting materials produced by different manufacturers, unless otherwise permitted by paint manufacturer's instructions.
- 3. Where thinners are required, they shall be produced by paint system manufacturer unless otherwise permitted by paint manufacturer's product literature and submitted to and accepted by Engineer with Shop Drawings.

B. Tinting:

- 1. Where multiple coats of the same material are to be provided, tint each undercoat a lighter shade to facilitate identification of each coat of paint.
- 2. Tint undercoats to match color of finish coat of paint, but provide sufficient difference in shade of undercoats to distinguish each separate coat. Provide a code number to identify material tinted by manufacturer.

C. Mixing:

- 1. For products requiring constant agitation, use methods in compliance with manufacturer's product literature to prevent settling during paint application.
- 2. Mix in containers placed in suitably sized non-ferrous or oxide resistant metal pans to protect floors from slashes or spills that could stain the floor or react with subsequent finish floor material.
- 3. Mix and apply paint in containers bearing accurate product name of material being mixed or applied.
- 4. Stir products before application to produce a mixture of uniform density and as required during the application. Do not stir into the product film that forms on surface; instead, remove film and, if necessary, strain product before using.
- 5. Strain products requiring such mixing procedures. After adjusting mixer speed to break up lumps and after components are thoroughly blended, strain through 35 to 50-mesh screen before application.

3.5 APPLICATION

A. General:

- 1. Apply paint systems by brush, roller, or airless spray per manufacturer's recommendations and in compliance with Paint Application Specifications No. 1 in SSPC Volume 2, where applicable. Use brushes best suited for type of paint applied. Use rollers of carpet, velvet back, or high pile sheeps

wool as recommended by paint manufacturer for product and texture required. Use air spray and airless spray equipment recommended by paint manufacturer for specific painting systems specified. Submit a list of application methods proposed, listing paint systems and location.

2. Paint dry film thicknesses required are the same regardless of the application method. Do not apply succeeding coats until previous coat has completely dried.
3. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is uniform finish, color, and appearance, particularly for intense chroma primary colors. Ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a film thickness equivalent to that of flat surfaces.
4. Surfaces of items not normally exposed-to-view do not require the same color as other components of system of which they are part, but require the same painting system specified for exposed surfaces of system.
5. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint before final installation of registers or grilles.
6. Paint backs of access panels and removable or hinged covers to match exposed surfaces.
7. Paint aluminum parts in contact with dissimilar materials with specified paint system.
8. Paint tops, bottoms, and side edges of doors the same as exterior surfaces.
9. Omit field-applied primer on metal surfaces that have been primed in the shop. Touch-up paint shop-primed coats and pre-finished items only when approved by Engineer using compatible primers and manufacturer's recommended compatible field-applied finishes.
10. Welds shall be stripe-coated with intermediate or finish coat of paint after application of prime coat.

B. Minimum/Maximum Paint Film Thickness:

1. Apply each product at not less than, nor more than, manufacturer's recommended spreading rate, and provide total dry film thickness as specified.
2. Apply additional coats of paint if required to obtain specified total dry film thickness.
3. Maximum dry film thickness shall not exceed 100 percent of minimum dry film thickness, except where more stringent limitations are recommended by paint manufacturer for a specific product.

C. Scheduling Surface Preparation and Painting:

1. As soon as practical after preparation, apply first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting. Apply first-coat material before subsequent surface deterioration due to atmospheric conditions existing at time of surface preparation and painting.

- Surfaces that have started to rust before first-coat application is complete shall be brought back to required standard by abrasive blasting.
2. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and application of another coat of paint does not cause lifting or loss of adhesion to undercoat.
 3. Scarify primers and other painting system components by brush-blasting if paint has been exposed for lengths of time or under conditions beyond manufacturer's written recommendations for painting systems required, intended use, or method of application proposed for subsequent coats of paint.
 4. Schedule cleaning and painting so that dust and other contaminants from cleaning process do not fall on wet, newly painted surfaces.
- D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient sealing.
- E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.
- F. Brush Application:
1. Brush out and work all brush coats onto surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are unacceptable. Neatly draw all glass and color break lines.
 2. Brush-apply primer or first coats, unless otherwise permitted to use mechanical applicators.
- G. Mechanical Applicators:
1. Use mechanical methods for paint application when permitted by governing ordinances, manufacturer, and approved by Engineer.
 2. Limit roller applications, if approved by Engineer, to interior wall finishes for second and third coats. Apply each roller coat to provide the equivalent hiding as brush-applied coats.
 3. Where spray application is used, apply each coat to provide equivalent hiding of brush-applied coats. Do not double back with spray equipment for purpose of building up film thickness of multiple coats in one pass.
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by Engineer.

3.6 FIELD QUALITY CONTROL

- A. Engineer may invoke the following material testing procedure at any time, and any number of times, during field painting Work:
 - 1. Contractor shall engage service of an independent testing laboratory to sample paints used, as designated by Engineer. Samples of products delivered to the Site shall be obtained, identified, sealed, and certified as to being products actually applied to the surfaces in each area, in the presence of Contractor.
 - 2. A testing laboratory selected by Owner and paid for by Contractor shall perform appropriate tests for any or all of the following:
 - a. Abrasion resistance.
 - b. Apparent reflectivity.
 - c. Flexibility.
 - d. Washability.
 - e. Absorption.
 - f. Accelerated weathering.
 - g. Dry opacity.
 - h. Accelerated yellowness.
 - i. Recoating.
 - j. Skinning.
 - k. Color retention.
 - l. Alkali resistance.
 - m. Quantitative materials analysis.
 - 3. If the test results show that the products being used do not comply with the specified requirements, Contractor may be directed to stop painting Work and remove non-complying paint, and shall prepare and repaint surfaces coated with the rejected paint with material complying with the Contract Documents.
- B. Notify Engineer after completing each coat of paint. After inspection and checking of film thickness, holidays, and imperfections, and after acceptance by Engineer, proceed with succeeding coat. Perform testing using testing instruments specified in Article 2.4 of this Section.
 - 1. Engineer will witness all testing and shall be notified of scheduled testing at least twenty-four hours in advance.
 - 2. Apply additional coats, if required, to produce specified film thickness and to correct holidays and to completely fill all surface air holes.
- C. For magnetic substrates, measure thickness of dry film nonmagnetic coatings following recommendations of SSPC PA-2. These procedures supplement manufacturers' approved instructions for manual operation of measurement gauges and do not replace such instructions.
- D. Record time, location, number of coats, dry film thickness, holidays, and other imperfections and submit testing results to Engineer.

3.7 PROTECTION OF NEW FINISHES

- A. Provide signs that read, “Wet Paint” as required to protect newly painted finishes. Remove temporary wrappings provided for protection of the Work and work of other contractors after completion of painting.

3.8 ADJUSTING AND CLEANING

- A. Correct damages to work of other trades through cleaning, repairing or replacing, and repainting, as acceptable to Engineer.
- B. During progress of Work, remove from Site all discarded paint materials, rubbish, cans, and rags at end of each workday.
- C. Upon completion of painting, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, while avoiding scratching or otherwise damaging finished surfaces.
- D. At completion of work of other trades, touch-up and restore damaged or defaced painted surfaces as determined by Engineer.

3.9 SCHEDULES

- A. The schedules listed below, following the “End of Section” designation, are a part of this Specification section.
1. Table 09900-C, Painting Schedule.

**TABLE 09900-C
PAINTING SCHEDULE**

Facility or Surface *	Room No.	Painting System **	Remarks
Valve Pit – New & Existing Concrete walls, columns, underside of slabs	Valve Pit	A	
Grinder Chamber (including Grinder Forebay), Equalization Tanks (including Equalization Tank Forebay) & Wet Wells - New & Existing Concrete walls, floors, columns, underside of slabs, sumps, troughs, etc.	Grinder Chamber, Equalization Tanks, Wet Wells	B	
Concrete Unit Masonry Wall	Electrical Room	C	All exposed sides and top of wall
New, and Existing to remain,	All locations	D	

Ferrous Metals, Structural Steel, Miscellaneous Ferrous Metals, Exterior Surfaces of Valves, Exterior Surfaces of Ferrous Piping, and Exterior Surfaces of All Ferrous Metal; Non-submerged, Interior			
New, and Existing to remain, Ferrous Metals, Non-Ferrous Metals and Exterior Surfaces of Piping; Submerged or Intermittently Submerged, including up to 4.0 above liquid surface; Interior and Exterior	Grinder Chamber, Equalization Tanks, Wet Wells	E	
New Galvanized Metal, and Fiberglass; Non-submerged, Interior	All locations	F	
New and Existing Aluminum in Contact with Dissimilar Materials	All locations	G	
New Pipe Insulation, Cloth, Paper and Canvas Jacketed; Non-submerged, Interior	Valve Pit, Electrical Room	I	

* Refer to Drawings for facility locations not listed above.

** Refer to Article 2.2 of this Section.

+ + END OF SECTION + +

SECTION 10400

IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install identification devices.
 - a. General Contractor shall be responsible for all identification devices throughout the Project as shown and as specified herein.
2. Extent of identification devices is shown and, where indicated, as specified.
3. Types of products required include the following:
 - a. Room identification, information, entry and directional signs.
 - b. Health, safety, warning, and fire extinguisher location signs.
 - c. Pipeline identification signs, tags, and equipment nameplates.
 - d. Stainless steel fasteners, supports, very-high-bond high-performance mounting tape, primers and other accessories.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the identification devices.
2. Coordinate adhesives and fasteners with mounting surfaces. Review other Sections in order to ensure compatibility of identification device mounting accessories for the various surfaces.

C. Related Sections:

1. Section 09900, Painting.

1.2 REFERENCES

A. Standards referenced in this Section or referenced in Product Performance Standards are listed below:

1. AA SAA-46, Standards for Anodized Architectural Aluminum.
2. AA DSA-45, Designation System for Aluminum Finishes.
3. ANSI A13.1 Scheme for the Identification of Piping Systems.
4. ANSI A117.1, Accessible and Usable Buildings and Facilities.
5. ANSI Z535.1, Safety Color Code.
6. ANSI Z535.2, Environmental and Facility Safety Signs.
7. ANSI Z535.3, Criteria for Safety Symbols.
8. ANSI Z535.4, Product Safety Signs and Labels.
9. ANSI Z535.5, Accident Prevention Tags (for Temporary Hazards).

10. ASTM A 167, Specification for Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet, and Strip.
11. ASTM E 527, Practice for Numbering Metals and Alloys (UNS).
12. CAS Registry Numbers for Specific Chemical Identity.
13. CDA, Properties of Cast Copper Alloys.
14. NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
15. OSHA 1970, Title 29, Code of Federal Regulations Part 1910.1200, Hazard Communication Standard.
16. OSHA 1970, Title 29, Code of Federal Regulations Part 1910, Subpart Z, Toxic and Hazardous Substances.
17. OSHA 1970, Title 29, Code of Federal Regulations Part 1910.144, Safety Color Code for Marking Physical Hazards.
18. OSHA 1970, Title 29, Code of Federal Regulations Part 1910. 145, Specification for Accident Prevention Signs and Tags.

1.3 QUALITY ASSURANCE

A. Identification Devices Manufacturers:

1. Engage firms specializing in the production of the types of products specified, in compliance with specified standards, with a documented record of successful in-service performance, and who can provide sufficient production capacity to avoid delaying the Work.
2. Submit name and experience record of manufacturers to Engineer.

B. Component Supply and Compatibility:

1. Obtain each separate type of identification device from a single supplier and from a single manufacturer.
2. Colors shall be brilliant, distinctive shades, matching the safety colors specified in ANSI Z535.1 and OSHA 1910.144.

C. Requirements of Regulatory Agencies:

1. All accident prevention signs and tags shall comply with OSHA 1910.145.
2. All health, safety and warning signs shall comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3 and OSHA 1910.144 and 1910.145, unless otherwise specified. The colors shall be those of opaque glossy samples as specified in Table 1 of ANSI Z535.1. Safety symbol pictograms shall be incorporated into each sign, in addition to text.

D. Codes: Comply with applicable requirements of New York State Building Code.

1.4 SUBMITTALS

A. Samples: Submit the following:

1. Each color and finish of exposed materials and accessories required for identification devices.
2. Actual full-size sample of each type of permanent room identification

sign and informational and directional sign incorporating all features specified; pipeline identification sign and mounting accessories; equipment and structure nameplate, valve tags and accessories; and right-to-know signs, labels and tags. Stamp valve tag with information shown on valve schedules. Information on the type of coding system will be furnished to Contractor by Engineer.

3. Engineer's review of samples will be for color and texture only. Compliance with all other requirements is the responsibility of Contractor.
4. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.

B. Shop Drawings: Submit the following:

1. Copies of manufacturer's technical data for each product specified including fabrication and erection information for all identification devices. Show anchorages and accessory items. Furnish location template drawings for items supported or anchored to permanent construction.
2. Complete selection of each specified manufacturer's standard and custom colors, alphabetic styles, graphic layouts and pictograms.
3. Coordinate mounting position, method, and proposed mounting accessories and fasteners with actual Project conditions. Indicate required mounting accessories on plans showing locations of all required exit signs based on measurements taken at the Site. Show final location and identify type of mounting surface for each exit sign. Coordinate location of exit signs for non-interference with other Work and as required by governing authorities having jurisdiction at the Site.

1.5 PROJECT CONDITIONS

A. Field Measurements:

1. Verify dimensions in areas of installation. Take measurements at the Site before fabrication and indicate dimensions on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
2. Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to dimensions established for identification devices Work.

B. Scheduling:

1. Coordinate the delivery of templates, instructions and directions for installation of anchorage devices with other Work to avoid delay.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:
 - 1. Details for identification devices shown, such as alphabet representation, letter spacing, borders designs, and other graphic features, are generic and intended to establish text, general positions and symbols only.
 - 2. Contractor shall submit for approval complete, camera-ready, color graphic layouts based on specified requirements and recommendations from manufacturer.
- B. Allowable Tolerances:
 - 1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16-inch measured diagonally.

2.2 ROOM IDENTIFICATION, INFORMATION, ENTRY AND DIRECTIONAL SIGNS

- A. Product Description: Provide unframed signs, surface-etched, 1/32-inch raised tactile lettering and pictograms, sandblasted on an opaque 3-ply laminate of self-extinguishing melamine plastic sheet with a non-glare surface and phenolic core.
- B. Size and Thickness: 0.125-inches thick; 8-inches by 8-inches with 1/2-inch radiused corners.
- C. Exposure: Recommended by the manufacturer for interior and non-direct sun exterior use and acceptable for continuous operating temperatures of 225°F.
- D. Graphics and Alphabet: White, Standard Helvetica Medium alphabet and matching arrow type-face; upper and lower case 1-inch high capitals.
- E. Colors and Contrast: Background of signs shall be eggshell, matte or other non-glare finish. Characters and symbols shall contrast by at least 70 percent with their background as determined by ADA formula in ADAAG Appendix A4.30.5.
- F. Products and Manufacturers: Provide one of the following:
 - 1. Graphic Blast HC-200 ADA System and Custom Design ADA Series by Best Manufacturing Sign Systems, Incorporated.
 - 2. ASI Signs Systems, Inc.
 - 3. Or equal.

2.3 HEALTH, SAFETY, WARNING, AND FIRE

EXTINGUISHER LOCATION SIGNS

- A. Product Description: Provide rigid fiberglass reinforced plastic signs with fade-resistant embedded graphics.
- B. Size and Thickness: 0.125-inches thick; 10-inches by 14-inches, unless otherwise specified.
- C. Graphics and Alphabet: Standard Helvetica Medium alphabet and matching arrow type-face; upper and lower case 1-inch high capitals.
- D. Exposure: Recommended by the manufacturer for both indoor and outdoor use and with a upper service temperature limit of 190°F. Average durability for outdoor use shall be 15 years.
- E. Safety Instruction Signs: Standard color of the background shall be white; and the panel, green with white letters. All letters used against the white background shall be black.
- F. Caution Signs: Standard color of the background shall be yellow; and the panel, black with yellow letters.
- G. Danger Signs: Standard color of the background shall be white; and the panel black with red insert containing white letters. All letters used against the white background shall be black.
- H. Warning Signs: Standard color of the background shall be orange; and the panel black with orange insert containing black letters. All letters used against the orange background shall be black.
- I. Notice Signs: Standard color of the background shall be white; the panel shall be blue with white letters. All letters used against the white background shall be black.
- J. No Smoking Signs: Standard color of the background shall be white. All letters used against the white background shall be red.
- K. Biohazard Signs: Standard color of the background shall be white; and the panel black with white letters. Incorporate red international biohazard pictogram on white background.
- L. Floor Loading Signs: Standard color of the background shall be white; and the panel blue with white letters. All letters used against the white background shall be black.

- M. Fire Extinguisher Location Signs (surface-mounted units only): Standard color of the background shall be red with white letters. Each sign shall incorporate an international fire extinguisher pictogram and a directional arrow indicating location of fire extinguisher.
- N. Auxiliary Products:
 - 1. Mounting Brackets: Provide manufacturer's standard mounting brackets for hanging, projected or double-sided signs.
- O. Products and Manufacturers: Provide one of the following:
 - 1. Graphic Blast Word and Picture Series by Best Manufacturing Sign Systems, Incorporated.
 - 2. ASI Signs Systems, Inc.
 - 3. Or equal.

2.4 PIPELINE IDENTIFICATION SIGNS

- A. Pipeline Identification Signs:
 - 1. Lettering of Titles:
 - a. Letter size shall be as indicated in the following table:

LETTER SIZE TABLE

<u>Outside Diameter of Pipe or Covering*</u>	<u>Size of Legend Letters</u>
3/4-inches to 1-1/4 inches	1/2-inches
1-1/2-inches to 1-7/8--inches	3/4-inches
2-inches to 5-7/8-inches	1-1/4-inches
6-inches to 9-7/8-inches	2-1/2-inches
10-inches and Over	3-1/2-inches

*Outside diameter shall include pipe diameter plus insulation and jacketing.

- b. Text and symbols shall be Standard Helvetica Medium, all upper case. Signs shall include text with separate arrow signs indicating direction of flow and be located as specified in Part 3 of this Section.
 - 2. Sign Materials: Provide the following:
 - a. Signs shall be coiled construction, polyester with ultraviolet light-resistant, sealed, subsurface color graphics, recommended by the manufacturer for both indoor and outdoor use and for service temperature range from -40 degrees F to 248 degrees F.
 - b. Provide manufacturer's full selection of standard and custom sizes, colors and graphics. Where manufacturer has established minimum order quantities for custom units provide minimum order quantities at no additional cost to Owner.

- c. Where large pipe diameters preclude overlap of pipeline sign material, provide Type 304, 1/4-inch wide stainless steel banding straps; two per sign, lengths as required by circumference of pipe or covering. Provide manufacturer's recommended banding tools for stainless steel banding.
3. Legend for Pipeline Identification Signs: Pipeline identification signs shall have the following text or abbreviations in the color combinations designated to identify the pipeline service.

TABLE 10400-B, SCHEDULE OF PIPE MARKERS*		
Pipeline Legend	Lettering/Text Color	Background Color
<u>WATER</u>		
City Water	White	Green
Flushing Water	White	Green
<u>FUELS AND LUBRICANTS</u>		
Diesel Fuel Oil	White	Brown
<u>PROCESS</u>		
Floor Drains	Black	Gray
Sewage	Black	Orange
Storm Drains	White	Gray
Sump Drains	White	Gray

- B. Products and Manufacturers: Provide one of the following:
 1. See Section 09900 for Pipe Markers.

2.5 EQUIPMENT NAMEPLATES

- A. Description:
 1. Provide a minimum of 50 equipment nameplates for equipment furnished under the Contract, and for other equipment items indicated to receive nameplates as directed by the Engineer. Equipment nameplates specified in this Article are in addition to equipment manufacturer's standard nameplate with manufacturer name, model number, serial number, and similar information.
 2. Install equipment nameplates as indicated in Part 3 of this Section. Mechanically fasten equipment nameplates to the associated equipment item.

- B. Products and Manufacturers: Provide one of the following:
 1. Brady-Etch Stainless Steel ID Tags (B-748) custom engraved, by Brady Worldwide, Inc.,

Long Beach WPCP Consolidation
Pump Station Conversion

2. Custom Screenprinted Nameplates – Stainless Steel, by Seton Identification Products, a Tricor Direct Company
 3. Or equal.
- C. Equipment Nameplates:
1. Material: Type 304 or Type 316 stainless steel with 0.0015-inch thick black enamel background or black screenprinted background, 26-gage thick with rounded corners. Provide nameplates with screenprinted background installed outdoors with acrylic overcoat. Suitable for temperatures ranging from -40 to 89 degrees C.
 2. Provide each equipment nameplate with not less than two holes, each approximately 3/16-inch diameter, for mechanically fastening nameplate to the associated equipment. Provide appropriate stainless steel fasteners.
 3. Nameplate Size:
 - a. Size shall be as required for required text, and shall be not less than one-inch by four inches.
 4. Text Engraved on Nameplates:
 - a. Text Size: Equipment nameplate titles shall have text as large as possible to fit on nameplate; text shall be not less than 1/2-inch high. All text on a given nameplate shall be one size.
 - b. Text and symbols shall be Standard Helvetica Medium, all upper-case.
 - c. Left-justify multiple lines of text
 - d. Where more than one item of the same type of equipment is furnished, consecutively number each associated equipment nameplates as shown or indicated; for example “Pump No. 1”, “Pump No. 2”, “Pump No. 3”, and so on.
- D. Operating Stands for Valves and Gates:
1. Nameplate material, size, and text requirements are the same as indicated above for other equipment nameplates.
 2. Operating stands for valves and gates shall carry the respective legends “V. No. ____” or “S.G. No. ____,” with the appropriate equipment number to be indicated by Engineer.
 3. Background and text color of nameplates for valve and gate operators shall be the same colors specified above for other equipment nameplates.
 3. Background and text color of nameplates for valves and gates shall be the same as for the associated pipe markers.

2.6 VALVE AND PIPELINE TAGS

- A. Metal Tags:
1. For all valves and pipelines larger than 2 inches in diameter provide permanently legible metal tags, 2-inch diameter round, Type 304 stainless steel tags with engraved lettering filled with black enamel. Provide all valve tags with a 3/16-inch diameter hole located so as not to interfere with legend.
 2. Legend for Valve Tags:

- a. Based on information provided on the Drawings, Contractor shall submit to Engineer, no less than 30 days before start-up, a Valve Schedule containing all required valves.
 - b. The Valve Schedule shall contain for each valve, the location, type, a number, words to identify the valve's function, type of operator and the normal operating position.
 - c. Each valve shall be coded and identified by Engineer utilizing a combination of up to twelve letters and numbers.
- 3. Miscellaneous Valve and Small Pipeline Tag Accessories:
 - a. Stainless Steel Wire: Nylon coated; outside diameter 0.048-inches.
 - b. Clamps: Brass.
 - c. Lead Seals: Monel; Four ply, 0.014-inches by 10-inches long; for attaching all tags.
 - d. Hand Sealing Press: As recommended by tag manufacturer for crimping lead seals.
- B. Products and Manufacturers: Provide one of the following:
 - 1. Custom Engraved Stainless Steel Valve Tags by NapTags, 800-451-3330 Grand Rapids, MI
 - 2. Custom Engraved Stainless Steel Valve Tags by Brady USA, Incorporated, Signmark Division.
 - 3. Or equal.

2.7 AUXILIARY MATERIALS

- A. Very-High-Bond High-Performance Bonding Tape:
 - 1. Provide all surface-mounted identification devices with very-high-bond foam tape backing except where specifically specified as requiring mechanical fasteners.
 - 2. Provide a very-high-bonding pressure sensitive joining system consisting of double-coated conformable acrylic foam tape and release liners:
 - 3. Thickness: 0.045-inch.
 - 4. Tape Width: 1-1/2-inches.
 - 5. Color: Dark grey.
 - 6. Bonding Adhesive: Acrylic; very-high-bond, solvent and shear resistance.
 - 7. Primer: High-performance tape manufacturers recommended acrylic primer.
 - 8. Products and Manufacturers: Provide one of the following:
 - a. Scotch Brand (Very-High-Bond) 4942 VHB Double Coated Acrylic Foam Tape and No. 94 Acrylic Primer by 3M Industrial Tape and Specialties Division.
 - b. Or equal.
- B. Mounting Brackets: Provide manufacturer's standard mounting brackets for hanging, projected or double-sided signs.
 - 1. Furnish inserts, and mechanical and adhesive anchoring devices as specified for the installation of identification devices.

- C. Fasteners: Provide fasteners of non-magnetic stainless steel of size and type required and recommended by individual identification device manufacturers.
- D. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts. Use toothed stainless steel or lead expansion bolts for drilled-in-place anchors.

2.8 FABRICATION

- A. Shop Assembly:
 - 1. Fabricate and preassemble items in the shop to the greatest extent possible.
 - 2. Disassemble units only to the extent necessary for shipping and handling limitations.
 - 3. Clearly mark units for reassembly and coordinated installation.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor and his installer shall examine the substrates and conditions under which the identification devices are to be installed and notify Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 INSTALLATION

- A. General:
 - 1. Install identification devices and components as directed by Engineer, securely mounted with concealed very-high-bond acrylic foam tape or mechanical/chemical fasteners where specified. Attach signs to surfaces in accordance with the manufacturer's instructions, unless otherwise shown. Installation of signs to railings is to match existing field conditions.
 - 2. Mount exit signs in locations shown. Surface mount signs above all exit doors, unless otherwise shown.
 - 3. Lightly mark and locate the position of all identification devices. Obtain Engineer's approval of all locations before mounting. Install level, plumb, and at the proper height. Repair or replace damaged units as directed by Engineer.
 - 4. Install very-high-bond acrylic foam tape on back of identification devices using a full perimeter of specified tape. Leave no gaps in tape perimeter at back of identification devices; peel off second release liner and press onto surfaces.
 - 5. Install level, plumb, and at the specified height.

- B. Room Identification, Directional and Information Signs:
1. Where permanent identification is provided for rooms and spaces, install signs on the wall adjacent to the latch side of the door.
 2. Where there is no wall space on the latch side of the door, including at double leaf doors, install signs on the nearest adjacent wall.
 3. Mounting height shall be 5 feet - 0 inches above the finish floor to the centerline of the sign. Mount such signage so that a person may approach within 3-inches of the sign without encountering protruding objects or, when reading sign, be forced to stand within the swing of a door.
- C. Pipe and Equipment Identification Signs, Nameplates and Tags:
1. The name of the materials in each pipeline and, alongside this, an arrow indicating the direction of flow of fluids, shall be indicated on each pipeline system.
 2. Titles shall not be located more than 30 linear feet apart and shall also appear directly adjacent to each side of all walls penetrated by pipeline, adjacent to each side of all valve regulators, flowcheck, strainer cleanouts, and all pieces of equipment. Arrows shall be located at intervals not to exceed 15 linear feet apart.
 3. Titles shall identify contents by complete name. Identification title locations shall be determined by Engineer, but in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering when they are overhead. Title shall be clearly visible from operating positions especially those adjacent to control valves.
 4. Signs on large valves shall be located on or adjacent to the valve itself. Tags for smaller valves shall be attached to bonnet or flange bolts. Do not attach tags or signs to handwheels of valves.
 5. Locate nameplates on equipment bases and on structures at readily visible levels in such positions relative to the equipment and structures as to prevent damage to the nameplate.
- D. Right-To-Know Signs, Labels and Tags:
1. Locate tags at 20 feet maximum center to center distance along chemical pipelines and fill pipelines and on each side of all locations where pipes emerge from penetrations with other materials.
 2. Install tank signs on all tanks shown to receive signage at quarter-points on tank circumference, 5 foot - 0 inches above finished floor.

3.3 PROTECTION AND CLEANING

- A. After installation, clean soiled identification device surfaces according to manufacturer's instructions.
- B. Protect units from damage until Final Completion by Owner.

++ END OF SECTION ++

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SECTION 10522

PORTABLE FIRE PROTECTION EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all portable fire protection equipment Work.
2. Extent of portable fire protection equipment Work is shown and specified.
3. Types of portable fire protection equipment Work required includes:
 - a. Dry chemical extinguishers.
 - b. Carbon dioxide extinguishers.
 - b. Mounting accessories and miscellaneous fasteners.

B. Coordination:

1. Review installation procedures under other Sections and coordinate installation of items that must be installed with or before portable fire protection equipment.

C. Related Sections:

1. Section 10400, Identification Devices.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. UL Fire Classification Rating.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Provide portable fire protection equipment products from one manufacturer.

B. Regulatory Requirements: Provide portable fire extinguishers approved and labeled by UL.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data: Submit the following:
 - a. Manufacturer's technical data, certification of UL rating, and

installation instructions for portable fire protection equipment.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

- A. General: Provide manufacturer's standard mounting brackets for portable fire extinguishers size as specified.
- B. Multi-Purpose Dry Chemical Fire Extinguishers:
 - 1. Ten-pound capacity, enameled steel container with pressure-indicating gauge, for Class A, Class B, Class C fires, UL rating 4A-60 BC.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Cosmic Model 10E by J.L. Industries.
 - b. Or equal.
- C. Carbon Dioxide Fire Extinguishers:
 - 1. Ten-pound enameled steel container capacity, for Class B and Class C fires UL rating.
 - 2. Products and Manufacturers: Provide one of the following:
 - a. Sentinel Model 10 by J.L. Industries.
 - b. Pro 460 Model by Kidde Commercial Division
 - c. Or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrates and conditions under which portable fire protection equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2 INSTALLATION OF FIRE EXTINGUISHERS

- A. When exact locations of portable fire protection equipment are not shown on Drawings, locate as directed by Engineer.
- B. Securely fasten products to structure, square and plumb, per Supplier's instructions. Mounting heights shall be:
 - 1. Install fire extinguishers with gross weight greater than 40 pounds with top of fire extinguisher no more than 3.5 feet above finished floor.

2. Install fire extinguishers with gross weight less than 40 pounds with top of fire extinguisher no more than 4.0 feet above finished floor.
 3. Clearance between bottom of fire extinguisher and finished floor shall be at least four inches.
- C. Identification Devices: Provide signs level and plumb directly above surface mounted portable fire extinguishers, securely mounted, attached to substrate per sign manufacturer's instructions. Signage shall be per Section 10400, Identification Devices.
- D. Recharge fire extinguishers provided under this Contract so that most recent inspection date coincides as nearly as possible with date of Substantial Completion. Inform Owner in writing of next required inspection and recharging date.

+ + END OF SECTION + +

++ NO TEXT ON THIS PAGE++

SECTION 11000

ELECTRIC MOTORS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Electric motors and accessories to be furnished under other equipment Sections shall comply with this Section, unless specified otherwise in the Section for the associated driven equipment.
2. Motor horsepower and voltage ratings, speed, enclosure type, and unusual service conditions (such as ambient temperatures above 40 degrees C, corrosive areas requiring severe duty motors, and variable frequency drive applications requiring inverter duty motors), and requirements for witnessing shop tests shall be as specified in the Sections for the associated driven equipment. Specific accessories and construction features may also be required by the Sections on the associated driven equipment.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ASTM A48/A48M, Specification for Gray Iron Castings.
2. ASTM B117, Practice for Operating Salt Spray (Fog) Apparatus.
3. IEEE 112, Test Procedure for Polyphase Induction Motors and Generators.
4. IEEE 522, Guide for Testing Turn-to-Turn Insulation on Form-Wound Stator Coils for Alternating Current Electric Machines.
5. IEEE 1043, Recommended Practice for Voltage Endurance Testing of Form-Wound Bars and Coils.
6. NEMA MG 1, Motors and Generators. (This Section's references to NEMA MG 1 followed by a hyphen and number, such as "NEMA MG 1-20.14", indicate the associated NEMA MG 1 paragraph reference.)
7. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems
8. UL 674, Electric Motors and Generators, for Use in Division 1 Hazardous (Classified) Locations.
9. UL 1004, Electric Motors.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

- a. Manufacturer shall have not less than five years experience producing equipment substantially similar to that required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Data sheets indicating nameplate data for fractional-horsepower motors.
 - b. Outline drawing or data sheet indicating complete motor dimensions for motors rated greater than 1/3-hp. Several motors of the same type and rating for the same application may be covered by an appropriate single drawing or data sheet. Drawings and data sheets shall have complete identifying data including frame size, speed, horsepower ratings, and application for each particular motor.
 - c. Details of motor heaters, winding thermal protection, and other accessories.
 - d. Copies of motor characteristic curves and data inputs when required for programming motor protection and management relays.
2. Product Data:
 - a. Submit motor test data sheets for each motor rated one horsepower or greater. Values indicated on test data sheets shall be from tests of a previously manufactured, electrically duplicate motor or calculated data. Mark each test data sheet to indicate the Project motor application location, manufacturer, type, frame size, horsepower, voltage, speed, bearing type, lubrication medium and enclosure type. Test data sheet shall also include:
 - 1) Winding resistances.
 - 2) Torques.
 - 3) Efficiencies.
 - 4) Power factors.
 - 5) Slip.
 - 6) Full load amperes.
 - 7) Locked rotor and no load amperes.
 - 8) Nameplate temperature and results of dielectric tests.
3. Testing Plans and Procedures:
 - a. When witnessed source quality control testing is required in the Section for associated driven equipment, submit description of proposed shop testing methods, procedures, and testing apparatus with calibration dates, together with proposed testing schedule and proposed travel and logistical plans for testing.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the motors.
 - b. Installation data for motors, including setting drawings, templates, and directions and tolerances for installing anchorage devices.
 2. Source Quality Control Submittals:
 - a. Written reports presenting results of required shop testing. Shop test reports shall be dated and signed by motor manufacturer.
 - b. When witnessed shop tests are required, shop test results shall be signed by and shall bear the seal of registered professional engineer. Name on seal, registration or license number, and jurisdiction or registration of license shall be legible.
 3. Field Quality Control Submittals:
 - a. Written reports presenting results of required field testing and inspections. Field testing reports shall be dated and signed by Contractor.
 4. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, persons contacted, problems encountered and resolved, tasks performed, results obtained, and other pertinent information. Submit within two days of completion of visit to the Site.
 5. Qualifications Statements:
 - a. Submit manufacturer's qualifications data when requested by Engineer.
- C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
 - a. Furnish operation and maintenance data for motors as part of the operations and maintenance data for the associated driven equipment.
- D. Maintenance Material Submittals: Submit the following:
1. Spare Parts and Extra Stock Materials: For each motor size and type, furnish spare parts in accordance with motor manufacturer's recommendations, including the following for three-phase motors:
 - a. One set of fans and guards for each set of three or fewer motors, for each size of totally-enclosed fan-cooled motor.
 - b. One set of bearing liners, or renewable ball or roller bearings, for each set of three or fewer motors, for each type and size of motor.
 - c. One set of oil rings, for each sleeve bearing motor.
 - d. One set of bearing temperature detectors, for each set of three or fewer motors, of each type of motor.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:

1. Ship motors with openings sealed.

B. Storage and Protection:

1. Protect materials and equipment from corrosion and deterioration.

PART 2 – PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. Equipment Description:

1. Motors shall comply with the product requirements specified in the individual Sections for the associated driven equipment.
2. Motors shall be suitable for continuous operation at an elevation of up to 3,300 feet above mean sea level, at ambient temperatures ranging from -25 degrees C to 40 degrees C, unless specified otherwise in the Section for the associated driven equipment.
3. Motors operated on variable frequency drives shall be suitable for inverter duty as described by NEMA MG 1-31 and shall be compatible with characteristics of the intended variable frequency inverters.

2.2 IDENTIFICATION

A. Nameplates:

1. Nameplates shall be Type 316 stainless steel with embossed or pre-printed lettering and fastened to the motor frame with Type 316 stainless steel pins.
2. Nameplates shall have stamped on them the motor manufacturer's name, voltage, number of Hertz and phases, horsepower rating, amperes and temperature rise at rated load, full load speed, locked rotor amperes or code letter, service factor, NEMA nominal efficiency, model number, insulation class, bearing number, serial number and maintenance manual number.
3. Name plates for explosion proof motors shall indicate the Division, Class and Group of the hazardous location in which the motor is intended for use.
4. Dual-voltage motor nameplates shall include connection diagrams.
5. Nameplate markings shall be in accordance with NEMA MG 1-10.

2.3 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Perform shop testing on the motors at the manufacturer's facility. Shop test shall be in accordance with NEMA MG 1, UL 674, and UL 1004 and shall demonstrate that the motors tested comply with the Contract Documents.
2. Submit shop test reports identifying tests performed and results obtained.

3. Motors shall be given Routine Test in accordance with NEMA MG 1-12.55 and IEEE 112. Test shall include the following:
 - a. Measurement of winding resistance.
 - b. No-load readings of current and speed at normal voltage and frequency.
 - c. Current input at rated frequency with rotor at standstill for squirrel-cage motors (locked rotor amperes).
 - d. High-potential test.
 - e. Bearing inspection.
4. Motors rated 200 hp and larger shall be given a "Complete Test" in accordance with IEEE 112 consisting of a "Routine Test" and a full-load heat run. When "Complete Tests" are required for a group of the same type, rating and horsepower for the same application, each motor of the group shall be given a "Complete Test", unless specified otherwise in the Section for the associated driven equipment. Testing shall document the following:
 - a. Percent slip.
 - b. No-load speed, voltage, current, and losses at rated frequency.
 - c. Full-load current.
 - d. Locked-rotor torque.
 - e. Locked-rotor current.
 - f. Breakdown torque (calculated).
 - g. Starting torque (squirrel-cage).
 - h. Winding resistance.
 - i. Sound pressure level at no-load.
 - j. Vibration levels.
 - k. Efficiency current, and power factor at 100, 75, and 50 percent of full load and at service factor load.
 - l. Stabilized full load temperature rise.
5. Motors with stator windings rated greater than six kV shall have the following additional tests:
 - a. Voltage endurance test of the ground-wall insulation system in accordance with IEEE 1043.
 - b. Partial discharge testing of the stator coils to insure proper impregnation and clearances. Acceptance criteria shall be based on manufacturer's quality assurance data base.
 - c. Voltage surge test on multi-turn stator coils in accordance with IEEE 522.

B. Witnessed Shop Testing:

1. When witnessed motor shop testing, which may also be referred to as witnessed source quality control motor testing, is specified in the Section for associated driven equipment, shop tests shall be witnessed at the motor manufacturer's testing and production facility. The number of attendees shall as indicated in the Sections for the associated driven equipment.
2. Dates of witnessed testing shall be acceptable to Owner and Engineer and shall be agreed upon in writing at least 45 days prior to the actual test. Perform all

witnessed tests at motor manufacturer's facility in one day or on consecutive days to minimize the time required to witness the tests.

3. Owner will be responsible for cost of Owner's and Engineer's time for first test on each motor, and for time to travel to and from motor manufacturer's facility once. Responsibility for cost of lodging, meals, and travel expenses shall be as indicated in the Section for the associated driven equipment.
4. If re-testing is required, all labor and expense costs incurred by Owner and Engineer will be deducted from the Contract Price via a Change Order. If tests are not performed on agreed-upon date as a result of Contractor's or motor manufacturer's action or inaction and Owner or Engineer incurs lost time or expense as a result of such action or inaction, the associated costs will be deducted from the Contract Price via a Change Order.
5. Not less than the number of days prior to the scheduled witnessed motor test specified in Paragraph B.2 of this Article, submit to Engineer the proposed witness testing plans and procedures.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:

1. Install motors in accordance with the Contract Documents and manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
2. Install in accordance with Laws and Regulations.
3. Do not modify structures to facilitate installation of motors, unless approved in writing by Engineer.
4. Carefully and properly align motors with the driven equipment.
5. Secure motors to mounting surfaces with anchorage devices complying with manufacturer's recommendations that are of sufficient size and quantity to secure motor to equipment.
6. Until start-up and operation, tightly cover and protect motors from dirt, water, and chemical and mechanical damage.

3.2 FIELD QUALITY CONTROL

A. Site Tests:

1. Inspect motors prior to supplying electricity to (energizing) equipment. Do not energize equipment without Engineer's permission. Inspections shall include the following:
 - a. Inspect motor and equipment for physical damage.
 - b. Inspect motor for proper anchorage, mounting, grounding, connection, and

- lubrication.
 - c. Check for unusual noise and indications of overheating during initial or test operation.
- 2. Perform testing at the Site for motors larger than 200 hp, as follows:
 - a. Testing shall be witnessed by Engineer.
 - b. Initial inspections and testing shall include the following:
 - 1) Electrical and grounding connections.
 - 2) Shaft alignment, proper mounting and lubrication.
 - 3) Check ventilating air passageways for blockage.
 - 4) Excessive noise.
 - 5) Overheating.
 - 6) Correct rotation.
 - 7) Protective detectors operation.
 - 8) Excessive vibration.
 - 9) Space heater operation.
 - c. Electrical testing shall include the following:
 - 1) Insulation resistance test.
 - 2) Surge comparison test.
 - 3) Vibration test.
 - 4) Bearing insulation resistance test on insulated bearings.
 - 5) Running current and voltage measurements and evaluations relative to load conditions over full range of operations and nameplate full-load amperes.
 - 6) High-potential test.
 - 7) For wound rotor motors, additional testing at minimum and normal operating load points and at ring short.
 - 8) Motor operation with the driven equipment for not less than 48 continuous hours per motor, with checks for overheating and vibration during operation.
 - d. Tests and values shall be in accordance with motor manufacturer's recommendations and ANSI/NETA ATS.
 - e. Prepare and submit field testing report in accordance with ANSI/NETA ATS.
- B. Manufacturer's Services:
 - 1. For motors 200 hp and larger, furnish services of motor manufacturer's qualified service representative to assist with installing motors, checking installed motors before initial operation, assisting in performing field quality control tests and inspections, observing and assisting initial operations, and training operations and maintenance personnel in caring for, operating, and maintaining motors.
 - 2. Preparing and submitting manufacturer's field report for each visit to the Site.

+ + END OF SECTION + +

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SECTION 11002

EQUIPMENT IDENTIFICATION TAG SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals, as shown, specified and required to furnish and install an equipment identification tag system.
2. The extent of the equipment identification tag system is specified herein and shown.
3. The type of equipment identification tag system includes, but is not necessarily limited to, the following:
 - a. Equipment identification tags.
 - b. Miscellaneous mechanical fasteners.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the equipment identification tag system Work.

C. Related Sections:

1. Division 11, Equipment.
2. Division 15, Mechanical.
3. Division 16, Electrical.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single equipment identification tag system manufacturer.
2. The equipment identification tag system manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the equipment identification tag system manufacturer.

1.3 SUBMITTALS

- A. Samples:
 1. Submit samples for color and finish of materials and accessories required for the equipment identification tag system. Engineer's review of samples will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of Contractor.
- B. Shop Drawings: Submit the following:
 1. List of all devices including tag number with device and signal name description.
 2. Anchorage and accessory items.
 3. Samples of actual equipment identification tags for five devices.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION TAGS

- A. Tags shall be 1-inch by 3-inches with two 1/8-inch holes centered on each end of the tag. Tags shall be made from aluminum 0.020-inch thick and coated with black enamel paint.
- B. Each tag shall be engraved with the equipment device number and name description as shown or as specified. The engraving print shall be 1/4-inch Gothic.
- C. Each tag shall be attached with fasteners of nylon coated, 48-mil, stainless steel wire as manufactured by Brady, Catalog Number 23310 or equal and brass double ferrule wire clamps, as manufactured by Brady Catalog Number 23312 or equal, to secure the stainless steel wire.
- D. Equipment Identification Tags:
 1. Equipment identification tags shall contain device numbers and name descriptions.
 - a. Device numbers shall consist of seven digits.
 - b. Name descriptions shall consist of a maximum of three lines with a maximum of 55 letters.
 2. Device numbers and name descriptions shall be furnished by the Owner.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Contractor shall examine the substrates and conditions under which the equipment identification tags are to be installed and notify Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 INSTALLATION

- A. Install equipment identification tags and components at the locations shown or, if not shown, as directed by Engineer; securely mount with concealed theft-resistant fasteners.
- B. Install level, plumb, and at the proper height. Repair or replace damaged units as directed by Engineer.

+ + END OF SECTION + +

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SECTION 11115

SUBMERSIBLE END SUCTION PUMPS – WET PIT (BYPASS)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Bypass pumping system shall be provided to keep the City of Long Beach WPCP operational during construction. The system shall include pumps, pipes, valves, screen, underground chambers and other components as shown on the Contract Drawings and specified herein. Upon completion of construction the bypass pumping system shall be partially decommissioned.
2. Contractor shall provide all labor, materials, equipment, and incidentals required to furnish and install extra heavy-duty submersible, end suction centrifugal pumps complete and operational with motors, control equipment, lifting chains and guide bars, discharge connections, and accessories as shown and specified. Anchorage devices are included in the scope of this Section.
3. The pump Supplier shall furnish and have overall system responsibility for variable frequency drives as specified in Section 16425, Variable Frequency Drives, and shall be responsible for coordination of the overall variable frequency drive system application. This shall include coordination of the pumps and motors with the variable frequency drive units, as well as coordination of the drive system interfacing with electrical work and instrumentation and control functions. Overall system responsibility shall include field testing, start-up, training, calibration and overall successful operation of the equipment. The Contractor through the Supplier shall guarantee and shall be the source of information for the complete system, including each piece of equipment furnished under this Section and other Sections, regardless of the manufacturing source of that equipment.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before submersible end suction pump Work.

C. Related Sections:

1. Section 05051, Anchor Systems.
2. Section 09900, Painting.
3. Section 11000, Electric Motors.
4. Section 13430, Process Control Panels and Enclosures.
5. Section 13491, Process Control Descriptions.
6. Section 15061, Ductile Iron Pipe.
7. Section 16425, Variable Frequency Drives.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. American Gear Manufacturers' Association, (AGMA).
 - 2. American National Standards Institute, (ANSI).
 - 3. American Society for Testing Materials, (ASTM).
 - 4. Standards of American Water Works Association, (AWWA).
 - 5. Institute of Electrical and Electronic Engineers, (IEEE).
 - 6. Standards of the Hydraulic Institute, (HI).
 - 7. National Electrical Code, (NEC).
 - 8. Standards of the National Electrical Manufacturers Association, (NEMA).
 - 9. National Sanitation Foundation, (NSF).

1.3 QUALITY ASSURANCE

- A. Supplier's Qualifications:
 - 1. Supplier shall have a minimum of ten years of experience producing substantially similar equipment to that required for the Project and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.
- B. Component Supply and Compatibility:
 - 1. Obtain all products included in this Section, regardless of component Supplier, from one submersible end suction pump manufacturer.
 - 2. Submersible end suction pump Supplier shall review and approve or prepare all Shop Drawings and submittals for all components provided under this Section.
 - 3. All components shall be suitable for specified service conditions and shall be integrated into overall assembly by the submersible end suction pump Supplier.
 - 4. To centralize responsibility and to ensure equipment is properly coordinated, the pump variable frequency drives specified under Section 16425 shall be provided under this Section.
- C. Certifications
 - 1. Certification of Compliance:
 - a. Obtain certification of compliance with the Contract Documents from the submersible end suction pump manufacturer on manufacturer letterhead; certification by manufacturer's representatives is not acceptable.
 - b. Certification shall be worded as follows:
"[Insert manufacturer's name] proposes to supply equipment included in Section 11115 for Nassau County. We have examined the Contract Documents and understand the Project requirements insofar as they affect the proposed products. We certify that the products will operate

satisfactorily under the conditions described in the Contract Documents and that the products meet the requirements of the Contract Documents:

[List exceptions, deviations or changes necessary or recommended to accommodate the proposed products.]

We further certify that the products to be furnished shall conform to the standards listed in Section 11115, Submersible End Suction Pumps – Wet Pit, of the Contract Documents and that any abnormal operating conditions imposed on the pump by the wet well cleaning cycle and pump shutdown procedures will not damage the pumping unit and will not void the warranty.

[List exceptions, deviations or changes necessary to accommodate the proposed products.]

Authorized Signature & Title

Date”

- c. Provide justification for exceptions, variations, deviations, or changes. Engineer will determine whether exceptions, deviations, and changes are acceptable. Exceptions, variations, deviations, and changes may result in rejection of products.
- d. Provide certification before submitting Shop Drawings. Shop Drawings will not be reviewed prior to receipt of certification.
- e. Acceptance of certification shall not relieve Contractor of responsibility for adequacy of all products.
- f. Submittal of certification shall not relieve Contractor and Supplier of requirement to comply with submittal procedures in the Contract Documents.

D. Professional Engineer:

- 1. Engage a registered professional engineer legally qualified to practice and experienced in providing the engineering services of the kind indicated. Professional engineer may be an employee of the manufacturer.
- 2. Submit qualifications data.
- 3. Responsibilities include but are not necessarily limited to:
 - a. Preparing or supervising the preparation of shop test set ups.
 - b. Performing or supervising the performance of shop tests, interpretation, and engineering analysis of shop test data, and preparation of test reports.
 - c. Certifying that the tests performed, and the results achieved conform to the Contract Documents.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:

Long Beach WPCP Consolidation
Pump Station Conversion

11115-3

01263 of 1950

- a. Submittals of pump controls, including panel layout and wiring diagrams. Conform to submittal requirements of Section 13401, Process Control System General Provisions.
 - 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, and engineering data including; dimensions, materials, size, weight, and part lists for all components in sufficient detail to allow an item-by-item comparison with the Contract Documents.
 - b. Pump performance data and curves showing overall pump efficiencies, required net positive suction head (NPSH), allowable suction lift, flow rate, head, brake horsepower, motor horsepower, speed, and shut-off head. For variable speed units, curves shall have at least five speeds plotted between maximum and minimum rpm. Curves shall indicate Preferred Operating Region (POR) and Allowable Operating Region (AOR), as defined in ANSI/HI 9.6.3.
 - c. Motor Data: Furnish certified motor data sheet for previously tested, electrically duplicate motor to that specified, including the following:
 - 1) Speed-torque relationship.
 - 2) Efficiency at 1/2, 3/4, and full load.
 - 3) Power factor at 1/2, 3/4, and full load.
 - 4) Slip at full load.
 - 5) Running light, full load and locked rotor current.
 - 6) Temperature rises and results of dielectric tests.
 - 7) Bearing type and lubrication medium
 - 8) Insulation class and temperature ratings.
 - d. Motor Data: Provide maximum safe stall time, number of starts per hour, and thermal protective devices (switch, thermistor, RTD).
 - 3. Samples:
 - a. Paint color samples for finish on pumps and motors. Color samples shall conform to Section 09900, Painting.
 - 4. Testing Plans, Procedures, and Testing Limitations:
 - a. Provide pump Supplier's proposed shop testing plan, including complete list of testing facility limitations.
 - b. Provide proposed field-testing plan.
- B. Informational Submittals:
- 1. Manufacturer Instructions:
 - a. Provide Supplier's instructions for handling and installing products.
 - b. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.
 - 2. Quality Assurance Submittals
 - a. Provide certification of compliance as specified in Paragraph 1.3 C.1.
 - b. Qualifications of professional engineer as specified in Paragraph 1.3 D.
 - c. Location of nearest permanent service headquarters of pump manufacturer to the Site.

3. Source Quality Control Submittals:
 - a. Results of shop testing for complete pump and motor unit. Test results shall be certified by a registered professional engineer and signed by an officer the manufacturing corporation.
 4. Field Quality Control Submittals:
 - a. Results of field testing.
 - b. Submit a written report of the results of each visit to Site by pump manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.
 5. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.
- C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Manuals:
 - a. Submit complete operation and maintenance manuals, including shop and field test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Provide operation and maintenance manuals per Section 01730, Operations and Maintenance Data.
 2. Warranty Documentation:
 - a. Manufacturer's Standard Warranty.
 - b. Special Warranty.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Prior to shipping, completely inspect products to assure that components are complete and comply with all requirements. Box or crate products as required to prevent damage during shipment. Protect machined surfaces and matching connections to prevent damage.
 2. Equipment shall not be shipped to the site until the Contractor has received written notification by the Engineer of their acceptance of the Shop Test results.
 3. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
 4. Inspect all boxes, crates, and packages upon delivery to Site and notify Engineer in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
- B. Storage and Protection:
1. Keep all products off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion and deterioration.

1.6 WARRANTY

A. Special Warranty on Submersible End Suction Pumps:

1. In addition to the manufacturer's standard guarantee, CONTRACTOR shall include the services of a factory trained serviceman to provide repair service for the equipment for the period of two years commencing with the time the equipment is placed in continuous permanent operation. This service shall include the cost of all replacement parts required during the interval.
2. The manufacturer shall guarantee clog-free operation for a period of 24 months from the date of start-up of the pumps by the local authorized factory representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. Should the impeller clog with typical solids and/or modern trash debris normally found in domestic wastewater during this period, an authorized representative shall travel to the jobsite, remove the pump, clear the obstruction and reinstall the pump at no cost or shall reimburse the Owner for reasonable cost to provide this service. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. System Description:

1. Pumps shall be submersible end suction centrifugal non-clog type. Pumps shall be constructed for operation under complete submersion, partial submersion, and dry conditions. Each pump shall be suitable for its intended service.
2. Pumps shall comply with ANSI/HI 14.3, ANSI/HI 9.6.3, and ANSI/HI 9.8.
3. Pumping unit shall be capable of withstanding periodic severe conditions during a wet well cleaning cycle. The cleaning cycle procedure is described in ANSI/HI 9.8-2012. During this procedure, the pump will be used to lower the level in the wet well until the pumps lose prime. The procedure will subject the pumping unit to vibration, dry running, and other severe conditions. The frequency and duration of the cleaning procedure is estimated to be for 5 minute periods, bi-weekly. Operation of the cleaning procedure as described above shall not void the warranty for the pump or any of its components. The pump manufacturer shall submit certification stating such. Pumps shall be capable of a minimum of 10 starts per hour to withstand the above conditions.

- B. Design and Performance Criteria: Each of the below listed sets of pumps shall comply with the below listed performance criteria. Additional specific requirements for each set of pumps are contained in Pump Data Sheet Supplements provided at the end of this Specification.

Location:	Bypass Pump Station
Pump ID	Pump No.1, Pump No. 2,

	Pump No. 3
Number of Pumps Required ¹	4
Fluid Pumped:	Raw Sewage
Full Speed Design Point:	
Flow ² :	4,858 gpm (7 mgd)
Total Head ² :	33 ft
Minimum Pump Efficiency:	78%
Reduced Speed Design Point:	
Flow:	1,557 gpm (2.25 mgd)
Total Head:	25 ft
Minimum Sphere Diameter:	5-inches
Minimum Head at Zero Flow:	73.0 ft
Maximum Motor Size ³ :	60 horsepower
Maximum Speed:	1185 rpm

Notes:

1. Number of pumps required includes one (1) spare for each pump type. Testing of spare pumps shall be as instructed by ENGINEER.
2. At maximum speed.
3. At all points on pump curve, pump horsepower requirements shall not exceed specified motor horsepower.

2.2 MANUFACTURERS/PRODUCTS

- A. Manufacturers and Products include: Provide products of one of the following:
1. Flygt,
 2. Sulzer,
 3. No substitutions allowed.

2.3 DETAILS OF CONSTRUCTION

- A. Pump Materials and Construction:
1. General:
 - a. Construct pumps for fluid service specified.
 - b. Pumps shall be of the wet pit submersible, non-clog type.
 2. Pump Body and Externals:
 - a. Stator casing, oil casing, volute, and other major pump components shall be gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities.
 - b. Provide lifting eyes on each pump capable of bearing weight of pump during removal and installation.
 - c. External Hardware: Bolts, nuts, and cap screws shall have hexagonal heads and be Type 316 stainless steel.

- d. Provide hand hole for inspection and cleaning of the interior parts of the pump. Provide neoprene or Buna-N gaskets.
- 3. Impeller: Impeller shall be ASTM A-532 Alloy III A 25% chrome cast iron or cast iron ASTM A48 Class 35B. Any impeller material different than ASTM A-532 Alloy III A 25% chrome cast iron shall have at least Rc60 hardness. Any coating to harden the surface of the impeller shall not be allowed. Impeller shall be of **semi-open or** enclosed, dynamically balanced, multiple-vane, non-clogging design having long throughlets without acute turns to protect against wear and clogging. The impeller shall be capable of handling solids, fibrous materials, sludge, and other matter found in raw wastewater. The impeller shall be securely fitted to the pump shaft in such a manner that it does not loosen or become detached when the pump is operated in the reverse direction.
- 4. Wear Rings / Insert Rings: Stainless steel impeller and casing wear rings shall be used to provide efficient sealing between the volute and suction inlet of the rotating impeller. They shall be firmly secured to prevent rotation or displacement.
 - a. Wear Plates: Shall be gray cast iron ASTM A-48 Class 35B with at least Rc60 hardness.
- 5. Shaft: The common pump/motor shaft shall be solid continuous and of stainless steel AISI Type 420 or Type 431 construction, and shall be completely isolated from the pumped liquid through the use of a stainless steel shaft sleeve.
 - a. Minimum Shaft Design/Sizing Requirements:
 - 1) The shaft shall be of sufficient size to transmit full driver output with a maximum deflection of 0.008 inches measured at the lower mechanical seal.
 - 2) The impeller shall not be allowed to deflect more than 50% of the wear ring clearance at all of the rated conditions listed in the Design and Performance Criteria in Paragraph 2.1 B.
 - 3) The maximum bending stress shall be less than 15,000 psi at any shaft section when the pump is operating at maximum speed with its maximum published impeller diameter at pump shut-off head.
 - 4) Sufficiently large in diameter to safely transmit the maximum torque developed by the drive unit.
 - 5) Design to provide rigid support for the impeller to prevent excessive vibration at maximum possible turbinning speed.
 - 6) The first critical speed of the shaft rotor, including impeller, shaft, sleeve, and coupling shall not be less than 120% of the highest rated running speed or calculated turbinning speed, whichever is greater.
- 6. Seals: Each pump shall be provided with tandem mechanical seals consisting of two completely independent seals. The sealing shall not depend on the direction of rotation. Each seal interface shall be held in contact by its own spring system.
 - a. The lower, primary seal unit, located between the pump and the lubricant chamber, shall be of corrosion-resistant tungsten-carbide or carbon/silicon-carbide.

- b. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall be of corrosion-resistant tungsten-carbide or carbon/silicon-carbide.
 - c. Each seal interface shall be held in contact by its own spring system. The seals shall require neither routine maintenance nor adjustment, and shall be capable of operating in either clockwise or counterclockwise direction of rotation without damage or loss of seal.
 - d. The seals shall operate in a lubricant chamber that hydrodynamically lubricates the lapped seal faces at a constant rate to allow for extended periods of dry-running operation without the need for external seal lubrication.
 - 1) The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity.
 - 2) Seal lubricant shall be environmentally friendly and non-toxic.
7. Bearings: The pump shaft shall rotate on anti-friction or grease-lubricated bearings with minimum B-10 life of 100,000 hours at any point along the usable portion of the pump curve at maximum speed. The bearing system shall be adequately designed so as to be capable of handling all axial thrust loads plus any and all radial loads.
8. Cooling System:
- a. Each pump/motor unit shall be provided with an integral, self-contained closed loop or self-supplying cooling system. The motor cooling jacket shall encircle the stator housing and shall be of cast iron, ASTM A-48, Class 35B. The cooling system shall be a closed loop type as specified.
 - b. The cooling jacket shall provide heat dissipation for continuous operation of the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air.
 - c. Closed Loop Cooling System Design:
 - 1) Provide a propylene glycol filled closed loop cooling system. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system. The cooling system shall have one fill port and one drain port integral to the cooling system.
 - 2) The internals of the cooling system shall be non-clogging by virtue of their dimensions.
9. Nameplate: A stainless steel nameplate shall be securely fastened to each pump at an easily accessible location. The following minimum data shall be clearly stamped on the nameplate, for both the pump and the motor:
- a. Manufacturer's name.
 - b. Model and serial numbers.
 - c. Pump rated speed
 - d. Pump rated flow and head
 - e. Frame designation.
 - f. Horsepower rating.

- g. Insulation class.
- h. Frequency.
- i. Number of phases.
- j. Voltage.
- k. Amperage and temperature rise at full load.
- l. NEMA Code letter.
- m. Service factor.

B. Motors:

1. Pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housing in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180 degrees C. Motor shall be 460 volts, 60 Hz, and 3 phase. The motor shall be able to operate continuously while non-submerged without damage while pumping under load.
2. Stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95 percent. Stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is not acceptable.
3. Motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The motor shall be able to withstand voltages greater than 1600 volts and rise times of 0.1 microsecond. Motor shall be designed for submersible pump usage, continuous duty, and capable of at least **15** evenly spaced starts per hour. Motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
4. Rotor bars and short circuit rings shall be made of cast aluminum.
5. Motor thrust bearings shall be designed for continuous thrust loads under all conditions of pump operation from zero head to shut-off. The anti-friction bearings shall be rated for a L-10 life of 100,000 hours.
6. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the terminal box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. Cable shall be capable of continuous submergence without loss of watertight integrity to a minimum depth of 65 feet, and shall be indicated by code or legend permanently applied to cable.
7. Cable entry seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the cable entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal.

- C. Accessories: Provide the following for each pump unless otherwise specified:
1. Anchor bolts and anchorage devices per Section 05051, Anchor Systems.
 2. Equipment for Wet Well Installation and Pump Lifting:
 - a. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 316.
 - b. For each pump the contractor shall supply and install a cable holder made with 4 hooks of Stainless steel AISI 316.
 - c. There shall be no need for personnel to enter the wet-well.
 - d. The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact or profile gaskets. Sealing of the discharge interface with a diaphragm or O-ring will not be accepted. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.
 - e. Each pump shall be fitted with a stainless steel lifting chain or lifting cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

2.4 CONTROLS

- A. Influent Pumps consist of the following controls:
1. Variable Frequency Drives shall be provided under this section in accordance with the requirements specified under Section 16425.
 2. Protective Control Devices – Smart pump electronic module system or discrete solid-state protective controllers, plus temperature, leak, and vibration sensors.
 3. The protective control devices shall interface with the Variable Frequency Drives. The electronic module system or discrete protective controllers shall be shipped to the variable frequency drive manufacturer for mounting in the drive enclosure.
 4. The electronic module system shall consist of a base unit for protection of the pump and relay modules. The relay modules shall communicate with the base unit and provide the specified indication. The system shall also include the power supply necessary for operation of the system.
 5. The protective control devices shall provide indication of Motor High Temperature, Motor Leakage, Pump Leakage, Bearing Temperature and Pump Vibration.
 6. The protective control devices shall be factory configured to the extent applicable prior to shipment and then commissioned in the field during startup.

B. Protective Monitoring Equipment:

1. General:

- a. Provide power and control cables and motor protective control devices as specified in Paragraph 2.3.B of this Section and in Paragraph 2.4.B.2., below, of this Section.
- b. Instrumentation and control system operational functional requirements relative to pump applications are shown and specified in applicable instrumentation and control Specifications in Division 13.

2. Motor Protective Control Devices:

- a. Each pump and motor shall be equipped with the following minimum protection and monitoring sensors:
 - 1) Three temperature thermistor probes, one installed in each motor stator phase winding, to provide direct stator temperature read-out of each phase winding.
 - 2) Upper and lower bearing temperature thermistors.
 - 3) One leakage sensor to detect water intrusion into the motor stator chamber. If activated, the leakage sensor shall activate an alarm and stop the motor.
 - 4) One leakage sensor to detect water intrusion into the power cable junction chamber of the pump/motor unit, if required.
- b. The pump/motor unit protective and monitoring sensors shall be connected to the electronic module or discrete controllers located in the respective variable frequency drive. The electronic module system or discrete controllers shall accept the inputs from thermistors, leakage sensors, and vibration sensors and be programmed to protect the pump if measured parameters exceed safe limits.
- c. The pilot cable shall be designed specifically for use with submersible pumps and shall be of the submersible cable (SUBCAB) type. The cable shall be multi-conductor type with stainless steel braided shielding, a chlorinated polyethylene rubber outer jacket and tinned copper conductors insulated with ethylene-propylene rubber. The conductors shall be arranged in twisted pairs. The cable shall be rated for 600 Volts and 90 degrees C, with a 40 degrees C ambient temperature. The cable length shall be adequate to reach the junction box without the need for splices.
- d. Provide power monitoring device as defined in Division 16, Electrical.

C. Operational Description:

- 1. Reference Section 13491, Process Control Descriptions, for overall operational description.

2.5 FINISHING

- A. Shop Finishing:
 - 1. At the factory, pumps, motors, and appurtenances shall receive manufacturer's standard finish paint system suitable for sewage service. Finish color of pumps shall be same as color of related process piping.
 - 2. Coat machined, polished, and non-ferrous surfaces with corrosion prevention compound.
- B. Touch-up of factory-applied finishes shall be compatible with factory-applied finish and specified service conditions.

2.6 SOURCE QUALITY CONTROL

- A. Pump Shop Tests: Shop Test all pumps provided under this Section.
 - 1. Hydrostatically test pump bodies per ANSI/HI 11.6, to the greater of: twice specified pump discharge head at the full speed design point, or 1.5 times pump's shutoff head.
 - 2. Nonwitnessed Factory Performance Test:
 - a. Each pump shall be subject to a nonwitnessed performance shop test to determine the head, capacity, speed, brake horsepower and efficiency at each condition specified in the Design and Performance Criteria. Pump shall be tested in dry pit operation.
 - b. Owner and Engineer shall be informed of the test dates a minimum of six weeks in advance.
 - c. If equipment fails tests, re-testing shall be scheduled as soon as possible.
 - d. Each pump shall be operated at the rated duty point. Results of the tests shall be shown on a plot of test curves showing head, flow, horsepower, efficiency, and current.
 - e. Operate each pump at full speed against a closed discharge valve for a minimum of two minutes. Inspect the wear rings for contact by removing the suction cover. Pumps exhibiting contact shall be rejected.
 - f. For a single pump, perform an extended pumping test at the full speed design point for a minimum of 2 hours to verify that the pump will operate at the rated capacity without loss of flow, head, or efficiency.
 - g. All other performance test procedures not stated above shall be in accordance with ANSI/HI 11.6. Performance predictions based on tests at a single speed will not be permitted.
 - 1) Repeat tests until results indicate compliance with the Contract Documents.
 - 2) Submit five copies of all Shop Test results certified by a Professional Engineer and signed by an officer of the manufacturing corporation.
 - 3) Equipment shall not be shipped to the site until the Contractor has received written notification from the Engineer of their acceptance of the results.

B. Motor Tests and Data:

1. Provide motor test data in accordance with Article 1.4, Submittals.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install submersible end suction pump equipment in complete accordance with manufacturer's instructions and recommendations and the approved Shop Drawings
- B. Furnish and install all required oil and grease for initial operation.
- C. Anchorages:
1. Install discharge elbow on concrete bases. Provide anchorages in new or existing concrete, as applicable, per equipment manufacturer's recommendations and the Contract Documents. Equipment manufacturer shall supply templates to facilitate location of anchorages for equipment. Contractor shall coordinate with Supplier to assure timely receipt of required templates.
- D. General:
1. Conform to ANSI/HI 14.4.
 2. Perform all fitting required for installation. Set products accurately in location, alignment, and elevation, plumb and true.
 3. Provide piping connections per the Contract Documents. Support piping and valves independent of pump. Verify that piping and valves are tested and operational before placing equipment into operation. When pumps are connected to piping with rigid hardware, connection of discharge nozzle to piping shall conform to ANSI/HI 9.6.2.
 4. Align and adjust products and piping in presence of Engineer.
 5. Provide for initial operation lubricants recommended by equipment manufacturer.
 6. Prior to energizing motor driven equipment, rotate drive motor by an external source to demonstrate free operation of mechanical parts. Do not energize equipment until safety devices are installed, connected, and functional.
 7. Provide commissioning of the pump control protective devices to the extent applicable to ensure they are configured properly and operate as intended.

Commissioning of the pump control devices shall be performed by the pump manufacturer control technician.

3.3 FIELD TESTS

A. General:

1. All necessary testing equipment and manpower shall be provided by Contractor at their expense.
2. Submit written test procedure for each field test at least 30 days prior to date of testing.
3. Submit report for each test including test procedure, data, and results.
4. In the event that Contractor is unable to demonstrate to Engineer that the equipment meets the requirements specified herein, the equipment will be rejected and Contractor shall correct, adjust, modify and/or replace the equipment and retest as often as necessary at their expense until acceptable results are obtained.

B. Running Test: After Contractor and Engineer have mutually agreed that the equipment installation is complete and ready for continuous operation, Contractor and a qualified field service representative of the manufacturer shall conduct a Running Test of the equipment and controls in the presence of Engineer to demonstrate that the units and their controls function correctly.

1. Field test each unit and its controls in local mode, followed by demonstrating proper operation and controls in automatic mode. Demonstrate that each part and component of system individually and all parts and components together function properly in manner intended, without excess vibration, overheating, or clogging. Total duration of testing shall be 3 days (24 hours per day), continuous and uninterrupted, in automatic mode.
1. Upon initiation of the Operational Demonstration, make observations of head, capacity, and motor input at full speed and at a minimum of three operating points and plot performance characteristics of the pump. Test one operating point, as chosen by Engineer, for each pump for a 4-hour duration to verify no loss of pumping capacity over time.

3.4 MANUFACTURER's SERVICES

A. A qualified, factory trained representative shall be provided for installation supervision, start-up and test services, and operation and maintenance personnel training services. The manufacturer's representative shall make a minimum of three visits to the Site as described below. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

1. First visit shall be for supervising unloading and handling of equipment and for instructing Contractor in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-site: 8 hours.

2. Second visit shall be for checking completed installation, start-up of system, and performing field quality control testing. Manufacturer's representative shall test operate the system in the presence of the Engineer and verify that the equipment conforms to the requirements. Minimum number of hours on-site: 16 hours, no more than 8 hours per day.
 3. Third visit shall be for instructing operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction, and other qualifications shall be in accordance with Section 01730, Operations and Maintenance Data.
- B. Reports: Submit report by manufacturer of each visit to the site that provides complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.
- C. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to Owner.

+ + END OF SECTION + +

SECTION 11117

SUBMERSIBLE END SUCTION PUMPS – WET PIT (PERMANENT)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals required to furnish and install extra heavy-duty submersible, end suction centrifugal pumps complete and operational with motors, control equipment, lifting chains and guide bars, discharge connections, and accessories as shown and specified. Anchorage devices are included in the scope of this Section.
2. The pump Supplier shall furnish and have overall system responsibility for variable frequency drives as specified in Section 16425, Variable Frequency Drives, and shall be responsible for coordination of the overall variable frequency drive system application. This shall include coordination of the pumps and motors with the variable frequency drive units, as well as coordination of the drive system interfacing with electrical work and instrumentation and control functions. Overall system responsibility shall include field testing, start-up, training, calibration and overall successful operation of the equipment. The Contractor through the Supplier shall guarantee and shall be the source of information for the complete system, including each piece of equipment furnished under this Section and other Sections, regardless of the manufacturing source of that equipment.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before submersible end suction pump Work.

C. Related Sections:

1. Section 05051, Anchor Systems.
2. Section 09900, Painting.
3. Section 11000, Electric Motors.
4. Section 13430, Process Control Panels and Enclosures.
5. Section 13491, Process Control Descriptions.
6. Section 15061, Ductile Iron Pipe.
7. Section 16425, Variable Frequency Drives.

1.2 REFERENCES

A. Standards referenced in this Section are:

Long Beach WPCP Consolidation
Pump Station Conversion

1. American Gear Manufacturers' Association, (AGMA).
2. American National Standards Institute, (ANSI).
3. American Society for Testing Materials, (ASTM).
4. Standards of American Water Works Association, (AWWA).
5. Institute of Electrical and Electronic Engineers, (IEEE).
6. Standards of the Hydraulic Institute, (HI).
7. National Electrical Code, (NEC).
8. Standards of the National Electrical Manufacturers Association, (NEMA).
9. National Sanitation Foundation, (NSF).

1.3 QUALITY ASSURANCE

A. Supplier's Qualifications:

1. Supplier shall have a minimum of ten years of experience producing substantially similar equipment to that required for the Project and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all products included in this Section, regardless of component Supplier, from one submersible end suction pump manufacturer.
2. Submersible end suction pump Supplier shall review and approve or prepare all Shop Drawings and submittals for all components provided under this Section.
3. All components shall be suitable for specified service conditions and shall be integrated into overall assembly by the submersible end suction pump Supplier.
4. To centralize responsibility and to ensure equipment is properly coordinated, the pump variable frequency drives specified under Section 16425 shall be provided under this Section.

C. Certifications

1. Certification of Compliance:

- a. Obtain certification of compliance with the Contract Documents from the submersible end suction pump manufacturer on manufacturer letterhead; certification by manufacturer's representatives is not acceptable.
- b. Certification shall be worded as follows:
 "[Insert manufacturer's name] proposes to supply equipment included in Section 11117 for Nassau County. We have examined the Contract Documents and understand the Project requirements insofar as they affect the proposed products. We certify that the products will operate satisfactorily under the conditions described in the Contract Documents and that the products meet the requirements of the Contract Documents:

[List exceptions, deviations or changes necessary or recommended to accommodate the proposed products.]

We further certify that the products to be furnished shall conform to the standards listed in Section 11117, Submersible End Suction Pumps – Wet Pit, of the Contract Documents and that any abnormal operating conditions imposed on the pump by the wet well cleaning cycle and pump shutdown procedures will not damage the pumping unit and will not void the warranty.

[List exceptions, deviations or changes necessary to accommodate the proposed products.]

Authorized Signature & Title

Date

- c. Provide justification for exceptions, variations, deviations, or changes. Engineer will determine whether exceptions, deviations, and changes are acceptable. Exceptions, variations, deviations, and changes may result in rejection of products.
- d. Provide certification before submitting Shop Drawings. Shop Drawings will not be reviewed prior to receipt of certification.
- e. Acceptance of certification shall not relieve Contractor of responsibility for adequacy of all products.
- f. Submittal of certification shall not relieve Contractor and Supplier of requirement to comply with submittal procedures in the Contract Documents.

D. Professional Engineer:

- 1. Engage a registered professional engineer legally qualified to practice and experienced in providing the engineering services of the kind indicated. Professional engineer may be an employee of the manufacturer.
- 2. Submit qualifications data.
- 3. Responsibilities include but are not necessary limited to:
 - a. Preparing or supervising the preparation of shop test set ups.
 - b. Performing or supervising the performance of shop tests, interpretation, and engineering analysis of shop test data, and preparation of test reports.
 - c. Certifying that the tests performed and the results achieved conform to the Contract Documents.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Submittals of pump controls, including panel layout and wiring diagrams. Conform to submittal requirements of Section 13401, Process Control System General Provisions.
- 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, and engineering data including; dimensions, materials, size, weight, and part lists for all

components in sufficient detail to allow an item-by-item comparison with the Contract Documents.

- b. Pump performance data and curves showing overall pump efficiencies, required net positive suction head (NPSH), allowable suction lift, flow rate, head, brake horsepower, motor horsepower, speed, and shut-off head. For variable speed units, curves shall have at least five speeds plotted between maximum and minimum rpm. Curves shall indicate Preferred Operating Region (POR) and Allowable Operating Region (AOR), as defined in ANSI/HI 9.6.3.
 - c. Motor Data: Furnish certified motor data sheet for previously tested, electrically duplicate motor to that specified, including the following:
 - 1) Speed-torque relationship.
 - 2) Efficiency at 1/2, 3/4, and full load.
 - 3) Power factor at 1/2, 3/4, and full load.
 - 4) Slip at full load.
 - 5) Running light, full load and locked rotor current.
 - 6) Temperature rises and results of dielectric tests.
 - 7) Bearing type and lubrication medium
 - 8) Insulation class and temperature ratings.
 - d. Motor Data: Provide maximum safe stall time, number of starts per hour, and thermal protective devices (switch, thermistor, RTD).
- 3. Samples:
 - a. Paint color samples for finish on pumps and motors. Color samples shall conform to Section 09900, Painting.
 - 4. Testing Plans, Procedures, and Testing Limitations:
 - a. Provide pump Supplier's proposed shop testing plan, including complete list of testing facility limitations.
 - b. Provide proposed field testing plan.

B. Informational Submittals:

- 1. Manufacturer Instructions:
 - a. Provide Supplier's instructions for handling and installing products.
 - b. Setting drawings, templates, and directions for installing anchor bolts and other anchorages.
- 2. Quality Assurance Submittals
 - a. Provide certification of compliance as specified in Paragraph 1.3 C.1.
 - b. Qualifications of professional engineer as specified in Paragraph 1.3 D.
 - c. Location of nearest permanent service headquarters of pump manufacturer to the Site.
- 3. Source Quality Control Submittals:
 - a. Results of shop testing for complete pump and motor unit. Test results shall be certified by a registered professional engineer and signed by an officer the manufacturing corporation.
- 4. Field Quality Control Submittals:
 - a. Results of field testing.

- b. Submit a written report of the results of each visit to Site by pump manufacturer's service representative, including purpose and time of visit, tasks performed, and results obtained.
 - 5. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.
- C. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Manuals:
 - a. Submit complete operation and maintenance manuals, including shop and field test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Provide operation and maintenance manuals per Section 01730, Operations and Maintenance Data.
 - 2. Warranty Documentation:
 - a. Manufacturer's Standard Warranty.
 - b. Special Warranty.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Prior to shipping, completely inspect products to assure that components are complete and comply with all requirements. Box or crate products as required to prevent damage during shipment. Protect machined surfaces and matching connections to prevent damage.
 - 2. Equipment shall not be shipped to the site until the Contractor has received written notification by the Engineer of their acceptance of the Shop Test results.
 - 3. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
 - 4. Inspect all boxes, crates, and packages upon delivery to Site and notify Engineer in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.
- B. Storage and Protection:
 - 1. Keep all products off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion and deterioration.

1.6 WARRANTY

- A. Special Warranty on Submersible End Suction Pumps:
 - 1. In addition to the manufacturer's standard guarantee, CONTRACTOR shall include the services of a factory trained serviceman to provide repair service for the equipment for the period of two years commencing with the time the equipment is placed in continuous permanent operation. This service shall include the cost of all replacement parts required during the interval.

2. The manufacturer shall guarantee clog-free operation for a period of 24 months from the date of start-up of the pumps by the local authorized factory representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. Should the impeller clog with typical solids and/or modern trash debris normally found in domestic wastewater during this period, an authorized representative shall travel to the jobsite, remove the pump, clear the obstruction and reinstall the pump at no cost or shall reimburse the Owner for reasonable cost to provide this service. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

A. System Description:

1. Pumps shall be submersible end suction centrifugal non-clog type. Pumps shall be constructed for operation under complete submersion, partial submersion, and dry conditions. Each pump shall be suitable for its intended service.
2. Pumps shall comply with ANSI/HI 14.3, ANSI/HI 9.6.3, and ANSI/HI 9.8.
3. Pumping unit shall be capable of withstanding periodic severe conditions during a wet well cleaning cycle. The cleaning cycle procedure is described in ANSI/HI 9.8-2012. During this procedure, the pump will be used to lower the level in the wet well until the pumps lose prime. The procedure will subject the pumping unit to vibration, dry running, and other severe conditions. The frequency and duration of the cleaning procedure is estimated to be for 5 minute periods, bi-weekly. Operation of the cleaning procedure as described above shall not void the warranty for the pump or any of its components. The pump manufacturer shall submit certification stating such. Pumps shall be capable of up to a minimum of 10 starts per hour to withstand the above conditions.

- B. Design and Performance Criteria: Each of the below listed sets of pumps shall comply with the below listed performance criteria.

Location:	LB Pump Station	LB Pump Station
Pump ID	Pump No.1, Pump No. 4, Pump No. 5	Pump No.2, Pump No. 3, Pump No. 6
Number of Pumps Required ¹	4	4
Fluid Pumped:	Raw Sewage	Raw Sewage
Full Speed Design Point:		
Total Flow	11,798 gpm (17 mgd)	5,552 gpm (8 mgd)
Flow/pump ² :	5,899 gpm (8.5 mgd)	2,776 gpm (4 mgd)
Total Head ² :	158 ft	59 ft
Number of pumps in	2	2

	operation		
	Minimum Pump Efficiency:	78%	80%
Reduced Speed Design Point:			
	Flow/pump:	5,552 gpm (8 mgd)	3,123 gpm (4.5 mgd)
	Total Head:	47.51 ft	27.05 ft
	Number of pumps in operation	1	1
	Minimum Sphere Diameter:	5-inches	5-inches
	Minimum Head at Zero Flow:	245.0 ft	79 ft
	Maximum Motor Size ³ :	385 horsepower	100 horsepower
	Maximum Speed:	1200 rpm	1200 rpm

Notes:

1. Number of pumps required includes one (1) spare for each pump type. Testing of spare pumps shall be as instructed by ENGINEER.
2. At maximum speed.
3. At all points on pump curve, pump horsepower requirements shall not exceed specified motor horsepower.

2.2 MANUFACTURERS/PRODUCTS

- A. Manufacturers and Products include: Provide products of one of the following:
1. Flygt,
 2. KSB,
 3. No substitutions allowed.

2.3 DETAILS OF CONSTRUCTION

- A. Pump Materials and Construction:
1. General:
 - a. Construct pumps for fluid service specified.
 - b. Pumps shall be of the wet pit submersible, non-clog type.
 2. Pump Body and Externals:
 - a. Stator casing, oil casing, volute, and other major pump components shall be gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities.
 - b. Provide lifting eyes on each pump capable of bearing weight of pump during removal and installation.
 - c. External Hardware: Bolts, nuts, and cap screws shall have hexagonal heads and be Type 316 stainless steel.
 - d. Provide hand hole for inspection and cleaning of the interior parts of the pump. Provide neoprene or Buna-N gaskets.

3. Impeller: Impeller shall be ASTM A-532 Alloy III A 25% chrome cast iron or cast iron ASTM A48 Class 35B. Any impeller material different than ASTM A-532 Alloy III A 25% chrome cast iron shall have at least 180 HB hardness. Any coating to harden the surface of the impeller shall not be allowed. Impeller shall be of semi-open or enclosed, dynamically balanced, multiple-vane, non-clogging design having long throughlets without acute turns to protect against wear and clogging. The impeller shall be capable of handling solids, fibrous materials, sludge, and other matter found in raw wastewater. The impeller shall be securely fitted to the pump shaft in such a manner that it does not loosen or become detached when the pump is operated in the reverse direction.
4. Wear Rings / Insert Rings: Stainless steel impeller and casing wear rings shall be used to provide efficient sealing between the volute and suction inlet of the rotating impeller. They shall be firmly secured to prevent rotation or displacement.
 - a. Wear Plates: Shall be gray cast iron ASTM A-48 Class 35B with at least Rc60 hardness or ASTM A-532 Alloy III A 25% chrome cast iron with at least Rc60 hardness.
5. Shaft: The common pump/motor shaft shall be solid continuous and of stainless steel AISI Type 420 or Type 431 construction, and shall be completely isolated from the pumped liquid through the use of a stainless steel shaft sleeve.
 - a. Minimum Shaft Design/Sizing Requirements:
 - 1) The shaft shall be of sufficient size to transmit full driver output with a maximum deflection of 0.008 inches measured at the lower mechanical seal.
 - 2) The impeller shall not be allowed to deflect more than 50% of the wear ring clearance at all of the rated conditions listed in the Design and Performance Criteria in Paragraph 2.1 B.
 - 3) The maximum bending stress shall be less than 15,000 psi at any shaft section when the pump is operating at maximum speed with its maximum published impeller diameter at pump shut-off head.
 - 4) Sufficiently large in diameter to safely transmit the maximum torque developed by the drive unit.
 - 5) Design to provide rigid support for the impeller to prevent excessive vibration at maximum possible turbinning speed.
 - 6) The first critical speed of the shaft rotor, including impeller, shaft, sleeve, and coupling shall not be less than 120% of the highest rated running speed or calculated turbinning speed, whichever is greater.
6. Seals: Each pump shall be provided with tandem mechanical seals consisting of two completely independent seals. The sealing shall not depend on the direction of rotation. Each seal interface shall be held in contact by its own spring system.
 - a. The lower, primary seal unit, located between the pump and the lubricant chamber, shall be of corrosion-resistant tungsten-carbide or carbon/silicon-carbide.

- b. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall be of corrosion-resistant tungsten-carbide or carbon/silicon-carbide.
 - c. Each seal interface shall be held in contact by its own spring system. The seals shall require neither routine maintenance nor adjustment, and shall be capable of operating in either clockwise or counterclockwise direction of rotation without damage or loss of seal.
 - d. The seals shall operate in a lubricant chamber that hydrodynamically lubricates the lapped seal faces at a constant rate to allow for extended periods of dry-running operation without the need for external seal lubrication.
 - 1) The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity.
 - 2) Seal lubricant shall be environmentally friendly and non-toxic.
- 7. Bearings: The pump shaft shall rotate on anti-friction or grease-lubricated bearings with minimum B-10 life of 100,000 hours at any point along the usable portion of the pump curve at maximum speed. The bearing system shall be adequately designed so as to be capable of handling all axial thrust loads plus any and all radial loads.
- 8. Cooling System:
 - a. Each pump/motor unit shall be provided with an integral, self-contained closed loop or self-supplying cooling system. The motor cooling jacket shall encircle the stator housing and shall be of cast iron, ASTM A-48, Class 35B, or of stainless steel, ASTM A276 Type 316 Ti.
 - b. The cooling jacket shall provide heat dissipation for continuous operation of the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air.
 - c. Option 1: Closed Loop (All Motor Unit Sizes)
 - 1) Provide a propylene glycol filled closed loop cooling system. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system. The cooling system shall have one fill port and one drain port integral to the cooling system.
 - 2) The internals of the cooling system shall be non-clogging by virtue of the cooling liquid.
 - d. Option 2: Open Loop (Motor Units > 300 HP)
 - 1) The cooling system shall be open loop for motor units larger than 300 HP, using water through large ports to cool the motor.
- 9. Nameplate: A stainless steel nameplate shall be securely fastened to each pump at an easily accessible location. The following minimum data shall be clearly stamped on the nameplate, for both the pump and the motor:
 - a. Manufacturer's name.
 - b. Model and serial numbers.

- c. Pump rated speed
- d. Pump rated flow and head
- e. Frame designation.
- f. Horsepower rating.
- g. Insulation class.
- h. Frequency.
- i. Number of phases.
- j. Voltage.
- k. Amperage and temperature rise at full load.
- l. NEMA Code letter.
- m. Service factor.

B. Motors:

- 1. Pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housing in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180 degrees C. Motor shall be 460 volts, 60 Hz, and 3 phase. The motor shall be able to operate continuously while non-submerged without damage while pumping under load.
- 2. Stator shall be insulated by the trickle impregnation or current-UV-dip impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95 percent. Stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins, or other fastening devices requiring penetration of the stator housing is not acceptable.
- 3. Motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The motor shall be able to withstand voltages greater than 1600 volts and rise times of 0.1 microsecond. Motor shall be designed for submersible pump usage, continuous duty, and capable of at least 10 evenly spaced starts per hour. Motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
- 4. Rotor bars and short circuit rings shall be made of cast aluminum.
- 5. Motor thrust bearings shall be designed for continuous thrust loads under all conditions of pump operation from zero head to shut-off. The anti-friction bearings shall be rated for a L-10 life of 100,000 hours.
- 6. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the terminal box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. Cable shall be capable of continuous submergence without loss of watertight integrity to a minimum depth of 65 feet, and shall be indicated by code or legend permanently applied to cable.
- 7. Cable entry seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the cable entry inside diameter. The grommets

shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal.

- C. Accessories: Provide the following for each pump unless otherwise specified:
1. Anchor bolts and anchorage devices per Section 05051, Anchor Systems.
 2. Equipment for Wet Well Installation and Pump Lifting:
 - a. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. The material of the guide bars shall Stainless steel AISI 316.
 - b. For each pump the contractor shall supply and install a cable holder made with 4 hooks of Stainless steel AISI 316.
 - c. There shall be no need for personnel to enter the wet-well.
 - d. The sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal contact or profile gaskets. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.
 - e. Each pump shall be fitted with a stainless steel lifting chain or lifting cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

2.4 CONTROLS

- A. Influent Pumps consist of the following controls:
1. Variable Frequency Drive shall be provided under this section in accordance with the requirements specified under Section 16425.
 2. Protective Control Devices – Smart pump electronic module system or discrete solid-state protective controllers , plus temperature, leak, and vibration sensors.
 3. The protective control devices shall interface with the Variable Frequency Drives. The electronic module system or discrete protective controllers shall be shipped to the variable frequency drive manufacturer for mounting in the drive enclosure.
 4. The electronic module system shall consist of a base unit for protection of the pump and relay modules. The relay modules shall communicate with the base unit and provide the specified indication. The system shall also include the power supply necessary for operation of the system.
 5. The protective control devices shall provide indication of Motor High Temperature, Motor Leakage, Pump Leakage, Bearing Temperature and Pump Vibration.

6. The protective control devices shall be factory configured to the extent applicable prior to shipment and then commissioned in the field during startup. B. Protective Monitoring Equipment:

1. General:

- a. Provide power and control cables and motor protective control devices as specified in Paragraph 2.3.B of this Section and in Paragraph 2.4.B.2., below, of this Section.
- b. Instrumentation and control system operational functional requirements relative to pump applications are shown and specified in applicable instrumentation and control Specifications in Division 13.

2. Motor Protective Control Devices:

- a. Each pump and motor shall be equipped with the following minimum protection and monitoring sensors:
 - 1) Three temperature thermistor probes, one installed in each motor stator phase winding, to provide direct stator temperature read-out of each phase winding.

- 2) Upper and lower bearing temperature thermistors.

- 3) One leakage sensor to detect water intrusion into the motor stator chamber. If activated, the leakage sensor shall activate an alarm and stop the motor.

- 4) One leakage sensor to detect water intrusion into the power cable junction chamber of the pump/motor unit, if required.

- b. The pump/motor unit protective and monitoring sensors shall be connected to the electronic module or discrete controllers located in the respective variable frequency drive. The electronic module system or discrete controllers shall accept the inputs from thermistors, leakage sensors, and vibration sensors and be programmed to protect the pump if measured parameters exceed safe limits.

- c. The pilot cable shall be designed specifically for use with submersible pumps and shall be of the submersible cable (SUBCAB) type. The cable shall be multi-conductor type with stainless steel braided shielding, a chlorinated polyethylene rubber outer jacket and tinned copper conductors insulated with ethylene-propylene rubber. The conductors shall be arranged in twisted pairs. The cable shall be rated for 600 Volts and 90 degrees C, with a 40 degrees C ambient temperature. The cable length shall be adequate to reach the junction box without the need for splices.

- d. Provide power monitoring device as defined in Division 16, Electrical.

- C. Operational Description:

1. Reference Section 13491, Process Control Descriptions, for overall operational description.

2.5 FINISHING

- A. Shop Finishing:
 - 1. At the factory, pumps, motors, and appurtenances shall receive manufacturer's standard finish paint system suitable for sewage service. Finish color of pumps shall be same as color of related process piping.
 - 2. Coat machined, polished, and non-ferrous surfaces with corrosion prevention compound.
- B. Touch-up of factory-applied finishes shall be compatible with factory-applied finish and specified service conditions.

2.6 SOURCE QUALITY CONTROL

- A. Pump Shop Tests: Shop Test all pumps provided under this Section.
 - 1. Hydrostatically test pump bodies per ANSI/HI 11.6, to the greater of: twice specified pump discharge head at the full speed design point, or 1.5 times pump's shutoff head.
 - 2. Nonwitnessed Factory Performance Test:
 - a. Each pump shall be subject to a nonwitnessed performance shop test to determine the head, capacity, speed, brake horsepower and efficiency at each condition specified in the Design and Performance Criteria. Pump shall be tested in dry pit operation.
 - b. Owner and Engineer shall be informed of the test dates a minimum of six weeks in advance.
 - c. If equipment fails tests, re-testing shall be scheduled as soon as possible.
 - d. Each pump shall be operated at the rated duty point. Results of the tests shall be shown on a plot of test curves showing head, flow, horsepower, efficiency, and current.
 - e. Operate each pump at full speed against a closed discharge valve for a minimum of two minutes. Inspect the wear rings for contact by removing the suction cover. Pumps exhibiting contact shall be rejected.
 - f. For a single pump, perform an extended pumping test at the full speed design point for a minimum of 2 hours to verify that the pump will operate at the rated capacity without loss of flow, head, or efficiency.
 - g. All other performance test procedures not stated above shall be in accordance with ANSI/HI 11.6. Performance predictions based on tests at a single speed will not be permitted.
 - 1) Repeat tests until results indicate compliance with the Contract Documents.
 - 2) Submit five copies of all Shop Test results certified by a Professional Engineer and signed by an officer of the manufacturing corporation.
 - 3) Equipment shall not be shipped to the site until the Contractor has received written notification from the Engineer of their acceptance of the results.

B. Motor Tests and Data:

1. Provide motor test data in accordance with Article 1.4, Submittals.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install submersible end suction pump equipment in complete accordance with manufacturer's instructions and recommendations and the approved Shop Drawings
- B. Furnish and install all required oil and grease for initial operation.
- C. Anchorages:
1. Install discharge elbow on concrete bases. Provide anchorages in new or existing concrete, as applicable, per equipment manufacturer's recommendations and the Contract Documents. Equipment manufacturer shall supply templates to facilitate location of anchorages for equipment. Contractor shall coordinate with Supplier to assure timely receipt of required templates.
- D. General:
1. Conform to ANSI/HI 14.4.
 2. Perform all fitting required for installation. Set products accurately in location, alignment, and elevation, plumb and true.
 3. Provide piping connections per the Contract Documents. Support piping and valves independent of pump. Verify that piping and valves are tested and operational before placing equipment into operation. When pumps are connected to piping with rigid hardware, connection of discharge nozzle to piping shall conform to ANSI/HI 9.6.2.
 4. Align and adjust products and piping in presence of Engineer.
 5. Provide for initial operation lubricants recommended by equipment manufacturer.
 6. Prior to energizing motor driven equipment, rotate drive motor by an external source to demonstrate free operation of mechanical parts. Do not energize equipment until safety devices are installed, connected, and functional.
 7. Provide commissioning of the pump control protective devices to the extent applicable to ensure they are configured properly and operate as intended.

Commissioning of the pump control devices shall be performed by the pump manufacturer control technician.

3.3 FIELD TESTS

A. General:

1. All necessary testing equipment and manpower shall be provided by Contractor at their expense.
2. Submit written test procedure for each field test at least 30 days prior to date of testing.
3. Submit report for each test including test procedure, data, and results.
4. In the event that Contractor is unable to demonstrate to Engineer that the equipment meets the requirements specified herein, the equipment will be rejected and Contractor shall correct, adjust, modify and/or replace the equipment and retest as often as necessary at their expense until acceptable results are obtained.

B. Running Test: After Contractor and Engineer have mutually agreed that the equipment installation is complete and ready for continuous operation, Contractor and a qualified field service representative of the manufacturer shall conduct a Running Test of the equipment and controls in the presence of Engineer to demonstrate that the units and their controls function correctly.

1. Field test each unit and its controls in local mode, followed by demonstrating proper operation and controls in automatic mode. Demonstrate that each part and component of system individually and all parts and components together function properly in manner intended, without excess vibration, overheating, or clogging. Total duration of testing shall be 3 days (24 hours per day), continuous and uninterrupted, in automatic mode.
1. Upon initiation of the Operational Demonstration, make observations of head, capacity, and motor input at full speed and at a minimum of three operating points and plot performance characteristics of the pump. Test one operating point, as chosen by Engineer, for each pump for a 4-hour duration to verify no loss of pumping capacity over time.

3.4 MANUFACTURER'S SERVICES

A. A qualified, factory trained representative shall be provided for installation supervision, start-up and test services, and operation and maintenance personnel training services. The manufacturer's representative shall make a minimum of three visits to the Site as described below. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

1. First visit shall be for supervising unloading and handling of equipment and for instructing Contractor in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-site: 8 hours.

2. Second visit shall be for checking completed installation, start-up of system, and performing field quality control testing. Manufacturer's representative shall test operate the system in the presence of the Engineer and verify that the equipment conforms to the requirements. Minimum number of hours on-site: 16 hours, no more than 8 hours per day.
 3. Third visit shall be for instructing operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction, and other qualifications shall be in accordance with Section 01730, Operations and Maintenance Data.
- B. Reports: Submit report by manufacturer of each visit to the site that provides complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.
- C. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to Owner.

+ + END OF SECTION + +

SECTION 11150
HYDRODYNAMIC SEPARATOR

PART 1 - GENERAL

- 1.1 This item shall govern the furnishing and installation of the storm water treatment device (SWTD), complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.
- 1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the SWTD and appurtenances specified in the Drawings and these specifications.
- 1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be manufactured by: Contech Engineered Solutions LLC or approved equal.
- 1.3 Related Sections
 - 1.3.1 Section 02200: Earthwork
 - 1.3.2 Section 02240: Dewatering
- 1.4 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.
- 1.5 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.
- 1.6 The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

- 1.7 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

PART 2 - MATERIALS

- 2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:
- 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
 - 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
 - 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
 - 2.1.4 Aggregates shall conform to ASTM C 33;
 - 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
 - 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
 - 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.
- 2.2 Internal Components and appurtenances shall conform to the following:
- 2.2.1 Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
 - 2.2.2 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
 - 2.2.3 Fiberglass components shall conform to the ASTM D-4097
 - 2.2.4 Access system(s) conform to the following:
 - 2.2.5 Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

PART 3 - PERFORMANCE

- 3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in

- the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using a particle size distribution having a mean particle size (d_{50}) of 125 microns unless otherwise stated.
- 3.2 The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.
- 3.3 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.
- 3.4 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.
- 3.5 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.
- 3.6 The SWTD shall have completed field tested following TARP Tier II protocol requirements

PART 4 - EXECUTION

- 4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.
- 4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.
- 4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.
- 4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

TABLE 1
Storm Water Treatment Device
Storage Capacities

Model	Minimum Sump Storage Capacity (yd ³)/(m ³)	Minimum Oil Storage Capacity (gal)/(L)
1	0.9(0.7)	61(232)
2	1.5(1.1)	83(313)
3	1.5(1.1)	99(376)
4	1.5(1.1)	116(439)
5	2.1 (1.6)	184(696)
6	2.1(1.6)	210(795)
7	2.1 (1.6)	236(895)
8	2.1 (1.6)	263(994)
9	2.9(2.2)	377(1426)
10	5.6(4.3)	426(1612)
11	5.6 (4.3)	520(1970)
12	5.6 (4.3)	568(2149)
13	8.7(6.7)	758(2869)
14	8.7(6.7)	965(3652)
15	8.7(6.7)	1172(4435)
16	8.7(6.7)	1309(4956)
17	3.6(2.8)	914 (3459)
18	5.0 (3.8)	792 (2997)
19	5.0 (3.8)	1057 (4000)
20	5.0 (3.8)	1320 (4996)

END OF SECTION

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SECTION 11217

MECHANICAL BAR SCREEN

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. The screen system shall consist of a mechanical multi-rake bar screen complete with motor, supports, anchor bolts, screen control panel, instruments, discharge, lifting attachments and accessories suitable for removing screenings from sanitary sewage as a complete and integrated package to ensure proper coordination, compatibility and operation of the system.
2. Equipment furnished under this section shall be suitable for operation in a sanitary sewer collection system. The sanitary sewage flow may be expected to contain waste solids, rags, flushable wipes, vegetable debris, lumber, rocks, sand, silt, petroleum products, industrial solvents, animal fats, and oils. The sanitary sewage will have a temperature of thirty-two to eighty degrees Fahrenheit (32 to 80) and will have a pH which may range from six to ten (6 to 10). The equipment will be located outdoors and the system must be designed to operate during freezing temperatures without damage.
3. Screen will be installed in a concrete channel and will remove screened material from the sanitary sewage. Screened materials will be discharged to a dumpster to be furnished by the Contractor.
4. The Contractor shall provide all labor, materials, and equipment necessary to furnish, paint, shop test, deliver, install, adjust, field test, and place in satisfactory operation the mechanically cleaned bar screen as specified herein.

B. Related Sections:

1. Section 01700, Maintenance of Plant Operations.
2. Section 05051, Anchor Systems.
3. Section 09900, Painting.
4. Section 11000, Electric Motors.
5. Section 13430, Process Control Panels and Enclosures.
6. Section 13491, Process Control Descriptions.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AISC 14th Edition Manual of Steel Construction, Eighth Edition
2. ASTM A36 Structural Steel
3. ASTM 283 Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars
4. ASTM A276 Standard Specification for Stainless Steel Bars and Shapes

5. ASTM A320 Alloy-Steel Bolting Materials for Low-Temperature Service
6. ASTM A380 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
7. ASTM A666 Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
8. ASTM B580 Anodic Oxide Coatings on Aluminum
9. AWS-B3.0 Welding Procedures and Performance Qualifications
10. AWS-D1.1 Structural Welding Code
11. NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies
12. NFPA 70 National Electrical Code (NEC)
13. NFPA 90 Electrical Standard for Industrial Machinery
14. ISO 9001 Quality Management Systems

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 1. The Contractor shall provide evidence to the Engineer that the manufacturer has a minimum of five (5) years' experience, in the design, manufacture, and supervision of installation of equipment of the type required under this Specification at locations within the United States.
- B. The Contractor shall be responsible to coordinate all details of the bar screen equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. The Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specification.

1.4 SUBMITTALS

- A. The Contractor shall submit the following:
 1. Working Drawings (see additional information below)
 2. Operation and Maintenance Manuals
 3. Lists of Spare Parts, Special Tools, and Supplies
 4. Table of recommended lubricants with contact information and addresses for lubricant suppliers.
 5. Shop Testing Plan (including description of testing arrangement), Field Testing and Startup Plan
 6. Reports of Shop Tests
 7. Reports of Field Tests and Start up
 8. Lists of Manufacturer's Service Facilities and Service Capabilities
 9. Reports of Manufacturer's Representative Site Visits
- B. Working Drawings shall include, but not limited to, the following:
 1. Manufacturer experience as specified herein.
 2. Certification of manufacturing facility, ISO 9001, or similar quality control protocols.

3. A copy of this Specification Section, with addendum updates included, and all referenced and applicable Sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements or those parts which are to be provided by the Contractor or others. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.
4. A copy of the Contract Document control diagrams and process and instrumentation diagrams, electrical drawings with addenda updates, that apply to the equipment in this section marked to show specific changes necessary for the supplied equipment. If no changes are required, the working drawing shall be marked "No Changes Required."
5. Manufacturer's equipment specifications and data sheets, which shall include but not limit to the following information:
 - a. Parts list with materials of construction and methods of fabrication Procedures for the cleaning, descaling, passivation, and detection of iron contamination in stainless steel in accordance with ASTM A380 shall be submitted for approval prior to the beginning of Work.
 - b. Weights of equipment component parts, assembled weight of equipment, and total shipping weight. As applicable, include dynamic loads and weight when full and all loads transmitted to supporting structure.
 - c. Product data sheets for all screen components.
 - d. Design performance data including, but not limit to, screen rotative speed, cleaning intervals, screenings removal capacity, maximum rated capacity, maximum differential head across bar rack for structural design, and maximum head-loss at peak flow.
 - e. External utility requirements for power for each component.
6. Complete assembly, layout, installation, and shop drawings, with clearly marked dimensions, and details. Details shall include but not limited to the following information:
 - a. Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface/ connections with other items or Work.
 - b. Equipment cross-section drawings.
 - c. Locations, minimum diameter openings for anchors and loads at each anchor point.

- d. Anchoring plan will include information on plan to avoid cutting existing reinforcing steel in accordance with Section 03200 Concrete Reinforcing.
- e. Screening discharge chute details.
- f. Cleaning rake and scraper details
- 7. The following calculations shall be submitted:
 - a. Calculations of maximum head-loss and velocity at peak flow for clean screen and blinded screen (0% and 30%) conditions.
 - b. Calculations of screen strength to handle the maximum differential water level.
 - c. Bearing life calculations per AFBMA standards.
 - d. Detailed summaries of structural, anchorage, and process design calculations. Structural calculation summary shall be signed and sealed by a Professional Engineer currently registered in the State of New York.
- 8. Certification of welders, steamfitters, and other workforces.
- 9. Painting and coating details.
- 10. Equipment nameplate data.
- 11. Manufacturer's delivery, storage, and handling requirements including a rigging plan for the screen.
- 12. Detailed Manufacturer's installation instructions and recommendations, including installation requirements requiring coordination with Contractor and/or other equipment suppliers.
- 13. Motor data as specified in Section 11000 – Electric Motors.
- 14. Testing and adjusting instructions.
- 15. Submit location of the nearest permanent service headquarters of the screen and motor manufacturer for the screen and motor submitted.
- 16. Equipment warranty information.

1.5 SPARE PARTS, SPECIAL TOOLS, AND SUPPLIES

- A. The Contractor shall procure and have available sufficient quantity of manufacturer recommended spare parts necessary to ensure uninterrupted operation of the screen for the duration of bypass pumping.
- B. The Contractor shall furnish such oil, grease, and any special lubricants as are necessary for the proper operation of the equipment provided under this Specification.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Equipment/Materials provided under this Specification shall be as manufactured (including all standard equipment, unless otherwise specified) by:
 - 1. Headworks International
 - 2. Huber Technology

- B. The Contractor shall supply products modified as necessary by the manufacturer to provide the specified features and to meet the specified operating conditions. The screens, instrumentation and controls shall be provided by a single supplier who will take full responsibility for the system.

2.2 MATERIALS / EQUIPMENT

A. General

1. The screens shall be suitable for operation under the conditions as specified in SCHEDULE 11217 – 1.
2. The only obstructions in the channel shall be the bar rack, frame, and rake mechanism. Except for the bottom bar rack and channel wall bracket anchoring bolts, all structural supports and fasteners shall be above the channel wall so they do not interfere with flow and allow screen removal without access into the screen channel.
3. Drive chains, chain guides, chain sprockets, bearings, axles, and bar racks shall be fully replaceable without having to remove the screen from the channel.
4. The system shall be designed such that no routine maintenance of any element below the operating floor at EL 8.0 is required.
5. All components, including the gear reducer, shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor.
6. The screen shall be structurally capable of withstanding all forces involved in the operation in a sewer system, including full bar rack blinding resulting in a maximum differential head as specified in SCHEDULE 11217 and an impact force equivalent to a two-hundred (200) pound object traveling at rate of three (3) feet per second.
7. All electrical appurtenances furnished by the equipment Manufacturer shall be rated for Class 1, Division 2, Group D, hazardous location.

B. Materials of Construction

1. Materials specified below are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

Component	Material
Bar rack	AISI, type 304 stainless steel
Dead plate	AISI, type 304 stainless steel
Discharge chute	AISI, type 304 stainless steel
Hinged bypass chute	AISI, type 304 stainless steel
Cleaning rake, rake arms, and wiper	AISI, type 304 stainless steel
Side frames	AISI, type 304 stainless steel
Fasteners and miscellaneous hardware	AISI, type 304 stainless steel

Component	Material
Dielectric isolation pads and grommets	Neoprene or EPDM
Connecting arms (rake arms excluded)	AISI, type 304 stainless steel
Sprockets	AISI, type 304 stainless steel
Chain	AISI, type 304 stainless steel
Chain rollers	Type 304 Stainless steel or polyamide
Scraper	AISI, type 304 stainless steel
Wiper Blade	Neoprene or UHMW polyethylene
Upper Bearings	cast steel, antifriction, rolling element type, grease lubricated
Submerged Bearings	UHMWPE or silicon carbide
Shafting	AISI, type 304 stainless steel
Stub Shaft	AISI, type 304 stainless steel or white cast iron
Covers	AISI, type 304 stainless steel
Anchor Bolts	AISI, type 316 stainless steel
Grease Line	Stainless steel tubing, ASTM A269, Grade TP316L, with stainless steel compression fittings; or stainless-steel pipe, ASTM A312, Grade TP316L, Schedule 40S, with threaded stainless-steel fittings
Anti-Seize Thread Lubricant	Provide manufacturer's standard product

C. Frame

1. Side frames shall be three-sixteenth (3/16)-inch thick minimum thickness, suitably reinforced to support all loads.
2. Support beams and wrap-around stainless steel stiffeners shall be provided above the maximum waterline. Beams and stiffeners shall be minimum three-sixteenth (3/16)-inch thick, U-shape.
3. Frames shall be securely fastened to the top of the concrete channels with stainless steel adhesive anchors designed by the screening system manufacturer.
4. Provide and install minimum one-half (1/2) inch thick EPDM or neoprene flaps to seal the screen to the channel walls. Flaps shall be bolted to the frame using fasteners on a minimum of six (6) inch centers.
5. Mounting brackets shall be furnished on the sides of the screen that are fixed to the top of the channel.
6. Mounting brackets shall be furnished on the back of the screen that are fixed to the sides of the channel as recommended by manufacturer.
8. Frame section shall be provided with a total of four (4) lifting lugs welded to the upper end of the frame sections.

D. Dead Plate

1. The dead plate shall be constructed of 0.16-inch minimum thickness and bolted to the side frames of the screen.
2. The dead plate shall extend from the bar rack to the point of screenings discharge.
3. Dead plate shall be true and flat such that a close clearance between the raking tines and the plate can be maintained during the cleaning cycle.
4. The back side of the dead plate shall be constructed to guarantee a maximum gap between rake bar and dead plate, leading to the discharge chute without interruption.
5. The dead plate shall be supplied with a heating system to prevent material from freezing inside of the machine.
 - a. The dead plate shall be fitted with self-regulating heat trace cable, and wrapped in closed cell foam insulation. A protective type 304 stainless steel jacket will enclose insulated tube protecting the assembly.
 - b. Screen covers located above top of channel shall be fitted with insulation.
 - c. Wiring from heat trace cable shall be provided with loose connections for field connection in a contractor supplied junction box by others.

E. Bar Rack

1. Bars shall be individually field-replaceable or replaceable in manageable sections. Each replaceable bar section shall not weigh more than 350 lbs.
2. Bars shall be affixed to the frame of the screen using fasteners. The framework of the bar rack shall be sufficiently braced and stiffened to form a rigid structure, such that the bar screen supports the load to meet the Maximum Differential Water Level for screen design specified in the Schedule 11217 – 1.
3. The bar rack shall be precisely constructed to provide clear openings as specified in the Schedule 11217 - 1.
4. Bars shall be constructed having a continuous taper bar (i.e., trapezoidal cross-section) or teardrop shape:
 - a. Taper bar shall have a minimum leading-edge thickness of 15/32-inch.
 - b. Teardrop shape shall have a minimum leading-edge thickness of one-quarter (1/4) inch.
 - c. The orientation of the bars shall minimize the potential for screening materials wedging between the bars.
5. Bars shall be extended from the bottom of the channel and bolted to a dead plate that extends to the point of screenings discharge.

F. Cleaning Rake

1. Rakes shall approach the channel invert from upstream side of screen and rake upward at the upstream face with tines between the bars.
2. The rakes shall operate in guides on each side of screen frame to ensure engagement and to clean the bars from the upstream side of the screen.
 - a. Engagement of the rake tines into the bar spacings shall be by mechanical means.

- b. Engagement of the rake tines into the bar spacings by the dead weight of the rake or chain mechanism will not be acceptable.
- 3. The rake mechanism shall consist of multiple rakes affixed to the roller chain with spacing to meet the cleaning interval and screening removal capacity as specified in the Schedule 11217 – 1. Rake teeth shall be designed to easily engage with the bar openings.
- 4. The rake shall have a minimum capacity of 0.074 cubic feet per foot. During each cleaning cycle, the rake tines shall engage the bottom of the screen field at the channel invert.
- 5. Rake tines shall have a tooth profile machined from a single continuous bar of thickness and depth to ensure adequate stiffness and strength to cope with the required duty cycle.
- 6. Each rake shall be designed such that screenings will not wrap around the rake tines and will not fall back into the sewage flow during the screening cycle. The rake tines shall penetrate the screen field sufficiently to ensure that screenings are completely removed during each cleaning cycle.

G. Chains

- 1. Each mechanically cleaned screen shall be provided with two (2) continuous catenary loops, one on each side of the screen.
- 2. Roller type chains shall be made of high tensile strength and resistance to corrosion.
 - a. Chain pins shall be constructed of stainless steel and hardened to Rockwell 26 HRC with a minimum weight of six (6) lbs./ft.
 - b. Chain shall be able to withstand, without damage or permanent distortion, the full stalling torque of the drive motor.
 - c. The average ultimate strength of the assembled chain shall be minimum twenty-five thousand (25,000) pound-force.
- 3. Chain Guide:
 - a. Each chain shall be provided with an L-profile, Type 304 stainless steel chain guide securely fixed to the side members of the screen frame for the full length of travel.
 - b. Thickness of chain guide shall be three sixteenth (3/16)-inch minimum.
 - c. Chain guide shall be bolted to the frame so that they can easily be replaced.
 - d. Chain guide shall be full height of travel and the location of chain guide shall minimize obstruction to flow.

H. Chain Sprockets

- 1. Each mechanically cleaned screen shall be provided with a total of four (4) chain sprockets.
- 2. The two (2) upper chain sprockets shall be installed on a drive shaft and be supported on each end by a grease lubricated bearing.
 - a. Drive shaft shall be capable of withstanding two-hundred percent (200%) percent of normal input torque.

- b. The shaft shall drive both chain assemblies and be equipped with an adjustable screw type take-up providing for a six (6)-inch adjustment for the screen chain. Take-up screw shall be stainless steel construction. Chain tensioning shall be achieved by method recommended by manufacturer.
 - c. Upper sprocket bearings shall be flange mounted to the side frame and have a minimum AFBMA B-10 life of fifty-thousand (50,000) hours. The bearings shall be furnished with externally accessible grease fittings.
 - d. A seal shall be provided around the shaft where each shaft passes through the screen frame.
 - 3. The two (2) lower chain sprockets shall be mounted on stub shafts and be designed to operate in a submerged condition.
 - a. The bearings for the lower submerged sprockets shall be self-lubricating UHMWPE, or silicone carbide and be maintenance free.
 - b. A coated ceramic collar or hardened steel shall be bonded onto the stub shaft to provide increased protection against wear.
 - c. The lower sprockets shall operate in a recess of the frame and not be directly exposed to the incoming flow.
 - 4. The screen manufacturer shall coordinate the sprocket diameter, pitch, tooth width, and hub diameter to meet the performance requirements.
- I. Discharge Chute
 - 1. Each discharge chute shall form a leak-free three (3)-sided chute and shall be constructed of three sixteenth (3/16)-inch minimum 304 SS sheet bolted to the frame.
 - 2. Each chute shall be oriented to deposit screenings directly into a 3 CY dumpster.
- J. Discharge System
 - 1. Screenings transported to the top of the screen shall be discharged positively by means of a scraper to the discharge chute.
 - 2. The scraper shall be designed to pivot to allow cleaning of each rake on each cleaning cycle and cushioned during travel to the rest position. The wiper arms shall be designed to return the wiper quietly and without shock.
 - 3. The primary removal device shall be the rake wiper, of minimum 5/32-inch thick stainless steel, shall be furnished with replaceable 3/8-inch thick polyethylene wiper blade and wear strips bolted to two (2) structural pivot arms.
 - a. The arms shall be mounted on a minimum 1-inch diameter pivot shaft and supported by self-aligning ball bearings or sleeve bearings.
 - 4. The entire wiper mechanism shall be located within the head section.
- K. Drive Unit
 - 1. The drive unit shall be of the motorized type mounted on an adjustable drive chain take-up based on the screen head section. The drive unit speed reducer

shall be of the helical gear type, fully housed, running in oil, with anti-friction bearing throughout and close coupled to the motor.

- a. The gear reducer shall be Bauer, SEW-Eurodrive USA or approved equal.
2. Each motor shall be sized based on the requirements of the driven loads with consideration given to all drive train components. Electrical service for each shall comply with Section 11000 – Electric Motors, Schedule 11217 – 1, and the requirements specified below:
 - a. The motor shall be capable of starting under full operational loading conditions
 - b. The motor shall be suitable for duty in a corrosive atmosphere and high shock loads complying the applicable provisions of the standards of NEMA and IEEE.
3. The drive unit shall be assembled by the Manufacturer and shipped as a completed assembly to ensure proper assembly of all components.
4. The gear box and motor shall be provided with lifting eye for ease of maintenance.
5. The drive mechanism for the rakes shall incorporate a solid shaft constructed of stainless steel. The drive unit, including the reduction gearbox, shall be directly shaft-mounted and shall be positioned to facilitate maintenance work.
6. Gear box and the motor mating faces shall configuration readily available in the USA. Procuring European dimensioned equipment for the motor and gear box is not acceptable.

L. Screen Covers

1. Front face of the screen shall have removable stainless steel cover. The covers shall be provided with turn locks and handles.
 - a. Where shown on the Contract Drawings, screen cover shall be one sixteenth (1/16)-inch Type 304 with appropriate stiffeners.
2. Covers will be hinged or clamp-down designed to be readily removable to provide for easy maintenance and adequate to protect operating personnel standing nearby.
3. Any removable cover piece shall not weigh more than forty (40) pounds. Each removal cover shall have lifting handles designed for convenient removal.
4. The contractor and the Manufacturer shall coordinate the cover locations with the walkway platform for screen access shown on the Contract Drawing.
 - a. The coordination shall be provided so that any cover provide shall not interfere with the walkway support members. If required, segment(s) of cover may be eliminated along the walkway horizontal support frame.
5. The cover system shall be structurally capable of withstanding the full impact and wedging action of large debris that may be carried up the screen face and clogging that may occur in the drive sprocket return area without damage.

6. Anchor Bolts:
 - a. Equipment anchoring system shall be sized and designed by the Contractor. Manufacturer shall provide on its General Arrangement Drawings the locations, minimum diameter and loads at each Anchor Point for the design and supply of Anchor Bolts by the Contractor.
 - b. Anchoring system shall be installed in accordance with the equipment manufacturer's instructions.
 - d. Adhesive anchors meeting the requirements of Section 05051 – Anchor Systems will be used for all anchoring to existing concrete. Anchoring must avoid existing reinforcing steel in accordance with Section 03200 – Concrete Reinforcing.

M. Controls and Control Strategy

1. Control Panel:
 - a. Bar Screen Main Control Panel shall be furnished, completely pre-wired and tested, requiring only mounting and connection to external wiring in the field. The Control Panel shall include all equipment required to control bar screen as specified herein. The panel shall be located in a non-classified area where no corrosive gases are present and shall be designed for outdoor installation. The panel will be installed as shown on the Contract Drawings.
 - b. Control Panel enclosure shall be sized as required to house equipment and shall be suitable for mounting to strut-type supports. Enclosure shall be rated NEMA 4X.
 - c. The control panel shall accept a 460-volt, 3-phase, 60 Hz power supply. Panel short circuit rating shall be 42,000 Amperes minimum. Include a front accessible and pad lockable main disconnect, transformer(s), and circuit breaker load center for all 120 volt panel power requirements.
 - d. Bar Screen motor shall be controlled by individual variable frequency drive (VFD), sized as required for bar screen motor horsepower and suitable for use with variable torque loads. VFD shall include discrete and analog input and outputs as required by control panel manufacturer. No bypass starters will be required.
 - e. The VFD shall be controlled by a PLC (Programmable Logic Controller). The PLC shall be used to control the VFD to operate the screen at two (2) speeds and through the automatic reversing/cleaning shuttle sequence. The PLC shall include discrete and analog inputs and outputs as required.
 - f. The screen shall be controlled in synchronization with ultrasonic level sensors. Upon reaching a predetermined differential set point the screen shall begin operation in low or normal speed and shall shut down after a predetermined time if the differential level is less than the predetermined set point. Upon reaching a second higher predetermined differential set point the screen shall operate in high speed.

- g. When an overcurrent is detected the screen shall automatically stop and run in reverse for a predetermined time. The screen shall then stop and return to forward. If the cause of the overload is cleared the screen shall automatically reset in normal operation. If an overload is again detected the reversing cycle is repeated up to four (4) times prior to initiating an alarm contact. The use of clutches, friction disks or similar devices for overload protection are not acceptable
- h. The Control Panel shall have an OIT (Operator Interface Terminal) to allow push button adjustment of counter values, timers and level set points without connecting to the PLC. The OIT shall be rated NEMA 4X and provide fault and troubleshooting information.
- i. Door mounted NEMA 4X indicating lights shall be provided to indicate running and alarm status of the bar screen. Legend plates and a door mounted Alarm Rest push button shall also be provided.
- j. A separate Local Operator Station rated NEMA 7 shall be provided. The local panel shall include Hand/Off/Automatic and Forward/Off/Reverse 3-position switches and an Emergency Stop mushroom pushbutton.

2. Sequence of Operation (2-Speed Operation):

Main Panel <i>On/Off</i>	Local Panel <i>Hand/Off/Auto & Fwd/Off/Rev</i>	Result	Action when Blockage occurs	Comments
<i>On</i>	<i>Auto & Any Position</i>	Screen starts in LSP when the rising water differential reaches set level (Level 1).	Screen performs cleaning shuttle up to 4 times. If no success, screen stops and initiates alarm contact.	LSP - Low Speed Mode. Approx. 10-second cleaning interval
<i>On</i>	<i>Auto & Any Position</i>	Screen starts in HSP when the rising water differential reaches set level (Level 2).	Screen performs cleaning shuttle up to 4 times. If no success, screen stops and initiates alarm contact.	HSP - High Speed Mode. Approx. 5-second cleaning interval.
<i>On</i>	<i>Auto & Any Position</i>	Exercise run	Screen performs cleaning shuttle up to 4 times. If no success, screen stops and initiates alarm signal.	X min in LSP, every Y min. (X & Y are Operator adjustable)
<i>On</i>	<i>Manual & Forward</i>	Screen operates forward in LSP.	Screen stops immediately. No cleaning shuttle.	

<i>On</i>	<i>Manual & Reverse</i>	Screen operates in reverse in LSP.	Screen stops immediately. No cleaning shuttle.	
<i>On</i>	<i>E-Stop Engaged</i>	Screen stops immediately.	N/A	
<i>On</i>	<i>Off & Any Position</i>	Screen will not operate.	N/A	
<i>On</i>	<i>Hand & Off</i>	Screen will not operate.	N/A	
<i>Off</i>	<i>Any Position & Any Position</i>	Screen will not operate.	N/A	

2.3 FABRICATION, ASSEMBLY, AND FINISHES

- A. Manufacturer shall confirm that welders and welding procedures are certified in accordance with AWS D1.6 – Structural Welding Code – Steel.
- B. All stainless steel assemblies and subassemblies shall be acid passivated after welding for corrosion resistance and to provide a superior surface finish in accordance with the requirements of ASTM A-380. Acid passivation accomplished by pickling paste is allowed.
- C. The screen frame shall be supplied in one piece. Where installation with height restrictions and/or shipping restrictions, the screen shall be supplied in flanged subassemblies such that the unit can be assembled and disassembled. The flanged subassemblies shall be bolted together onsite during installation.
- D. Side frames shall be designed to provide an unobstructed path for the rack cleaning mechanism.
- E. Bars shall be one continuous section and shall be designed to provide an unobstructed path for the rack cleaning mechanism.

2.4 SOURCE QUALITY CONTROL AND SHOP TESTS

- A. Certified Shop Tests:

1. Shop testing shall be performed at the manufacturer's testing facility prior to shipment. Shop tests shall demonstrate that the equipment tested conforms to the requirements stated in this Section.
2. Manufacturer's testing facility shall be in the USA. Contractor shall notify the Engineer 30 days in advance of scheduled shop testing should the shop testing be done outside of USA.
3. The contractor shall provide shop test procedures for approval of the Engineer.
 - a. Shop test procedures shall be submitted for Engineer's review at a minimum of 2 weeks before scheduled shop test.
 - b. Shop test procedures shall identify the tests to be performed. Manufacturer shall respond to any questions raised by the Engineer and resubmit to the Engineer.
 - c. No shop test shall be performed prior to approval of the shop test procedures.
4. The Manufacturer shall, through the contractor, provide shop test reports.
 - a. The manufacturer shall provide a letter report certifying that the unit has passed the specified test and inspection requirements.
 - b. Shop test report shall be submitted within 3 weeks of the shop test.
 - c. Shop test reports shall identify the tests performed and the results obtained with a descriptive narrative indicate whether the equipment passed or failed.
 - d. Failure to meet the requirements as specified in this Section shall be discussed along with steps to be taken by the Manufacturer that are necessary to correct any deficiencies. Manufacturer shall demonstrate corrective steps taken to the Engineer and shall receive Engineer's approval before scheduling a re-testing.
 - 1) Re-testing shall follow approved shop test procedures.
 - 2) Re-testing shall be conducted at no additional cost.

B. Screen Tests

1. Certified shop tests shall be performed as specified herein.
2. The following factory testing shall be provided for the screen and performed by the manufacturer at the manufacturers testing facility:
 - a. Each bar screen shall be factory assembled and tested complete including drive units and controls.
 - b. A visual inspection of the unit to confirm Project requirements.
 - c. A no-load test run to confirm that no oil leaks, excessive lubricant temperature, excessive noise and excessive vibration occur, and confirm the control operations.
 - d. Testing shall include a simulation of a fixed screen obstruction requiring the initiation of an auto-reverse sequence in accordance with the control strategy to clear the obstruction.
 - e. Run equipment and test for minimum of two (2) hours.
 - f. Measurement of the no load motor current shall be performed.
 - g. Measurement of the output speed to verify gear ratio shall be performed.

- h. Loading and Impact Tests:
 - 1) Sand bags weighing two-hundred (200) lbs shall be loaded on a stopped rake. The screen shall be started at low speed and the sand bags shall be transported from the lower portion (i.e. bottom sprocket elevation) of the screen to discharge elevation. This shall be completed for each screen three (3) times in succession without alarm.
 - 2) A fifty (50) lb rigid object (e.g. a log) shall be dropped onto the screen field from a three (3) ft height (with the screen in the horizontal position) and distortion of the screen field shall be measured. A successful test shall result in zero measurable distortion of the bars.

C. Inspection

- 1. The entire assembly shall be visually inspected for any deformation prior for shipment.

PART 3 – EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. In general, workmanship and finish of all metalwork shall be of the highest grade and equal to the best practice of modern shops. Exposed surfaces shall have smooth finish and sharp, well defined lines. Materials of construction where not specified herein shall be suitable for the service encountered, and as reviewed by the Engineer.
- B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the equipment is ready for continuous operation. The equipment shall be delivered onsite in two (2) or more components. Each component will be as fully assembled as transportation will allow. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- C. Finished iron or steel surfaces shall be painted per manufacturer's recommendation in a color chosen by Contractor. Each box or package shall be properly marked to show its net weight in addition to its contents. Care shall be taken to avoid supporting or lifting the screens in a manner that will place excessive stress on parts or shafts that are not designed to support the weight of the unit. The screens assembly shall be lifted by eyebolts provided in the frame. All appurtenances shall be handled and stored in accordance manufacturer's recommendations and as specified herein.

3.2 INSTALLATION

- A. Installation of equipment and materials provided under this Specification shall be in accordance with the manufacturer's recommendations, and the approved working drawings.
- B. Installation shall be carried out by mechanics skilled in Work of this kind, under the general supervision of a factory-trained representative of the manufacturer. The equipment shall be checked, aligned, tested, and placed in operation by a factory-trained manufacturer's representative.

3.3 FIELD TESTING AND QUALITY CONTROL

- A. After installation and prior to being placed in operation, the screen shall be inspected and checked by a qualified representative of the equipment manufacturer, as required. The following items will be verified:
 - 1. Verification that all external system protective functions are functional and have been tested.
 - 2. Verification that all internal protective functions are operational.
 - 3. Verification that connections between the screen discharge chute and discharge dumpster allow discharge without spilling material onto the operating floor.
 - 4. Review and verify that the specified control strategies, to ensure proper protection and operation of all components, systems, and interlocks.
 - 5. Manufacturer's recommendations for prestart preparation and preoperational checkout procedures.
- B. Make all adjustments to each unit as directed by the equipment manufacturer prior to placing the unit in operation. Each screen shall be checked by the manufacturer for lubrication, rotation, and the representative shall notify the Contractor and Engineer of anything in the installation which affects the manufacturer's guarantee. The manufacturer's representative shall provide certification that each screen is rotating in the right direction and is ready for testing.
- C. Functional test shall be coordinated with Owner. Provide certification of test results. Tests and certification shall be as specified in Section 01650 – Starting of Systems.
 - 1. A factory trained representative shall test the installed equipment at full load and full speed for a minimum of four (4) hours. The test runs shall be undertaken with water in the channels filled up to the peak water elevations shown on the Contract Drawings. The test runs shall determine acceptable running noise, speed, and rotational direction.
 - a. Contractor shall perform this test by isolating the screen and fill the channel with plant service water.
 - 2. Motor temperature shall be recorded at intervals of no greater than fifteen (15) minutes and shall not exceed the manufacturer's recommended maximum. Sound level shall be recorded and shall not exceed seventy-five (75) dBA at a distance of three (3) feet from the equipment.
 - 3. Provide a written certification from the equipment manufacturer that the equipment has been properly installed according to the plans, specifications and manufacturer's specifications, and that the equipment is operating normally.

- D. In the event of improper installation, correction of the Work and subsequent test runs will be provided until the defects are corrected at no additional cost to the Owner. Manufacturer will provide certification that the improper installation has been corrected.

3.4 MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the service of the manufacturer's representative to assist in the installation of equipment; check the installation before the equipment is placed into operation; assist in the start-up of the equipment; and train the plant operations and the maintenance staff in the care, operation, and maintenance of the equipment.
- B. At a minimum, the services of the manufacturer's representative shall be provided as indicated herein below. The number of visits and person-days per visit indicated below shall be understood as referring to the minimum required services for the lot of equipment provided under this Specification.

Occurrence	Duration
Installation inspection	One visit (1) of one (1) person-days per visit
Field Testing	One visit (1) of one (1) person-days per visit
Start-up / Training	One visit (1) of one (1) person-days per visit

+ + END OF SECTION + +

SCHEDULE 11217 – 1		
NUMBER OF UNITS		1
DESCRIPTION		MECHANICAL SCREEN
CONDITION	CHANNEL WIDTH, FT	3.0
	CHANNEL INVERT ELEVATION, FT	-11.0
	TOP OF CHANNEL ELEVATION, FT	8.0
	MINIMUM DISCHARGE HEIGHT ABOVE OPERATING FLOOR	5'0"
	MAXIMUM FLOW RATE THROUGH SCREEN	14 MGD
	AVERAGE FLOW RATE THROUGH SCREEN	4.2 MGD
	MINIMUM FLOW RATE THROUGH SCREEN	0.5 MGD
SCREEN	MAXIMUM WATER DIFFERENTIAL FOR STRUCTURAL DESIGN	6'-6"
	MINIMUM SCREEN BAR RACK HEIGHT, FT	6'-6"
	MINIMUM SCREEN FIELD WIDTH, FT	2'-0"
	BAR SPACING	1"
	MAXIMUM ALLOWABLE HEADLOSS, CLEAN SCREEN	0'-3"
	MAXIMUM ALLOWABLE HEADLOSS, 30% BLIND	0'-7"
	DOWNSTREAM WATER DEPTH AT PEAK FLOW	3'-4"
	SCREEN INCLINE FROM VERTICAL	10 DEGREE
	MINIMUM SCREENINGS REMOVAL CAPACITY, CF/HR	53
	CLEANING INTERVAL	10 SEC (NORMAL OPERATION) 5 SEC (HIGH SPEED)
MOTOR	MOTOR HORSEPOWER (MAXIMUM)	2
	ENCLOSURE TYPE	as required for classification of the screen area
	RPM	1800
	VOLTAGE	460
	PHASE	3

SECTION 11220

OPEN CHANNEL GRINDERS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: The CONTRACTOR shall furnish all labor, tools, materials, equipment and incidentals required to provide three channel type grinders and three channel support frames, complete and operational with control equipment and accessories, for mounting in a concrete channel as shown on the drawings and specified herein. Anchor bolts, expansion anchors and inserts are included in this Section. Grinder Control Panels shall be located as shown on the drawings.
- B. Responsibility: The grinder manufacturer shall furnish all components specified herein and shall be vested with unit responsibility for the proper function of the complete grinder systems including the grinder explosion proof motor, grinder control panel, channel support frame, and all appurtenances.
- C. Related Sections:
 - 1. Section 03600, Grouting
 - 2. Section 05051, Anchor Systems.
 - 3. Section 09900, Painting.
 - 4. Section 13430, Process Control System Panels and Enclosures
 - 5. Section 13491, Process Control Descriptions

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of 10 years of experience of producing substantially similar equipment and shall be able to show evidence of at least 5 installations in satisfactory operation for at least 5 years in the continental United States. Include reference lists, which are inclusive of contact names, phone numbers, application and length of service.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section from a single grinder equipment manufacturer.
 - 2. Grinder equipment manufacturer shall review and approve or shall prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically designed for grinding service and shall be integrated into the overall equipment design by the grinder equipment manufacturer.
- C. Source Quality Control:
1. Shop Test: Grinder and motor controller shall be factory tested to ensure satisfactory operation.
 2. Visual Inspection: Verify that equipment complies with Specifications and approved Shop Drawings.
 3. Packing:
 - a. Inspect prior to packing to assure that assemblies and components are complete and undamaged.
 - b. Protect machined surfaces and mating connections.
 - c. Protect bearings and gearing with a shop applied corrosion prevention coating.
 - d. Cover all openings into gear boxes with vapor inhibiting and water repellent material.
 - e. Adequately crate to prevent damage during shipment, delivery and storage.
 - f. Identify crate contents on packing slip fastened to outside of crate.
- D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. Standards of the Hydraulic Institute.
 2. American Gear Manufacturers Association.
 3. Anti-Friction Bearing Manufacturers Association.
 4. National Electrical Code (NEC).
 5. Underwriter Laboratory (UL and cUL).
 6. Standards of National Electrical Manufacturers (NEMA) Association.
 7. American National Standards Institute (ANSI).
 8. Standards of American Society for Testing and Materials.
 9. American Iron and Steel Institute.
 10. ASTM A536-77: Standard Specification for Ductile Iron Casting; AISI 303 Stainless Steel, AISI 204 Stainless Steel, AISI 4140 Heat Treated Hexagon Steel; AISI 4130 Heat Treated Alloy Steel; 45-50 Rockwell AC \pm .

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Product Data:
 - a. Manufacturer's literature, data sheets, fabrication, assembly and mounting drawings of the following components showing materials and significant dimensions in sufficient detail to demonstrate compliance with specified requirements.
 1. Housing:
 - a) Materials of construction.

2. Shafts and Cutting Elements:
 - a) Diameter.
 - b) Materials of construction.
 - c) Seals.
 3. Gear Reducers:
 - a) Materials of construction.
 - b) Bearing ratings.
 - c) Bearing life under maximum loading conditions.
 4. Motors:
 - a) Horsepower.
 - b) Rpm.
 - c) Insulation and enclosure details.
 - d) Efficiency at full, 3/4 and 1/2 load.
 5. Electrical Information:
 - a) Wiring diagrams showing all electrical connections to the motor and controls.
 - b) Drawings of control panels furnished in accordance with Section 13430 Process Control System Panels and Enclosures.
 6. Weight of the complete assembly.
- B. Informational Submittals: Submit the following:
1. Source Quality Control Submittals:
 - a. Submit results of Hydrostatic test.
 - b. Submit results of required control panel shop tests.
 2. Site Quality Control Submittals:
 - a. Submit a written report giving the results of the required field tests.
 - b. Submit written report of the results of each visit by a manufacturer's serviceman, including purpose and time of visit, tasks performed and results obtained.
 3. Support Design Information:
 - a. Weight of the complete assembly.
- C. Closeout Submittals:
1. Operation and Maintenance Manuals:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operations and Maintenance Data.
- D. Maintenance Material Submittals: Furnish the following:
1. Spare Parts:
 - a. Furnish all required spare parts as specified in Part 2 of this specification.

2. Tools:
 - a. Furnish all required special tools as specified in Part 2 of this specification.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The grinders shall be electrically-driven and shall reduce solids to a size that will pass through the slot size specified.
- B. The grinders shall be flow-through type, installed in the influent channels to the wet well. The grinders shall be readily removable by removal of fastening devices only, without requiring demolition and repair of the concrete.
- C. The grinders shall operate automatically and continuously and shall be capable of operating satisfactorily at low or zero flows for extended periods.
- D. Service Conditions: The grinders shall conform to the following design criteria:
 1. Number Required: 3 (2 duty, 1 standby)
 2. Minimum Flow (gpm): 350
 3. Maximum Flow (gpm): 5,900
 4. Channel Width (in): 48
 5. Channel Height (in): 60

- | | | |
|----|--|-----------|
| 6. | Max Water Depth
upstream of Grinder (in): | 48 |
| 7. | Max Grinder headloss
at peak flow (in): | 30 |
| 8. | Minimum Downstream
Water Surface Elevation: | -10.00 EL |

2.2 DETAILS OF CONSTRUCTION

A. General:

1. The grinders shall be of two-shaft design and be capable of continuous operation, processing wet or dry. Bar screens or single shaft devices utilizing a single rotating cutter bar with stationary cutters will not be acceptable. Individual cutters and spacers must be surface ground to the inside hexagon to a tolerance of 0.015 inch.
2. Two-shaft design consists of two parallel shafts alternately stacked with intermeshing cutters and spacers positioned on the shaft to form a helical pattern. The two shafts shall counter-rotate with the driven shaft operating at approximately two-thirds (2/3) the speed of the drive shaft.
3. Grinders shall include end housings, covers, shafts, side rails, reducer, torque motor, cutters, spacers, bearings and seals, and an optional perforated screen drum.
4. Optional: Rotating perforated screen drums shall consist of cylindrical perforated sheet, support rings, and stub shafts. The rotating drums shall direct all solids towards and into the counter-rotating dual-shaft grinder. The drums shall be driven by the grinder drive mechanism.

B. Components:

1. Grinder:
 - a. Grinder end housings shall be cast of ASTM A536-84 ductile iron or ASTM A48 cast iron. with a flow deflector, designed to guide the particles directly into the cutting chamber.
 - b. Top covers shall be ASTM A536-84 ductile iron or Cast ASTM A48 Class 40 gray iron and bottom covers shall be ASTM A36 hot rolled plates.
 - c. Grinder drive and driven shafts shall be made of AISI 4140 Heat Treated Steel with a tensile-strength rating of not less than 149,000 psi. Each shaft diameter shall be a minimum of 2-inches.
2. Cutters and Spacers
 - a. Cutters shall be Alloy Steel and hardened to a minimum 45-50 Rockwell C.
 - b. Cutters shall be nitrated for high corrosion resistance.
 - c. Cutters shall have a minimum of 7 cam shaped teeth.
 - d. Spacers shall be alloy steel and hardened to a minimum 34 Rockwell C.

3. Bearings and Seals:
 - a. The radial and axial loads of the cutter shafts and coil drum stub shafts shall be borne by sealed, oversized, deep-groove ball bearings at each end.
 - b. The bearings shall be protected by a combination of a replaceable and independent tortuous path device and mechanical seals.
 - c. Face materials shall be of tungsten carbide to tungsten carbide.
 - d. O-rings shall be made of Buna-N elastomers or viton (fluorocarbon).
 - e. Products requiring continuous or occasional lubrication or flushing shall not be accepted.
 - f. The mechanical seal shall be rated at minimum 90 psi continuous duty by the seal supplier.
 - g. The bearings shall be housed in a replaceable cartridge that supports and aligns the bearings and seals, as well as protects the shafts and end housings. The seal elements shall be independent of the stack height; therefore cutter stack tightness shall not affect seal performance. The seal elements shall maintain their factory set preload independent of the cutter stack tightness.
 - h. Seals shall meet required pressure rating regardless of cutter stack fit. The seal cartridge shall provide seal protection against axial loading on shafts and bearings during shaft deflection.
 - i. Each seal element shall be positively locked to its corresponding rotating or static cartridge element. This positive lock on the seal elements is critical to long seal life in applications where grit or other abrasive materials are present.
4. Reducer:
 - a. The gear speed reducer shall be a grease-filled planetary type of reducer with "Heavy Shock" (500%) load classification. The reduction ratio shall be 29:1.
 - b. The input shaft of the reducer shall be directly coupled to the motor using a three-piece coupling, and the output shaft of the reducer shall be directly coupled with the grinder using a two-piece coupling.
5. Motor:
 - a. The motors shall be rated for a Class 1, Division 1, explosion-proof, 460 volt, 60 Hz, 3-phase.
 - b. Motor shall be submersible or immersible, capable of operating without issues while submerged for 72 hours at a depth up to 30 feet.
 - c. Motor service factor shall be 1.15, the efficiency factor not less than 85% at full load and the power factor not less than 80% at full load.
 - d. Motor shall be furnished with sufficient length of conductor submersible cable for connection to an external junction box. Contractor to confirm length in the field.
 - e. Required Running Torque per Horsepower (kW):
 - 1) At momentary load peaks: 4,756 in-lbs

6. Channel Support Frame and Rail System:
 - a. Provide channel frame system to support the grinder in place in the channel. Channel frame system shall allow for easy removal of the grinder without the removal of the support frame attached to the concrete channel. Provide all required support angles and all anchorage devices. System shall be standard unit designed and fabricated by the grinder manufacturer for the proposed application.
 - b. Entire assembly, including anchors, shall be fabricated of type 304 stainless steel.
 - c. Side Rail system and required hardware shall be 304 stainless steel.

2.3 CONTROL PANEL

A. General:

1. Each channel grinder shall be provided with a dedicated Control Panel conforming to the specification section 13430 Process Control System Panels and Enclosures.
2. Factory test control panel prior to shipment and conforming to specification section 13402 Process Control System Factory Testing.
3. The control panel shall accept a 460-volt, 3-phase, 60 Hz power supply. Panel short circuit rating shall be 42,000 Amperes minimum. Include a front accessible and pad lockable main disconnect, transformer(s), and circuit breaker load center for all 120 volt panel power requirements.
4. Panel shall contain the following:
 - a. Full voltage reversing motor starter with 120-volt control power transformer sized for all 120-volt requirements. Solid-state control logic shall be provided with fuse protection and shall shut down the motor and provide an alarm on motor overload (as specified below).
 - b. Provide Programmable Logic Controllers (PLC) that are used to perform the specified functions for each grinder. Provide one laptop and a copy of the program, which will be turned over to the OWNER. PLC shall be of the same manufacturer as the one specified under specification section 13451, Programmable Logic Controllers Hardware and Software.
 - c. Equip panel with a load sensing control, which shall sense high torque caused by grinder jam or overload. When this occurs, the grinder shall stop instantly, reverse its rotation to clear the obstruction, stop once again, and commence the forward or normal action. If the jam is cleared, the counting circuit shall reset after approximately 30 seconds. If the jam remains, the above procedure shall be repeated up to three times. After three cycles have occurred, the grinder shall shut down automatically and energize a fail alarm.
 - d. Provide panel with Hand/Off/Auto switch, Hand/Off/Remote switch indicating lights for Grinder Running, Grinder stop, and Grinder Malfunction and Power on, for each grinder. All panel mounted devices shall conform with Section 13430 Process Control System Panels and Enclosures. Run

lights are to be red, stopped to be green, fault to be amber, power on light to be white. All lights shall be push-to-test transformer type.

- e. Provide SPDT contacts rated at 5A, 120 VAC for remote indication of Grinder Running, Malfunction, E-Stop and Not in Remote position at Hand/Off/Remote switch. Each signal shall be individual per grinder supplied.
- f. Panel shall accept a maintained type Emergency Stop and momentary type Start push button from a Local Control Station (LCS) for each channel grinder provided. Emergency Push buttons and momentary type Start push button supplied by others. When the emergency stop is activated, the grinder shall de-energize and shutdown.
- g. When the Hand/Off/Remote switch is in the Hand position and the start pushbutton is activated from the LCS, the grinder shall run and the control shall seal-in to maintain the grinder run operation.
- h. When the Hand/Off/Remote switch is in the Remote position, the grinder shall start and stop as commanded by the LBP_MCP's PLC.
- i. The Hand/Off/Auto selector switch controls operation of the grinder's Screen Motor. In the Hand position, the screen motor runs continuously. Whenever the selector switch is in the Auto position, the screen motor operation is controlled by the CGUCP internal Controller (PLC).
- j. Panel shall have two 1-inch hubs at the top and two 1-inch hub at the bottom for conduit installation.

B. Components:

- 1. Control panel enclosure shall house the control devices, relays, terminal blocks, and reversing motor starter.
- 2. Control Devices
 - a. Control devices that are mounted in the front panel of the enclosure shall be labeled with matte finished modified acrylic laminate labels.
 - b. Indicating lights shall be integral push-to-test transformer type with low voltage life 6 volts lamps.
 - c. Lamps and pushbuttons shall be heavy duty type. Pushbutton and selector switch contacts shall be rated NEMA A600.
- 3. Relays:
 - a. Control relays shall be equipped with a 120-volt operating coil and 10 amp 240 VAC (resistive load) from "C" dry contacts. Contacts shall be wired to the terminal strip for easy field wiring.
 - b. Thermal overload relays shall have one (1) normally closed contact and one (1) normally open contact to signal a failure. The overload relay shall detect single phase and phase unbalance with the motor full load amps (FLA) adjustable so that the range selected includes the FLA rating and service factor.
- 4. Terminal Blocks:
 - a. Terminals for control and power wiring shall be provided for all field

connections. A compression clamp of hardened steel shall grip the conductor on the connector bar captive and hardened steel screws shall tighten the compression clamp without touching the wire conductor. Terminals shall be vibration proof and fully shielded. Terminal blocks shall be suitable for wire sizes from 22 to 10 AWG. Terminal block bodies shall be molded of flea retardant polyamide type 6/6 nylon. Each terminal shall be individually labeled.

b. Power terminal blocks shall be strap screw type suitable for wire sizes from 22 to 8 AWG. Each terminal shall be individually labeled.

5. Wiring:

The AC power wiring shall be minimum No. 12 AWG gauge black; control wiring shall be No. 14 gauge red; neutral wiring shall be No. 16 gauge white. All wires shall be XHHW with 600 volt 90 degree C rating and have machine printed self-laminating labels.

6. Reversing Motor Starter:

Controller shall be equipped with NEMA Size 1 full voltage motor reversing starter with a 120 volt operating coil and captive terminal screws. The adjustable self-contained heater with thermal OL relay shall be class 10 and mounted directly to the contactor. OL relay shall be sized to the motor full load amperage. Forward and reverse contactors on the starter shall have both mechanical and electrical interlocks.

2.4 PRODUCT AND MANUFACTURER

A. The Channel Grinders and appurtenances shall be manufactured by:

1. Franklin Miller,
2. JWC,
3. Or Equal.

2.5 SHOP PAINTING

A. Clean and prime ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900.

2.6 ANCHOR BOLTS

A. Furnish anchor bolts and nuts of ample size and strength for the purpose intended, sized by the equipment manufacturer. Provide hooked anchor bolts for direct embedment during placement of concrete. Anchor bolt material shall be 304 stainless steel conforming to requirements of Section 05051.

2.7 SPARE PARTS

A. Furnish and deliver the following boxed and labeled:

1. 100 percent replacement seals for (1) machine.
 2. 100 percent replacement cutter cartridges for (1) machine.
- B. Manufacturer shall furnish a list of additional recommended spare parts for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.
- C. One shelf spare grinder shall be provided. CONTRACTOR shall coordinate location to store shelf spare with OWNER.

2.8 LUBRICANTS

- A. Furnish lubricants, oil and grease as required for initial operation. Products shall be as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with approved Shop Drawings, manufacturer's recommendations, and as shown and specified.
- B. Lubricate equipment as recommended by the manufacturer.
- C. Check, align and adjust all equipment.

3.2 FIELD PAINTING

- A. Field painting shall conform to the requirements of Section 09900.

3.3 START-UP AND FIELD TEST

- A. CONTRACTOR shall verify that all components of the grinder equipment and appurtenances, including controls, are compatible.
- B. CONTRACTOR shall conduct a functional field test of grinder and appurtenant equipment to demonstrate that each part and all components together function correctly. CONTRACTOR shall provide all testing equipment required.
- C. CONTRACTOR shall make adjustments required to place the system in proper operating condition.
- D. CONTRACTOR shall test and operate the system and verify that the grinder and

appurtenant equipment will operate continuously without vibrating, jamming or overheating and perform its specified function satisfactorily.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Furnish the services of a qualified factory-trained service representative from the manufacturer to assist in the installation of the equipment, check the installation before it is placed into operation, assist in the performance of field tests, supervise initial operations, and instruct plant operators in the care, operation, and maintenance of the equipment. A certificate from the manufacturer relative to these services is required under Section 01650. The representative shall revisit the job site as often as necessary to place the equipment in proper working order, supervise testing and initial operations.
- B. Field Reports: Submit a report by manufacturer of each visit to the site. Reports shall provide complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information and facts.

3.5 TRAINING

- A. In addition to above requirements, furnish services of a qualified factory trained operations and maintenance service representative to instruct and train plant operators in the proper care, operation and maintenance of equipment in accordance with the requirements of Section 01730.

++ END OF SECTION ++

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SECTION 11287

STAINLESS STEEL SLIDE GATES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install stainless steel slide gates and appurtenances complete and operational.
 - 2. Included are stainless steel slide gates, anchorage systems and all appurtenances.
 - 3. Extent of the equipment is shown on the Stainless Steel Slide Gate Schedule located at the end of this Section.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the stainless steel slide gates Work.
- C. Related Sections:
 - 1. Section 03300, Cast-In-Place Concrete.
 - 2. Section 03600, Grouting.
 - 3. Section 05051, Anchor Systems.
 - 4. Section 09900 Painting. (Specifications for Surface Preparation and Shop Painting required under Section 11287, Stainless Steel Slide Gates, are under Section 09900, Painting.)

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 276, Specification for Stainless Steel Bars and Shapes.
 - b. ASTM B 584, Specification for Copper Alloy Sand Castings for General Applications
 - 2. National Electrical Code, (NEC).
 - 3. National Electrical Manufacturers' Association, (NEMA).

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
 2. Stainless steel slide gates shall be the product of one manufacturer.
- B. Component Supply and Compatibility:
1. Obtain all equipment included in this Section regardless of the component manufacturer from a single stainless steel slide gate manufacturer.
 2. The stainless steel slide gate equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically designed for the specified service and shall be integrated into the overall assembly by the stainless steel slide gate equipment manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Fabrication, assembly and installation diagrams.
 - b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 - c. Wiring diagrams for electric motor operators.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications and engineering data.
 - b. Deviations from the Contract Documents.
 - c. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment.
- B. Informational Submittals: Submit the following:
1. Support Design Information:
 - a. Submit for record purposes only the weight of each slide gate and expected opening and closing thrust loads on the supporting structure.
 2. Shop Test Results:
 - a. Submit results of required shop tests.
 3. Field Test Results:
 - a. Submit a written report giving the results of the field tests required.
- C. Closeout Submittals:
1. Operation and Maintenance Manuals:
 - a. Submit complete Installation, Operation and Maintenance Manuals including, test reports, maintenance data and schedules, description of operation and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:

1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
2. Handle all stainless steel slide gates and appurtenances properly, in accordance with manufacturer's recommendations. Stainless steel slide gates, which are distorted or otherwise damaged, will not be acceptable. Protect all bolt threads and ends from damage.

B. Storage and Protection:

1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
2. Store all mechanical equipment in covered storage off the ground and prevent condensation.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. General:

1. Design stainless steel slide gates to safely withstand conditions listed in Stainless Steel Slide Gate Schedule, located at the end of the Section.
2. Stainless steel slide gates shall be substantially watertight with leakage less than 0.5 gpm per foot of seating perimeter at design head.
3. Manual operators shall turn right to close, unless otherwise specified. Operators shall indicate the direction of operation.
4. Bolts, studs, cap screws, and adjusting screws shall be of ample section to withstand the force created by operation of the gate under a full head of water.

2.2 MANUFACTURERS

A.Manufacturers: Provide equipment of one of the following:

1. Rodney Hunt Company.
2. Waterman Industries.
3. H. Fontaine Ltd.
4. Or equal.

2.3 FABRICATION

A. Materials of Construction:

1. Stainless Steel: For frame, slide, rail and yoke, ASTM A 276, Type 316 stainless steel. All metal for stainless steel slide gate parts shall have a minimum thickness of 1/4-inch.
2. Bronze Casting: For operating nut, thrust nut and lift nut, ASTM B 584 Alloy 865.
3. All bolts, studs, cap screws and adjusting screws shall be of Type 316 stainless steel.
4. Bolts and nuts shall have hexagon heads.
5. Gasket material and installation shall conform to manufacturer's recommendations.

B. Disc:

1. Fabricate the slide or disc of ASTM A 276, Type 316 stainless steel plate reinforced with structural shapes attached by welding.
2. Provide reinforcing to limit deflection under full head to not more than 1/360 of the span.
3. Extend reinforcing ribs into the guides overlapping the seating surface of the guide.
4. Weld stem mounting guides to the disc.

C. Disc Guides:

1. Guides shall be of Type 316 stainless steel incorporating a sandwich type construction using plates and structural angles.
2. Guides shall be designed for maximum rigidity as columns to take the thrust developed during the stainless steel slide gate operation under maximum head.
3. Guides shall extend beneath the opening a sufficient amount to support the disc in the fully open or closed position.

D. Stem:

1. Operating stems shall be of Type 316 stainless steel and designed as specified below.
2. Design stem to transmit in compression at least 2-1/2 times the rated output of the operating mechanism with an 80-pound effort on the crank or handwheel. Determine the critical buckling load using the Euler column formula, using $C = 2$. Where electric motor driven lifts are used, the stem design force shall not be less than 1.25 times the output thrust of the unit in the stalled motor condition.
3. Stems shall have a slenderness ratio (L/R) less than 200.
4. Threaded portion of the stem shall have machined cut threads of the Acme type. Join stems of more than one section by stainless steel couplings threaded and keyed, or bored and pinned to the stems. All threaded and keyed couplings of the same size shall be interchangeable. Couplings shall be designed to be of greater strength than the stems.
5. Connect the stem to the disc by means of a bolted connection.

6. Provide rising stems (where indicated on the schedule) with an adjustable stop collar on the stem above the floorstand lift nut.
- E. Yoke (For Self Contained Type Gates): (NOT USED)
- F. Lower Seals:
1. Mount a specially shaped resilient neoprene seal on the bottom of the disc to provide flush-bottom closure for stainless steel slide gates. As an alternate, a poured urethane seal shall be mounted in the invert of the frame to form a flush bottom seal.
 2. Shape of the seal shall produce a seating surface having a minimum width of 3/4-inch, and the seal will extend beyond the seating surface of the frame.
 3. Vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners.
- G. Side and Upper Seals:
1. Side and upper seals shall be fabricated from ultra high molecular weight (UHMW) polyethylene or UHMW polymer. UHMW bearing strips shall be mechanically retained to lock seat in place.

2.4 APPURTENANCES

- A. Stem Guides:
1. Stem guides shall be fabricated from Type 316 stainless steel and shall be equipped with UHMW polyethylene or UHMW polymer.
 2. Guides shall be adjustable in two directions and shall be spaced so that stems have a maximum unsupported length of 84-inches.
 3. Anchor bolts for stem guides shall be Type 316 stainless steel.
- B. Anchor Bolts:
1. Provide Type 316 stainless steel anchor bolts as required for stem guides, floorstands, and all equipment or appurtenances, which must be secured to concrete walls or floors. Anchor bolts shall be of ample size and strength for the purpose intended, and shall be furnished by the manufacturer. Anchor bolts shall be hooked, and provided for direct embedment during placement of concrete.
- C. Stem Cover:
1. Furnish all stems with a clear polycarbonate or butyrate plastic pipe stem cover. Covers shall be furnished with a cast aluminum adaptor for mounting covers to floor stands. Stem covers shall be designed and furnished with gasketing and breathers to eliminate water intrusion into operators and condensation within the covers.
 2. Engrave the covers with legible markings showing as a minimum the gate position at 1/4 open, 1/2 open, 3/4 open and full open.
- D. Manual Operators:

1. Manual operation shall be by handwheel as shown and specified.
2. Handwheel-operated type shall be without gear reduction Each type shall be provided with a threaded cast manganese bronze lift nut to engage the operating stem.
3. Provide anti-friction bearings to properly support both opening and closing thrusts.
4. Stands shall operate the gates under the specified operating head with not greater than a 40-pound pull on the handwheel.
5. All components shall be totally enclosed in a cast-iron weather-proof housing. Provide positive mechanical seals to exclude moisture and dirt and prevent leakage of lubricant out of the unit.
6. Provide lubricating fittings for all gears and bearings.
7. Stands shall include a cast-iron pedestal designed to position the input shaft approximately 36-inches above the operating floor. An arrow with the word "OPEN" shall be permanently attached or cast on the floorstand indicating the direction of rotation to open the stainless steel slide gate.
8. Operators shall be furnished with a limit switch to indicate fully closed position, where shown.
9. Provide mechanical stops adjustable \pm five degrees at each end of travel.

E. Electric Operators:

1. Electric motor operators shall be furnished for continuous duty, open-close operation.
2. Electric motor operator shall be capable of providing not less than 1-1/2 times the required operator torque for opening and closing of the stainless steel slide gate.
3. Operator shall be of NEMA 4X construction and furnished with a handwheel for manual operation.
4. Operator gear reducer shall be provided with a pair of limit switches and torque switches and a reversing contactor. The torque switches shall be adjustable.
5. Limit switches furnished for all stainless steel slide gates shall be equipped with 16 contacts (four rotors with four contacts each). Contacts shall open and close as shown.
6. Reversing starter, limit switches, and torque switches shall be supplied in NEMA 4X enclosures, furnished and mounted on the operators.
7. Where shown, furnish a resistance-to-current converter for remote position indication.
8. Electric motor shall be totally enclosed, sized to open or close the stainless steel slide gate full cycle in approximately 240 seconds, and suitable for operation on 480 volt, 3 phase, 60 Hz power. All electrical equipment, which is mounted on the operator, shall be housed in NEMA 4X enclosures.
9. Starter shall include an adequately sized, fused, control power transformer, 480 volt primary and 120 volt secondary.
10. Manufacturer shall comply with all requirements of the electrical control schematic diagrams as shown.
11. The stainless steel slide gates shall be controlled as shown.

12. Where shown or specified, provide electric operator for modulating continuous duty service.
 13. Provide mechanical stops adjustable \pm five degrees at each end of travel.
 14. Electric motor operator shall include a thermostatically controlled space heater.
 15. A handwheel shall be provided for manual operation. It shall not rotate during motor operation. The change from motor operation to handwheel operation shall be accomplished by a positive declutching device, which shall disengage the motor and motor gearing mechanically, but not electrically. Hand operation shall not require more than 80 pounds of rim effort at maximum required torque.
 16. Each stainless steel slide gate actuator shall be provided with an integral dial-type disc position indicator.
 17. Manufacturers: Provide equipment of one of the following:
 - a. Rotork
 - b. EIM.
 - c. Or equal.
- F. Identification: Identify each stainless steel slide gate with a stainless steel nameplate stamped with the approved designation as shown in the Stainless Steel Slide Gate Schedule, located at the end of this Section. Nameplate shall be permanently fastened to the gate at the factory.

2.5 SURFACE PREPARATION AND PAINTING

- A. Clean, prime coat, and finish coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900, Painting.
- B. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound, which shall be maintained during storage, and until equipment begins operation.
- C. CONTRACTOR shall certify, in writing, that the shop primer and coating system conforms to the requirements of Section 09900, Painting.

2.6 SOURCE QUALITY CONTROL

- A. Shop Tests:
 1. Test each stainless steel slide gate fully assembled in the vertical position for proper seating.
 2. Fully open and close gate disc in its guide system to ensure that it operates freely.
 3. Operate and test floor stands, bench stands and motor operators to ensure proper assembly and operation.

2.7 SLIDE GATE SCHEDULE

- A. The Stainless Steel Slide Gate Schedule is located at the end of this Section. Conform to type, size, operation and other data specified, unless otherwise approved by ENGINEER.
- B. Provide all stainless steel slide gates as shown and listed in the schedule.
- C. Schedule Abbreviation:
 - 1. Type:
 - a. EF - Embedded Frame.
 - b. SM - Surface Mounted Frame.
 - c. WG - Downward Opening Weir Gate.
 - 2. Operator Type:
 - a. CO - Crank Operated.
 - b. HW - Handwheel.
 - c. MO - Motor Operated.
- D. The seating and unseating design head as stated in the Stainless Steel Slide Gate Schedule is based on the head measured to the centerline of the gate in its closed position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install stainless steel slide gate equipment in accordance with manufacturer's instructions and recommendations.
- B. Brace guides and frames during placement of concrete.
- C. Set anchor bolts in accordance with approved Shop Drawings and manufacturer's recommendations.
- D. Provide minimum of 1-inch of non-shrink grout below all floorstands.
- E. Adjust all parts and components as required to provide correct operation.

3.2 START-UP AND FIELD TESTS

- A. After CONTRACTOR and ENGINEER have mutually agreed that the equipment installation is complete and ready for continuous operation, CONTRACTOR and a qualified field service representative of the manufacturer shall conduct a functional field test and a leakage test of each stainless steel slide gate in the presence of ENGINEER to demonstrate that each stainless steel slide gate furnished will function correctly and that maximum permissible leakage is not exceeded.
 - 1. Functional Tests:

- a. Each stainless steel slide gate with appurtenances shall be field-tested. Tests shall demonstrate to ENGINEER that each part and all parts together function in the manner intended. All necessary testing equipment and manpower shall be provided by CONTRACTOR at their expense. OWNER will furnish all power, and incidental material and labor required for the tests.
2. Leakage Tests:
 - a. Maximum permissible leakage shall be in accordance with the requirements of Paragraph 2.1, above. Excess leakage shall be reduced to meet specified requirements by adjusting the gate, or replacement will be required.
3. In the event that the manufacturer is unable to demonstrate to ENGINEER that their equipment meets the requirements of the tests, the deficient equipment will be rejected and CONTRACTOR shall adjust and/or modify and retest the equipment as often as necessary to meet the specified requirements. No separate payments shall be made for adjustments and/or modifications.

3.3 MANUFACTURER'S SERVICES

- A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 2 visits, minimum 4 hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up and training of the system. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
- B. All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

Gate ID	Location	Type	Opening Size (W x H)	Frame	Gate Invert Elevation	Floor Mounting Elevation	Design Head (Seating/ Unseating)¹	Stem (Rising/ Non- rising)	Operator
SG-9509-01	Grinder Forebay	EM	54inx54in	316 SS	-10.80 EL	9.89 EL	4.00 ft / 4.00 ft	Rising	MO
SG-9509-02	Grinder Forebay	EM	54inx54in	316 SS	-10.80 EL	9.89 EL	4.00 ft / 4.00 ft	Rising	MO
SG-9509-03	Grinder Forebay	EM	54inx54in	316 SS	-10.80 EL	9.89 EL	4.00 ft / 4.00 ft	Rising	MO
SG-9509-04	Grinder Forebay	EM	54inx54in	316 SS	-10.80 EL	9.89 EL	4.00 ft / 4.00 ft	Rising	MO
SG-9509-05	Grinder Forebay	EM	54inx54in	316 SS	-10.80 EL	9.89 EL	4.00 ft / 4.00 ft	Rising	MO
SG-9509-06	Grinder Forebay	EM	54inx54in	316 SS	-10.80 EL	9.89 EL	4.00 ft / 4.00 ft	Rising	MO
SG-9509-07	Grinder Forebay	EM	54inx54in	316 SS	-10.80 EL	9.89 EL	4.00 ft / 4.00 ft	Rising	MO

SG-9509-08	Grinder Forebay	EM	54inx54in	316 SS	-10.80 EL	9.89 EL	4.00 ft / 4.00 ft	Rising	MO
SG-9509-09	EQ Tank Forebay	SM	54inx54in	316 SS	-10.80 EL	9.89 EL	2.00 ft / 2.00 ft	Rising	MO
SG-9509-10	EQ Tank Forebay	SM	54inx54in	316 SS	-10.80 EL	9.89 EL	2.00 ft / 2.00 ft	Rising	MO
SG-9509-11	EQ Tank No.1	SM	48inx115in	316 SS	-17.88 EL	9.89 EL	9.08 ft / 9.08 ft	Non-rising	MO
SG-9509-12	EQ Tank No.2	SM	48inx115in	316 SS	-17.88 EL	9.89 EL	9.08 ft / 9.08 ft	Non-rising	MO
SG-9509-13	Wet Wells	SM	36inx36in	316 SS	-22.88 EL	9.89 EL	14.08 ft /14.08 ft	Rising	MO

Note 1: Design head measured from invert of gate.

++ END OF SECTION ++

++ NO TEXT ON THIS PAGE ++

SECTION 13122

METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to design, furnish and install all metal building systems. The Work also includes:
 - a. Building into metal building systems required items and providing openings, closures and escutcheons for metal building systems to accommodate the Work under this and other Sections and attaching to the metal building systems all items such as sleeves, hoods, supports, fasteners and all items required, for which provision is not specifically included under other Sections.
2. Extent of metal building systems is shown.
3. Types of products required include the following:
 - a. Multi-bay clear span structural system of low rigid frame type.
 - b. Insulated, standing-seam, metal roof panel system.
 - c. Insulated metal wall panel system.
 - d. Stone fiber batt roof insulation.
 - e. Personnel doors and trim.
 - f. Cupola with translucent wall panels.
 - g. All auxiliary system components and miscellaneous accessories, fasteners, trim, framed openings, flashing closures, base moldings, gutters, downspouts, vapor retarders and all other items not specified under this or other Sections, but required to provide a completely watertight and functioning building.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the metal building systems.
2. Coordinate the locations of equipment, piping, heating and ventilating ductwork, electrical conduit and similar items in order to provide required clearances and supports for such items without modification of metal building system components at the Site.

C. Related Sections:

1. Section 03300, Cast-in-Place Concrete.
2. Section 07920, Joint Sealants.
3. Section 08120, Aluminum Doors and Frames.

4. Section 08710, Door Hardware.
5. Section 09900, Painting.
6. Section 16061, Grounding.
7. Section 16062, Lightning Protection System.

1.2 REFERENCE STANDARDS

- A. Comply with the applicable provisions and recommendations of the following, except as otherwise shown and specified:
 1. ASTM A36, Carbon Structural Steel, Standard Specification for.
 2. ASTM A53, Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless, Standard Specification for.
 3. ASTM A153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware, Standard Specification for.
 4. ASTM A307, Carbon Steel Bolts and Studs, 60,000psi Tensile Strength, Standard Specification for.
 5. ASTM A325, High-Strength Bolts for Structural Steel Joints, Standard Specification for.
 6. ASTM A366, Commercial Steel (CS) Sheet, Carbon, (0.15 Maximum Percent) Cold-Rolled, Standard Specification for.
 7. ASTM A463, Steel Sheet, Aluminum-Coated, by the Hot-Dip Process, Standard Specification for.
 8. ASTM A475, Zinc-Coated Steel Wire Strand, Standard Specification for.
 9. ASTM A490, Heat-Treated Steel Structural Bolts, 150ksi Minimum Tensile Strength, Standard Specification for.
 10. ASTM A500, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Standard Specification for.
 11. ASTM A501, Hot-Formed Welded and Seamless Carbon Steel Structural Tubing, Standard Specification for.
 12. ASTM A529, High-Strength Carbon-Manganese Steel of Structural Quality, Standard Specification for.
 13. ASTM A568, Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for, Standard Specification for.
 14. ASTM A569, Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality, Standard Specification for.
 15. ASTM A570, Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality, Standard Specification for.
 16. ASTM A572, High-Strength Low-Alloy Columbium-Vanadium Structural Steel, Standard Specification for.
 17. ASTM A611, Structural Steel (SS), Sheet, Carbon, Cold-Rolled, Standard Specification for.
 18. ASTM A653, Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, Standard Specification for.
 19. ASTM A687, High-Strength Nonheaded Steel Bolts and Studs, Standard Specification for.

20. ASTM A755, Sheet Steel, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products, Standard Specification for.
21. ASTM A792, Sheet Steel, 55 Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, Standard Specification for.
22. ASTM B695, Coatings of Zinc Mechanically Deposited on Iron and Steel, Standard Specification for.
23. ASTM C36, Gypsum Wallboard, Standard Specification for.
24. ASTM C423, Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method, Standard Test Method for.
25. ASTM C442, Gypsum Backing Board and Coreboard, Standard Specification for.
26. ASTM C578, Rigid, Cellular Polystyrene Thermal Insulation, Standard Specification for.
27. ASTM C665, Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing, Standard Specification for.
28. ASTM C920, Elastomeric Joint Sealants, Standard Specification for.
29. ASTM C991, Flexible Glass Fiber Insulation for Pre-Engineered Metal Buildings, Standard Specification for.
30. ASTM C1107, Packaged Dry, Hydraulic-Cement Grout (nonshrink), Standard Specification for.
31. ASTM C1136, Flexible, Low Permeance Vapor Retarders for Thermal Insulation, Standard Specification for.
32. ASTM D523, Specular Gloss, Standard Test Method for.
33. ASTM D1494, Diffuse Light Transmission Factor of Reinforced Plastics Panels, Standard Specification for.
34. ASTM D3841, Glass-Fiber-Reinforced Polyester Plastic Panels, Standard Specification for.
35. ASTM D4214, Evaluating Degree of Chalking of Exterior Paint Films, Standard Test Method for.
36. ASTM E84, Surface Burning Characteristics of Building Materials, Standard Test Method for.
37. ASTM E94, Radiographic Testing, Standard Guide for.
38. ASTM E96, Water Vapor Transmission of Materials, Standard Test Methods for.
39. ASTM E119, Fire Tests of Building Construction and Materials, Standard Test Methods for.
40. ASTM E136, Behavior of Materials in a Vertical Tube Furnace at 7500 C, Standard Test Method for.
41. ASTM E142, Controlling Quality of Radiographic Testing, Standard Method for.
42. ASTM E164, Ultrasonic Contact Examination of Weldments, Standard Practice for.
43. ASTM E165, Liquid Penetrant Examination, Standard Test Method for.

44. ASTM E283, Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen, Standard Test Method for.
45. ASTM E329, Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction, Standard Specification for.
46. ASTM E331, Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference, Standard Test Method for.
47. ASTM E548, General Criteria Used for Evaluating Laboratory Competence, Standard Guide for.
48. ASTM E709, Magnetic Particle Examination, Standard Guide for.
49. ASTM E1646, Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference, Standard Test Method for.
50. ASTM E1680, Rate of Air Leakage Through Exterior Metal Roof Panel Systems, Standard Test Method for.
51. ASTM F959, Compressible-Washer Type Direct Tension Indicators for Use with Structural Fasteners, Standard Specification for.
52. Metal Building Manufacturers Association (MBMA), Low Rise Building Systems Manual.
53. American Institute of Steel Construction (AISC), S303 - Code of Standard Practice for Steel Buildings and Bridges.
54. American Institute of Steel Construction (AISC), S335 - Specification for Structural Steel Buildings, Allowable Stress Design, Plastic Design.
55. American Iron and Steel Institute (AISI), SG-671 - Specification for the Design of Cold-Formed Steel Structural Members.
56. American Iron and Steel Institute (AISI), SG-911 - Load and Resistance Facet Design Specification for Steel Structural Members.
57. American Society of Civil Engineers, ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
58. Architectural Metal Products Division of The National Association of Architectural Metal Manufacturers (NAAMM), Metal Finishes Manual for Architectural and Metal Products.
59. American Welding Society (AWS), D1.1 - Structural Welding Code - Steel.
60. American Welding Society (AWS), D1.3 - Structural Welding Code - Sheet Steel.
61. Sheet Metal and Air Conditioning Contractors National Association, Incorporated, SMACNA, Architectural Sheet Metal Manual.
62. Steel Door Institute, SDI 122, Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
63. Factory Mutual Engineering Corporation, FM 1-7 - Wind Forces on Buildings and Other Structures.
64. Research Council on Structural Connections, (RCSC), Specification for Structural Joints Using ASTM A325 and ASTM A490 Bolts.
65. Steel Joist Institute (SJI), Standard Specifications and Load Tables.
66. Steel Structures Painting Council (SSPC), Steel Structures Painting Manual Vol. 2.

67. Underwriters' Laboratories Incorporated (U.L.), Standard for Safety - UL 580 - Tests for Uplift Resistance of Roof Assemblies.
68. New York State Building Code, 2020.
69. New York State Energy Conservation Code, 2020.

1.3 DEFINITIONS

- A. Terminology used in this Specification shall comply with MBMA's, "Low Rise Building Systems Manual" for definitions of terms for metal building systems construction, and the following:
 1. The term "bay spacing" shall mean the dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured perpendicular to end wall (outside face of end-wall girt).
 2. The term "building length" shall mean the dimension of the building measured perpendicular to main framing from end wall to end wall (outside face of girt to outside face of girt).
 3. The term "building width" shall mean the dimension of the building measured parallel to main framing from sidewall to sidewall (outside face of girt to outside face of girt).
 4. The term "clear span" shall mean the distance between supports of beams, girders, or trusses (measured from lowest level of connecting area of a column and a rafter frame, or knee).
 5. The term "eave height" shall mean the vertical dimension from finished floor to eave (the line along the sidewall formed by intersection of the planes of the roof and wall).
 6. The term "clear height under structure" shall mean the vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.

1.4 SYSTEM DESCRIPTION

- A. Metal building systems include complete, integrated sets of mutually dependent components and assemblies, capable of withstanding structural and other loadings, thermally induced movements, and exposure to weather in the area of the Site, without failure or infiltration of water into the building interior. The system includes primary and secondary framing, roof and wall panels, auxiliary system components and all associated trim, complying with requirements shown and specified, all requirements of the metal building systems manufacturer, and governing authorities having jurisdiction at the Site.
- B. Metal building systems also include all internal reinforcements and supports, fasteners, closure plates, flashing, fascias, and all other components necessary to complete the Work in a manner that provides a completely functioning system supportive of, and integrated with, all building service equipment in compliance with the requirements of governing authorities having jurisdiction at the Site.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Engage a manufacturer specializing in the production of the types and quality of products specified and with a documented record of successful in-service metal building system performance.
2. Manufacturer shall be a member of MBMA and be certified by AISC as a manufacturer that designs and produces metal building systems in a AISC-Certified Facility.
3. Engage a manufacturer who will provide complete technical services including preparation and review of Shop Drawings, including installation methods and detailing for metal building system components. Where the manufacturer requires additions, or changes to the Contract Documents in order to facilitate its design and fabrication of system components, these shall be made at no cost to OWNER and only as acceptable to ENGINEER.

B. Erector Qualifications:

1. Engage a single erector skilled, trained and with successful and documented experience in the installation of metal building systems who is acceptable to the metal building system manufacturer, and with specific skill and successful experience in the erection of the types of components required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualification to ENGINEER along with the following information on a minimum of three successful projects:
 - a. Names and telephone numbers of owner, architects or engineers responsible for projects.
 - b. Approximate contract cost of the metal building system.
 - c. Amount of area installed.

C. Professional Engineer:

1. Engage a registered professional engineer legally qualified to practice in the jurisdiction where the Project is located and experienced in providing engineering services of the kind indicated.
2. Responsibilities include, but are not necessarily limited to, the following:
 - a. Carefully reviewing system performance and design criteria stated in the Contract Documents.
 - b. Preparing written requests for clarification or interpretation of performance or design criteria for submittal to ENGINEER by CONTRACTOR.
 - c. Preparing, or supervising the preparation of design calculations, and reviewing and approving related Shop Drawings prepared by the metal building system manufacturer prior to submission to ENGINEER; testing plan development, and test-result interpretations; and providing

comprehensive engineering analyses verifying compliance of the system with the requirements of the Contract Documents.

- d. Signing and sealing all calculations and engineering analyses.
- e. Certifying that:
 - 1) it has performed the design of the system in accordance with the performance and design criteria stated in the Contract Documents, and
 - 2) the said design conforms to all applicable local, state and federal codes, rules and regulations and to the prevailing standards of practice.

D. Testing Agency Qualifications: To qualify for approval, an independent testing agency shall demonstrate to ENGINEER's satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated, in accordance with ASTM E329 and as documented according to ASTM E548, without delaying the Work.

E. Erection and Location Tolerances:

- 1. Comply with MBMA's "Low Rise Building Systems Manual," Chapter IV, Section 9, "Fabrication and Erection Tolerances."
- 2. Structural-Steel Erection Tolerances: Comply with erection tolerance limits of AISC S303, "Code of Standard Practice for Steel Buildings and Bridges."
- 3. Roof Panel Installation Tolerances: Shim and align units within installed tolerance as follows:
 - a. Slope and Location: 1/4 inch in 20 feet on lines as indicated, and within 1/8-inch offset of adjoining faces and alignment of matching profiles.
- 4. Wall Panel Installation Tolerances: Shim and align units within installed tolerances as follows:
 - a. Level and Plumb: 1/4 inch in 20 feet on location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- 5. Door Installation Tolerances: Fit doors in frames within clearances specified in SDI 122.

F. Source Quality Control:

- 1. Obtain all metal building system components through a single source and from a single manufacturer.
- 2. In some cases, incidental accessories necessary to the proper functioning of the specified system or component may not be mentioned in the Specifications. CONTRACTOR shall follow the recommendations of the specified metal building system manufacturer and provide systems and components with all required incidental accessories and component items necessary for the proper functioning of the metal building or other building systems, at no additional expense to OWNER. Provide materials matching the specified material and finish of similar items.

3. Do not change material gages, system components or construction details after approval of Shop Drawing by ENGINEER.
 4. Contract Documents establish requirements for metal buildings aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignments, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, or in-service performance.
 5. Provide specified material gages, or heavier gages, if calculations based on performance criteria indicates the need for heavier gage material. All such modifications shall be at no additional expense to OWNER. Where compliance with performance criteria indicates that materials of lesser gage, or size, may be adequate, provide specified gages and sizes as minimum acceptable standard.
 6. Welding:
 - a. Qualify procedures and personnel according to AWS D1.1 and AWS D1.3.2.
 - b. Provide certification that all welders employed on the fabrication of the metal building systems have satisfactorily passed AWS qualification tests within the previous twelve months. Manufacturer shall ensure that all certifications are kept current.
 7. Structural Steel: Comply with AISC S335 for design requirements and allowable stresses.
 8. Cold-Formed Steel: Comply with AISC SG-671 and AISC SG-911 for design requirements and allowable stresses.
- G. Requirements of Regulatory Agencies:
1. Fabricate and label structural framing to comply with special inspection requirements at point of fabrication for welding and other connections required by governing authorities having jurisdiction at the Site.
- H. Mock-Ups:
1. Before installing wall panels, build mock-ups for each required form of construction and finish to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution.
 2. Build mock-ups of the types and of the sizes shown.
 - a. Include wall panel assembly with window, window opening framed with metal trim, and insulation with vapor retarder.
 - b. Include all sealants at perimeter of window and joints of wall.
 3. Incorporate materials and methods of fabrication and installation that are identical with Project requirements.
 4. Obtain ENGINEER's acceptance of visual qualities, color, erection tolerances and workmanship demonstrated on the mock-ups before start of metal building system Work. Retain and protect mock-ups during

construction as a standard for judging completed metal building system Work. Do not alter mock-up after approval by ENGINEER.

5. Build as many mock-ups as necessary to achieve ENGINEER's acceptance of the metal building systems. Disassemble rejected mock-ups and remove all components from Site. Do not incorporate rejected mock-up components into the Work. Accepted mock-ups may be incorporated into the finished Work.
6. Metal building systems that do not meet the standard of workmanship approved on the approved sample areas shall be removed and replaced with new material.

1.6 SUBMITTALS

A. Qualifications Data: Submit qualifications data for the following:

1. Manufacturer.
2. Erector.
3. Professional engineer.
4. Test agency.

B. Samples: Submit the following:

1. Manufacturer's full selection of standard and custom colors showing the full range of colors available for each type of product included in the metal building system, that incorporates a factory-applied color finish, for initial selection by ENGINEER.
2. 12-inch long by actual width of roof and wall panels, with required finishes. Include all auxiliary system components such as clips, caps, battens, fasteners, closures, and other exposed panel accessories.
3. 6-inch square sample of vapor-retarders.
4. 12-inch long actual profile of corner section of aluminum window frame specified in Section 08120, glazed with glass specified in Section 08710, including all glazing shims, sealants, wedges and other glazing accessories. Insulating glass need not be hermetically sealed, but intermediate films and requirements for special interstitial gas fills shall be included and identified on the sample, if specified.
5. Each fastener proposed for use in erection of metal building system, tagged as to location and use in the Work.
6. ENGINEER's review will be for color and profile, only. Compliance with all other requirements is the responsibility of CONTRACTOR.

C. Shop Drawings: Submit the following:

1. Completely dimensioned plans, elevations and cross-sections of the metal building system completely coordinated with all required equipment and building service clearances. Accurately locate, show and dimension the following:
 - a. Structural framing system including the center lines of the bottom of all columns. Show complete fabrication of primary and secondary

- framing. Indicate welds and bolted connections, distinguishing between shop and Site applications. Include transverse cross-sections.
- b. Complete erection drawings showing locations of sidewall, endwall, and roof framing, covering and trim details, and accessory installation details to clearly indicate the proper assembly of building components. Include plans, elevations, details, and attachments to other Work.
- c. Show layouts of wall, roof and liner panels on support framing, details of edge conditions, joints, panel profiles, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and Site-assembled Work.
- d. Insulations.
- e. Vapor-retarders.
- f. Trim and closures.
- g. Furnish schedule of doors and frames including finish hardware sets, using the same reference numbers as shown. Include details of reinforcement and installation requirements for finish hardware.
- h. Windows.
- i. Louvers.
- j. All required wall and roof penetrations.
- k. All roof mounted equipment and curbs, service-way walkways and flashings.
- l. Auxiliary and accessory components. Include details of ventilators, louvers, gutters and downspouts and similar auxiliary and accessory system components.
- m. All details shall be drawn at a scale of not less than 1-1/2 inches equal to 12 inches.
- 2. Manufacturer's complete product information, specifications and installation instructions for metal building components and accessories. Include material descriptions, dimensions and profiles of individual system components.
- 3. Hard copy print-outs of structural analysis calculations required to show compliance with loading requirements, deflection requirements, other anticipated movements in the metal building system, and other system performance criteria specified prepared, signed and stamped with the seal of a registered professional engineer, as specified. All calculations and assumptions shall be presented so that ENGINEER can easily follow the progress and logic of registered professional's structural analysis.
- 4. Foundations Loads and Anchor-Bolt Plans:
 - a. Drawing showing all vertical and horizontal reactions on foundations. Include direction and location of each load application.
 - b. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
- 5. Copies of special warranties, as specified.

D. Certificates: Submit the following:

Long Beach WPCP Consolidation
Pump Station Conversion

13122-10

1. Letter of Design Certification: Registered professional engineer who prepares, signs and stamps its seal shall provide a written statement confirming responsibility for the design and attesting that the design prepared meets the performance criteria required by the Contract Documents, the requirements of governing authorities having jurisdiction at the Site, and conforms to prevailing standards of practice. Include the following:
 - a. Name and location of Project.
 - b. Order number.
 - c. Name of manufacturer.
 - d. Name of CONTRACTOR.
 - e. Building dimensions, including width, length, height, and roof slope.
 - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - g. Governing building code and year of edition.
 - h. Design Loads: Include dead load, roof live load, collateral loads, impact loads, roof snow load, deflection, wind loads/speeds and exposure, seismic zone or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads, such as loading superimposed on the system by erection equipment.
 - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing authorities having jurisdiction.
 - j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
 - k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.
2. Welding Certificates: Copies of certificates for welding procedures and personnel, as specified.

E. Test Reports: Submit the following:

1. Material Test Reports: From a qualified testing agency indicating and interpreting test results of steel for compliance with requirements specified.
2. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, indicating the following current products comply with requirements:
 - a. Insulation and Vapor-Retarders: Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:

1. Deliver components to the Site in manufacturer's original, unopened and undamaged packages, legibly labeled and accurately representing contents, indicating materials and components submitted on approved Shop Drawings.
2. Package roof and wall panels for protection during transportation and handling.
3. Clearly identify manufacturer, brand name, contents, color stock number, and order number on each package.
4. Metal building system components that are damaged during delivery or while being unloaded shall not be stored on Site. Remove such products from Site and replace with new, undamaged material.
5. Inspect materials, account for the presence of all hardware, auxiliary items and other accessories required for the Work, and reject components differing from approved Samples and Shop Drawings. Immediately remove rejected components from the Site.
6. Do not open packages or remove markings until packages are inspected and accepted. Packages showing indications of damage that may affect condition of contents will not be acceptable. Packages with illegible or removed labels will be rejected for use in the Work.

B. Storage of Materials:

1. Store roof and wall panels in a manner that will protect strippable coating from exposure to sun and condensation; with good air circulation around each piece.
2. Stack metal building system components on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Do not store pallet crates directly on the ground. Provide sufficient clearance between enclosure and system components for air circulation and for protection from wind blown rain.
3. Store metal sheets and panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage, in an area protected from dirt, weather and from all construction activities. Do not store outside or allow components to become wet or soiled in any way while on Site.
4. If crated system components become wet, remove all system components from the pallet crate immediately, separate and allow to dry under protective cover meeting the requirements of this Specification.

C. Handling of Materials:

1. Unload, store, and erect roof and wall panels and other metal building system components in a manner that prevents bending, warping, twisting, and surface damage.
2. Do not subject preformed metal siding and accessory materials to bending or stress. Do not carry or transport panels in the horizontal (flat) position. Hold panels upright on edge when handling.

3. Do not erect components that become dented, scratched or damaged in any way. Remove such panels from Site and replace with new, undamaged material at no additional expense to OWNER.
4. Panels that are damaged during erection shall be removed from Site and replaced with new, undamaged material. Damaged panels erected into the finished Work shall be removed immediately.

1.8 PROJECT CONDITIONS

A. Environmental Conditions:

1. Weather Limitations: Proceed with erection only when weather conditions permit roof and wall panel installation to be performed according to manufacturer's written instructions and warranty requirements.

B. Site-Measurements:

1. Verify dimensions in areas of erection by taking measurements at the Site before fabrication. Indicate dimensions on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delay.
2. Where Site-measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating components without Site-measurements. Coordinate supports, adjacent construction, equipment and locations of openings to ensure actual dimensions correspond to dimensions established for metal building system Work.

C. Protection:

1. Provide continuous protection of materials against damage primarily by storing materials under cover and above ground and away from other construction traffic.
2. Do not expose plastic insulation to sunlight, except to extent necessary for period of installation and concealment.
3. Protect plastic insulation against ignition at all times. Do not deliver plastic insulation materials to Site before it is required to be built into the Work.

D. Scheduling:

1. Schedule the arrival of metal building system components, auxiliary items and accessories to minimize the time they are stored at the Site before erection.
2. Do not proceed with the erection of metal building systems until CONTRACTOR can provide finished Work complying with all requirements of the Specifications.
3. Where metal building systems require the building-in of plates, inserts, anchors and other items, furnish required inserts to avoid delay in the Work of other trades. Provide setting drawings, templates, and directions for installation of plates, inserts and anchors, required by the Work of this Section but installed under other Sections.

4. Coordinate with other Work by furnishing Shop Drawings, inserts and similar items at the appropriate times for proper sequencing of construction without delays.
 5. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
- E. Preinstallation Conference:
1. Prior to erection of metal building system components and associated Work, CONTRACTOR shall schedule and meet at the Site with the metal building system erector, the installer of each component of associated Work, the installers of substrate construction to receive the metal building systems Work, the installers of other Work in and around metal building system that follows the metal building system Work, including mechanical Work, ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the metal building system Work, including but not necessarily limited to, the following:
 - a. Review Project requirements and the Contract Documents.
 - b. Review required submittals, both completed and yet to be completed.
 - c. Review status of mock-ups.
 - d. Review status of foundation work, including approval of surface preparations, structural loading limitations and similar considerations.
 - e. Review construction schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
 - f. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
 - g. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.
 - h. Review procedures needed for protection of metal building systems during the remainder of the construction period.
 - i. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
 - j. Review required inspection, testing, and certifying procedures.
 2. Record the discussions of the conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending.
 3. Record all revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.
 4. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

1.9 WARRANTY

- A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under

the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.

B. Special Warranties:

1. **Coating Wear Warranty:** Furnish a written warranty, signed by the manufacturer and running to benefit of OWNER, agreeing to replace, for a period of ten years from the date of Substantial Completion, wall, roof and auxiliary system components and accessories finish that shows excessive wear, as specified, and stating that the coil and spray coated polyvinylidene fluoride based coating specified complies with the following:
 - a. Coating will not blister, peel, flake, check nor chip; and shall also be warranted against excessive color change, chalking and cracking, spalling, crazing, or from otherwise losing adhesion for a period of twenty years from the date of installation, to the extent that such shall create unsightly conditions, impair the intended architectural qualities of the building or otherwise fail to meet performance criteria specified, when viewed from a distance of 5 feet from the item.
 - b. In the event that the coil coated polyvinylidene fluoride based coating fails to meet the specified standards the manufacturer shall, at his own expense, replace or field paint, at the discretion of OWNER, all areas affected by the failure. In the event that repainting is selected, it shall be done at mutually agreeable intervals throughout the term of the warranty.
 - c. The warranty does not apply where any failure is caused by accidents, or any external conditions or forces beyond the control of the manufacturer.
2. **Material and Workmanship Warranty:** Furnish a written warranty, signed by the manufacturer and running to benefit of OWNER, agreeing to replace metal building system components that fail in material or workmanship within three years of the date of Substantial Completion. Failure of materials or workmanship shall include, but is not limited to, leakage or air infiltration, deflections, or deterioration of metal in excess of normal weathering, and in excess of performance criteria specified; and defects in, and improper arrangement of, the various parts, accessories, weather-stripping, and other components of the system.
3. **Standing Seam Roof Panel Weathertightness:** Furnish a warranty, secured by a recognized surety company and executed by an authorized representative of the manufacturer, running to the benefit of OWNER, agreeing to replace, for a period of twenty years from the date of Substantial Completion, standing seam metal roof panel assemblies and flashing that fail to remain water- and weather-tight. CONTRACTOR shall obtain all approvals and inspections as may be required by the manufacturer for warranty coverage.

1.10 MAINTENANCE

- A. Extra Materials:
 - 1. Furnish extra materials from the same manufactured lot as the materials installed.
 - 2. Provide a minimum of five percent excess over the required amount of metal wall panels, metal roof panel, roof insulation, gutters, downspouts, metal trim, flashing, nuts, bolts, screws, washers, and other required fasteners for building. Pack in cartons and store on the site where directed.
- B. Do not provide partial containers or packages of materials. Round-up quantities to furnish only complete, unopened and undamaged containers and packages; with legible labels accurately representing contents of container or package indicating compliance with approved Samples and Shop Drawings, and matching materials actually installed.
 - 1. Submit quantities of each system component required for the Work, based on actual purchase order to manufacturer for materials to be used for this Project, with calculations establishing quantity of extra materials to be furnished to OWNER.
- C. Do not furnish materials whose remaining shelf-life will be less than six months, at the time of Substantial Completion. Furnish only materials that are accompanied by a documented record of proof of being continuously stored and handled according to manufacturer's recommended storage and temperature limitations.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Performance Criteria:
 - 1. General:
 - a. Standards: Comply with applicable standards, recommendations and specified publications of MBMA, AISC, ASCE 7 and FM 1-7, except to the extent more stringent requirements are specified or required by governing authorities having jurisdiction at the Site.
 - b. Modifications: The metal building system requirements shown are based on the specific system shown. Other manufacturer's systems with equal performance characteristics may be considered. Within these limitations CONTRACTOR shall be responsible for the structural adequacy, detailing and fabrication of the entire metal building system, including anchorage, and to make whatever modifications of, and additions to, the details as may be required to fulfill the performance requirements as acceptable to ENGINEER. Maintain the visual design concept as shown, including member sizes, profiles, support locations and alignment of components, as judged solely by ENGINEER. Clearly identify, in a manner that is

- highlighted to ENGINEER, all proposed substitutions, modifications, variations, unspecified features and “or equal” products. Provide complete comparative data, with specified products, at time of Shop Drawing submission.
- c. Professional engineer, to whom design of the metal building system is delegated, shall prepare written requests for clarification of system performance criteria and for clarification of other requirements of the Contract Documents for CONTRACTOR to submit to ENGINEER.
2. Metal Building System Design: Provide size, spacing, and spans shown, and as follows:
- a. Primary Frame Type: Provide the following:
 - 1) Rigid Clear Span: Solid-member structural framing system without interior columns.
 - 2) Rigid Modular: Solid-member structural framing system with interior columns.
 - 3) Truss-Frame Clear Span: Truss-member structural framing system without interior columns.
 - 4) Truss-Frame Modular: Truss-member structural framing system with interior columns.
 - 5) Long Bay: Solid- or truss-member structural framing system without interior columns.
 - 6) Lean to: Solid- or truss-member structural framing system without interior columns, designed to be partially supported by another structure.
 - b. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, as follows:
 - 1) Provide load-bearing end-wall and corner columns, and rafters.
 - c. Secondary Frame Type: Manufacturer's standard rafters and the following girts:
 - 1) Exterior-framed (bypass) girts.
 - d. Eave Height: Manufacturer's standard height, as indicated by nominal height shown.
 - e. Bay Spacing: As determined by manufacturer, as indicated by nominal height shown.
 - f. Roof Slope: 4 inch per 12 inches.
 - g. Roof System: Insulated, standing-seam, metal roof panels.
 - h. Exterior Wall System: Manufacturer's standard factory-assembled insulated wall panels.
 - j. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - j. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

- 1) Live Loads: Include vertical loads induced by the building occupancy. Include loads induced by personnel, materials, and equipment for roof live loads.
 - a) Building Occupancy: As shown.
- 2) Roof Snow Loads: Include vertical loads induced by the weight of snow, as determined by 50-year mean-recurrence-interval ground snow load at Site. Allow for unbalanced and drift loads.
- 3) Wind Loads: Include horizontal loads induced by a basic wind speed corresponding to a 10-year mean-recurrence interval at Site.
- 4) Collateral Loads: Include additional dead loads for items such as sprinklers, mechanical systems, electrical systems, material conveying systems and ceilings.
- 5) Auxiliary and Impact Loads: Include dynamic live loads, such as those generated by cranes and material conveying equipment.
- 6) Load Combinations: Design metal building systems to withstand the most critical effects of load factors and load combinations.
- k. Deflection Limits: Design component assemblies to withstand design loads with deflections no greater than the following:
 - 1) Purlins and Rafters: Vertical deflection of $L/240$ of the span.
 - 2) Girts: Horizontal deflection of $L/240$ of the span.
 - 3) Roof Panels: Vertical deflection $L/240$ of the span.
 - 4) Wall Panels: Horizontal deflection of $L/240$ of the span.
- l. Drift: Lateral deflection of the building frame at the roof line in relationship to the position of the floor or slab-on-grade shall be limited to metal building system manufacturer's maximum for type of warranted construction specified, or not greater than allowed by MBMA, whichever is less.
- m. Design secondary framing system to accommodate deflection of primary structure, construction tolerances, and to maintain clearances at openings.
- n. Seismic Performance: Design metal building systems capable of resisting the effects of earthquake motions determined according to governing authorities having jurisdiction at the Site or ASCE 7, whichever is more stringent.
- o. Thermal Movements: Provide metal building roof and wall panel systems designed for thermal movements. Employ detailing and fabrication techniques that prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects resulting from the following maximum change (range) in ambient and surface temperatures. Base design calculation on surface temperatures of materials caused by both solar heat gain and nighttime-sky heat loss.
 - 1) Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.
- p. Thermal Performance: Provide metal building roof and wall assemblies with the following thermal-resistance values (R-value):

- 1) Roof Assemblies: $R = 20$.
 - 2) Wall Assemblies: $R = 24ci$.
- q. Air Infiltration:
- 1) Roof Panels: Provide roof panel assemblies with permanent resistance to air leakage through assembly of not more than 0.40 cfm/sq. ft. of fixed roof area when tested according to ASTM E1680 at 0.3 inches W.G.
 - 2) Wall Panels: Provide wall panel assemblies with permanent resistance to air leakage through assembly of not more than 0.40 cfm/sq. ft. of fixed wall area when tested according to ASTM E283 at 0.3 inches W.G.
- r. Water Penetration:
- 1) Roof Panels: Provide roof panel assemblies with no water penetration as defined in the test method when tested according to ASTM E1646 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft..
 - 2) Wall Panels: Provide wall panel assemblies with no water penetration as defined in the test method when tested according to ASTM E331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft.
- s. Wind-Uplift Resistance: Provide roof panel assemblies that meet requirements of UL 580 for the following wind-uplift resistance:
- 1) Class 90.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Alliance Steel, Incorporated.
 2. American Buildings Company.
 3. American Steel Building Company, Incorporated.
 4. Butler Manufacturing Company.
 5. Ceco Building Systems.
 6. Star Building Systems.
 7. Steelox Systems Incorporated.
 8. Varco-Pruden Buildings; a United Dominion Company.

2.3 STRUCTURAL FRAMING MATERIALS

- A. Hot-Rolled Structural Shapes: ASTM A36 or A529.
- B. Steel Tubing or Pipe: ASTM A500, Grade B; ASTM A501 or ASTM A53, Grade B.

- C. Steel Plate, Bar or Strip: ASTM A529, A570, or A572.
- D. Structural Steel Sheet: Hot-rolled, ASTM A570, Grade 50 or Grade 55; hot-rolled, ASTM A568; or cold-rolled, ASTM A611, structural quality, matte (dull) finish.
- E. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, structural quality, Grade 50, with G60 coating designation; mill-phosphatized.
- F. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755 and the following requirements:
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, G90 coating designation; structural quality.
- G. Joist Girders: Provide girders, complying with SJI's requirements, manufactured with angle top and bottom chord members, to produce girder types, end arrangements, and top chord arrangements indicated and required for primary framing.
- H. Steel Joists: Provide joists, complying with SJI's requirements, manufactured with steel-angle top and bottom chord members, to produce joist types, end arrangements, and top chord arrangements indicated and required for secondary framing.
- I. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy, hex-head structural steel bolts, heavy hex carbon steel nuts, and hardened carbon steel washers.
 - 1. Finish: Hot-dip zinc coating, ASTM A153, Class C.
 - 2. Direct-Tension Indicators: ASTM F959, Type 325 or Type 490.
 - a. Finish: Hot-dip zinc coating, ASTM A153, Class C.
- J. Anchor Rods, Bolts, Nuts, and Washers:
 - 1. Headed Bolts: ASTM A490, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
 - 2. Washers: ASTM A36.
- K. Primers: As selected by manufacturer for compatibility with finish paint systems specified in Section 09900, and capable of providing a sound substrate for Site-applied topcoats, despite prolonged exposure without topcoat protection.

2.4 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755, and the following:
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653, G90 coating designation; structural quality.
 - 2. Surface: Smooth, flat, mill finish.
- B. Panel Sealants: Provide the following:
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2-inch wide and 1/8-inch thick.
 - 2. Joint Sealant: ASTM C920; one-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant; of type, grade, class, and use classifications required to seal joints in panels and remain weathertight; and as recommended by metal building system manufacturer.
 - 3. Mastic for Translucent Panels: Nonstaining, saturated vinyl polymer as recommended by panel manufacturer for sealing laps.

2.5 INSULATION MATERIALS

- A. Fire-Test-Response Characteristics for Insulation: Provide insulation with the fire-test-response characteristics indicated, as determined by testing identical products in compliance with test methods specified below by a testing and inspecting agency acceptable to governing authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E84.
- B. Mineral-Fiber-Blanket Insulation: Thermal insulation combining glass or slag/rock-wool fibers with thermosetting resins, complying with ASTM C665 and as follows:
 - 1. Type I: Unfaced.
- C. Molded Polystyrene Board Insulation: Rigid, cellular, thermal insulation formed by the expansion of polystyrene resin beads or granules in a closed mold, complying with ASTM C578, for type indicated below:
 - 1. Type II: 1.35-pounds per cubic foot, minimum density.
- D. Vapor-Retarder Facing: Complying with ASTM C1136, with permeance not greater than the following when tested according to ASTM E96, Desiccant Method:
 - 1. Composition: Vinyl-faced, scrim-reinforced polyester, with permeance not greater than 0.02 perm.
 - 2. Manufacturers: Provide products by one of the following manufacturers:
 - a. CGI Silvercote, Incorporated.
 - b. Lamtec Corporation.

- c. Owens-Corning Fiberglas Corporation.
- E. Retainer Strips: 0.019-inch thick, formed, galvanized steel or polyvinylchloride retainer clips colored to match insulation facing.

2.6 DOOR AND FRAME MATERIALS AND DOOR HARDWARE

- A. Doors and Door Frames: Refer to Section 08120, Aluminum Doors and Frames.
- B. Door Hardware: Refer to Section 08710, Door Hardware.

2.7 AUXILIARY AND ACCESSORY MATERIALS

- A. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound, free of asbestos fibers, sulfur components, and other deleterious impurities.
- B. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, of consistency suitable for application, and with a 30-minute working time.
- C. Shop Primer and Finish Painting: As specified in Section 09900.

2.8 FABRICATION, GENERAL

- A. Shop-fabricate bearing plates, and other plates as required for building erection, to the required sizes, sections and profiles, complete with base plates welded in place, and with all required holes for anchoring or connections shop-drilled, or punched, to template dimensions.
 - 1. Shop Connections: Riveted, bolted, or welded.
 - 2. Site Connections: Bolted.
- B. Fabricate components, and necessary field connections required for erection, to permit easy assembly and disassembly. Fabricate components such that once assembled they may be disassembled, repackaged and reassembled with a minimum amount of labor and maximum salvageability.
- C. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
- D. Fabricate components in a manner that once assembled in the shop, they may be disassembled, repackaged, and reassembled at the Site.

- E. Fabricate framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Cold-formed members shall be free of cracks, tears, and ruptures.
- F. Primary Framing:
 - 1. Shop-fabricate framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted Site-assembly.
 - 2. Make shop connections by welding or by using high-strength bolts.
 - 3. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
 - 4. Brace compression flange of primary framing by angles connected between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - 5. Weld clips to frames for attaching secondary framing members.
- G. Secondary Framing:
 - 1. Shop-fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place.
 - 2. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - 3. Make shop-connections by welding or by using non-high-strength bolts.
- H. Shop-Painting: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter that might interfere with paint bond. Follow procedures and substrate preparation recommendations of the painting manufacturers for the paint systems specified in Section 09900, Painting.

2.9 STRUCTURAL FRAMING FABRICATION

- A. Primary Framing:
 - 1. Provide metal building system manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - a. Provide frames with attachment plates, bearing plates, and splice members. Factory drill for Site-bolted assembly. Provide frame span and spacing indicated.
 - b. Slight variations in span and spacing may be acceptable if necessary to meet manufacturer's standard, as approved by ENGINEER.
 - 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural steel shapes.

3. Long-Bay Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates. Provide steel joist rafters.
4. Frame Configuration: Single gable.
5. Exterior Column Type: Uniform depth or Tapered as designed by Delegated Design Engineer to provide the most compact and cost-effective design.
6. Rafter Type: Uniform depth or Tapered as designed by Delegated Design Engineer to provide the most compact and cost-effective design.

B. Secondary Framing:

1. Provide metal building system manufacturer's standard structural secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural steel sheet or roll-formed, metallic-coated steel sheet prepainted with coil coating, unless otherwise shown or specified.
2. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598-inch thick steel sheet, built-up steel plates, or structural steel shapes; minimum 2-1/2-inch wide flanges.
 - a. Depth: As designed by Delegated Design Engineer to provide the most compact and cost-effective design.
3. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598-inch thick steel sheet, built-up steel plates, or structural steel shapes. Form ends of Z-sections with stiffening lips angled 45 to 50 degrees to flange and with minimum 2-1/2-inch wide flanges.
 - a. Depth: As designed by Delegated Design Engineer to provide the most compact and cost-effective design.
4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598-inch thick steel sheet, built-up steel plates, or structural steel shapes; to provide adequate backup for both roof and wall panels.
5. Flange and Sag Bracing: Minimum 1-5/8-inch by 1-5/8-inch structural steel angles, with a minimum thickness of 0.0598-inch, to stiffen primary frame flanges.
6. Base or Sill Angles: Minimum 3-inch by 2-inch by 0.0747-inch thick, zinc-coated (galvanized) steel sheet.
7. Purlin and Girt Clips: Minimum 0.0747-inch thick, zinc-coated (galvanized) steel sheet.
8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0747-inch thick, zinc-coated (galvanized) steel sheet.
9. Framing for Openings: Channel shapes; fabricated from minimum 0.0598-inch thick, cold-formed, structural steel sheet or structural steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.

10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- C. End-Wall Framing:
1. Provide metal building system manufacturer's standard primary end-wall framing fabricated for Site-bolted assembly.
- D. Bracing: Provide adjustable wind bracing as follows:
1. Rods: ASTM A36; ASTM A572, Grade D; or ASTM A529, Grade 50; 1/2-inch diameter steel; threaded full length or threaded a minimum of 12 inches at each end.
 2. Cable: ASTM A475, 1/4-inch diameter, extra-high-strength grade, Class B zinc-coated, seven-strand steel; with threaded end anchors.
 3. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
- E. Bolts: Provide shop-painted bolts, unless structural framing components are in direct contact with roof and wall panels. Provide galvanized bolts when structural framing components are in direct contact with roof and wall panels.

2.10 ROOF PANEL FABRICATION

- A. Insulated Standing-Seam Roof Panels: Manufacturer's standard panels complying with the following:
1. Vertical-Rib Roof Panels: Fabricate flat-pan panels from metallic-coated steel sheets prepainted with coil-coating, factory-formed to provide coverage as shown on drawings; with 2-inch high, inverted-L, vertical ribs at panel edges. Design panels for mechanical attachment to roof purlins using concealed clips in side laps. Factory-apply sealant at each interlocking joint. Comply with the following:
 - a. Material: Aluminum-zinc alloy-coated steel.
 - b. Yield Strength: 33-ksi.
 - c. Metal Thickness: 22 gauge.
 - d. Joint Type: As standard with manufacturer.
 - e. Clip System: Thermally broken.
 - f. Products and Manufacturers:
 - 1) KingZip by Kingspan Insulated Panels.
 - 2) Or Equal.
- B. Roof Panel Auxiliary System Components: Provide components required for a complete roof panel assembly including trim, copings, fascia, mullions, sills, corner units, ridge closures, clips, seam covers, battens, flashings, gutters, sealants, gaskets, fillers, closure strips, lightning protection accessories and similar items. Match materials and finishes of roof panels, unless otherwise indicated.

1. Closures: Provide closures at eave and ridge, fabricated of same metal as roof panels.
2. Clips: Minimum 0.0625-inch thick, stainless steel panel clips designed to withstand negative-load requirements.
3. Cleats: Mechanically seamed cleats formed from minimum 0.0250-inch thick, stainless steel or nylon-coated aluminum sheet.
4. Thermal Spacer Blocks: Where panels attach directly to purlins, provide 1-inch thick, thermal spacer blocks; fabricated from extruded polystyrene.
5. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

2.11 WALL PANEL FABRICATION

- A. Insulated Wall Panels: Provide manufacturer's standard factory-assembled units with interior and exterior zinc-coated (galvanized), metallic-coated steel face sheets prepainted with coil-coating, bonded to a foamed-in-place insulating core. Fabricate panels with a weathertight tongue-and-groove side edge for joining panels with a concealed metal clip and Site-applied sealant, in a manner that will prevent condensation on interior face. Comply with the following:
 1. Insulating Core: Manufacturer's standard core consisting of closed-cell, urethane-modified isocyanurate or polyurethane, with a 95 percent closed-cell structure.
 - a. Fire-Test-Response Characteristics: Provide insulating core with the following fire-test-response characteristics as determined by testing identical products per ASTM E84 by UL or another testing and inspecting agency acceptable to governing authorities having jurisdiction:
 - 1) Flame Spread: 25 or less.
 - 2) Smoke Developed: 450 or less.
 2. Face Sheet Thickness: Provide the following:
 - a. Exterior Face Sheet: 22 gauge.
 - b. Interior Face Sheet: 22 gauge.
 3. Nominal Panel Thickness: As shown with a minimum R-value of R-24.
- B. Wall Panel Accessories:
 1. Provide components required for a complete wall panel assembly, including trim, copings, mullions, sills, corner units, clips, seam covers, battens, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match materials and finishes of panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

2.12 TRANSLUCENT PANEL FABRICATION

- A. Fire-Test-Response Characteristics: Provide panels with the following surface-burning characteristics as determined by testing identical products per

ASTM E84 by UL or another testing and inspecting agency acceptable to governing authorities having jurisdiction:

1. Flame Spread: 50 or less.
2. Smoke Developed: 250 or less.

B. Panel Components:

1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
 - a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
 - b. Face sheets shall not deform, deflect or drip when subjected to fire or flame.
2. Interior face sheets:
 - a. Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than 50 and smoke developed no greater than 250 when tested in accordance with UL 723.
 - b. Burn extent by ASTM D 635 shall be no greater than 1".
3. Exterior face sheets:
 - a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after 5 years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
 - b. Strength: Exterior face sheet shall be uniform in strength, impenetrable by handheld pencil and repel an impact minimum of 70 ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.
4. Appearance:
 - a. Exterior face sheets: Smooth .070" thick and crystal in color.
 - b. Interior face sheets: Smooth .045" thick and crystal in color.
 - c. Face sheets shall not vary more than $\pm 10\%$ in thickness and be uniform in color.

C. Grid Core:

1. Aluminum I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16".

D. Manufacturers:

1. Kalwall Corporation.
2. Or Approved Equal.

2.13 FASCIA AND SOFFIT PANEL FABRICATION

A. Fascia Panels: Manufacturer's standard panels complying with the following:

1. Match roof panel profile and material.
- B. Soffit Panels: Manufacturer's standard panels complying with the following:
 1. Match wall panel profile and material.
- C. Finishes: Finish panel surfaces to match adjacent panels as follows:
 1. Fascia Panels: Match finish and color of wall panels.
 2. Soffit Panels: Match finish and color of wall panels.

2.14 DOOR AND FRAME FABRICATION

- A. Personnel Doors: Provide personnel doors and frames as specified in Section 08120, Aluminum Doors and Frames. Prepare and reinforce doors and frames to receive factory- and Site-applied hardware according to Section 08710.
 1. Finish Hardware: As specified in Section 08710.

2.15 AUXILIARY SYSTEM COMPONENTS AND MISCELLANEOUS ACCESSORIES

- A. Accessories shall be as specified in Section 8 of the Recommended Guide Specifications in the MBMA Manual, including gutters and downspouts.
 1. Provide sheet metal accessories of same material and in same finish as roof and wall panels, unless otherwise specified.
- B. Gutters and Downspouts: Provide the following:
 1. Form from 0.0179-inch thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil-coating. Match profile of roof fascia and rake trim.
 2. Gutters: Formed in sections not less than 8 feet in length, complete with end pieces, outlet tubes, and all special pieces that may be required and sized according to SMACNA's "Architectural Sheet Metal Manual." Unless otherwise shown, provide expansion-type slip joint at the center of runs. Furnish gutter supports spaced at 36 inches on centers, constructed of same metal as gutters. Provide standard aluminum wire ball strainers at each outlet.
 3. Downspouts: Formed from 0.0179-inch thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil-coating, in sections approximately 10 feet long, complete with elbows and offsets. Join sections with minimum 1-1/2 inches telescoping joints. Provide fasteners at top, bottom and at 5 foot centers designed to securely hold downspouts not less than 1 inch away from walls. Finish downspouts to match wall panels.
 4. Provide preformed rubber weatherseals to completely fill roof corrugation voids prior to installation of contour gutter.
 5. Provide 26-gage galvanized steel closures to close corrugations in wall panels prior to installation of gutters.

- C. Flat Eave and Gable Trim: Provide the following:
1. Gable and eave trim shall be flat type fabricated from 26-gage galvanized steel, ASTM A525, G90 coating.
 2. Gable and eave trim shall have a factory applied paint finish.
 3. Install preformed corner closures to match the configuration of the gable and eave trim.
 4. Install preformed rubber weatherseals to completely fill the roof panel corrugation voids prior to installation of eave trim.
 5. Install preformed wall closures to completely fill the wall panel corrugation voids prior to installation of eave and gable trim. Wall closures shall be 26-gage galvanized steel factory painted in slate black.
- D. Flashing and Trim:
1. Trim and wall panel transitions and other wall accessories for doors and windows and other openings through the metal panels shall be as required to coordinate with doors, window walls and other components specified in other Sections and Contracts.
 2. Provide manufacturer's standard profiles to the extent possible. Custom fabricate profiles where required, or shown, and to accommodate the Work of other Sections.
 3. Form flashing and trim from 0.0179-inch thick, aluminum-zinc alloy-coated steel sheet prepainted with coil-coating.
 4. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent roof or wall panels.
 5. Door Head and Jamb Opening Trim: Minimum 20 gauge thick steel sheet. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
 6. Base Molding Trim: Provide continuous interior base moldings in all perimeter wall areas except toilet rooms, fabricated from 22-gage galvanized steel. Finish shall be slate black. Provide base molding 3-7/8-inches high by 3/4-inch wide with a sloping top.
 7. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- E. Fasteners:
1. Sheet Panel Fasteners: Manufacturer's standard system of self-tapping screws, bolts and nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 2. Provide metal-backed neoprene washers under heads of fasteners bearing on weather side of panels.
 3. Locate and space fastenings for true vertical and horizontal alignment. Use appropriate fastening tools to obtain controlled uniform compression, for positive seal without rupture of neoprene washer.

4. Provide fasteners with heads matching color of roofing or siding sheets by means of plastic caps or factory-applied coating. Provide self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Comply with the following:
 - a. Fasteners for Roof and Wall Panels: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of panels.
 5. Fasteners for Flashing and Trim: Blind stainless steel rivets or stainless steel self-drilling screws with hex washer head.
- F. Closures: Closed-cell, laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match roof and wall panel profile. Provide closure strips where shown or as required to provide weathertight construction.

2.16 WALL, ROOF AND LINER PANELS, AND AUXILIARY WALL AND ROOF PANEL SYSTEM COMPONENTS COATINGS

- A. Comply with NAAMM's standards and recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Fluoropolymer Two-Coat System for Exposed Wall and Roof Panel Surfaces: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a total minimum dry film thickness of 1-mil and 30 percent reflective gloss when tested according to ASTM D523.
 1. Durability: Provide coating field tested under normal range of weather conditions for a minimum of 20 years without significant peel, blister, flake, chip, crack, or check in finish; without chalking in excess of a chalk rating of 8 according to ASTM D4214; and without fading in excess of five Hunter units.
 2. Colors, Textures, and Glosses: As selected by ENGINEER from manufacturer's complete selection of standard and custom colors, textures and glosses.
- D. Siliconized-Polyester System Exposed Finish for Liner Panels: Apply the following coil coating:

1. Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2-mil for primer and 0.8-mil for topcoat.
 2. Colors, Textures, and Glosses: As selected by ENGINEER from manufacturer's complete selection of standard and custom colors, textures and glosses.
- E. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored backer finish, consisting of prime coat and wash coat with a total minimum dry film thickness of 0.5-mil.
- F. Protective Coating: Immediately upon completion of the metal siding and roofing finish, apply a transparent, color-coded, strippable-film coating, not less than 1.0-mil dry film thickness, suitable for protection of the finish through completion of erection, and capable of being easily hand-stripped from the surface at that time.

PART 3 - EXECUTION

3.1 INSPECTION

- A. CONTRACTOR shall examine the areas and conditions under which the metal building systems are to be erected and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

- A. Clean substrates of all substances, including grease, oil, rolling compounds, incompatible primers, and loose mill scale, that may impair bond of materials.
- B. Clean and prepare items to be finished with Site-applied coatings in compliance with Section 09900.

3.3 ERECTION

- A. Place and secure metal building systems in accordance with approved Shop Drawings, and the Contract Documents.
- B. Do not field cut, drill, or alter structural members without written approval from ENGINEER.
- C. Set structural framing in locations and to elevations indicated and according to AISC specifications. Maintain structural stability of frame during erection.
- D. Baseplates, Leveling Plates and Bearing Plates: Clean concrete and masonry

- bearing surfaces of bond-reducing materials and roughen surfaces before setting baseplates and bearing plates. Clean bottom surface of baseplates and bearing plates.
1. Set baseplates and bearing plates for structural members on wedges, shims, or setting nuts.
 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of baseplate or bearing plate before packing with grout.
 3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - a. Comply with manufacturer's written instructions for proprietary grout materials.
- E. Align and adjust framing members before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Make adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.
- F. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.
1. Make field connections using high-strength bolts. Tighten bolts by turn-of-the-nut method.
- G. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts. Hold rigidly to a straight line by sag rods.
1. Provide rake or gable purlins with tight-fitting closure channels and fascia.
 2. Locate and space wall girts coordinated with door and window arrangements and heights.
 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Steel Joists and Joist Girders: Install joists, girders, and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Site in more than one piece.
 2. Space, adjust, and align joists accurately in location before permanently fastening.
 3. Install temporary bracing and bridging, connections, and anchors to ensure that joists are stabilized during construction.
 4. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise specified.
 - a. Comply with RCSC's recommendations for high-strength structural bolt installation and tightening requirements.
 5. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.
- I. Bracing: Install bracing in roof and sidewalls where shown. Tighten rod and cable bracing to avoid sag.
- J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to building structural frame.

3.4 ROOF PANEL INSTALLATION

- A. General: Provide roof panels of full length from eave to ridge when possible. Install panels perpendicular to purlins.
1. Field cutting by torch is not permitted.
 2. Rigidly fasten eave end of roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels.
 3. Provide weatherseal under ridge cap.
 4. Flash and seal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 5. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in pre-drilled holes.
 6. Use stainless steel fasteners for exterior applications and galvanized fasteners for interior applications.
 7. Locate and space fastenings in true vertical and horizontal alignment.
 8. Install ridge caps as roof panel work proceeds.
 9. Locate panel splices over, but not attached to, structural supports. Stagger panel splices to avoid a four-panel lap splice condition.
- B. Standing Seam Roof Panels: Fasten roof panels to purlins with concealed clips at each standing seam joint. Install clips over top of insulation at location and spacing shown on approved Shop Drawings.
1. Install clips to supports with self-drilling fasteners.

2. Crimp standing seams with manufacturer-approved motorized seamer tool so clip, panel, and factory-applied side-lap sealant are completely engaged.
3. At panel splices, nest panels with minimum 6 inch end lap, sealed with butyl sealant and fastened together by interlocking clamping plates.

3.5 WALL PANEL INSTALLATION

- A. General: Provide panels full height of building when possible. Install panels perpendicular to girts.
 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Install panels with vertical edges plumb. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 2. Unless otherwise indicated, begin panel installation at corners with center of rib lined up with line of framing.
 3. Site-cutting of wall panels with a torch is not permitted.
 4. Align bottom of wall panels and fasten with blind rivets, bolts, or self-tapping screws.
 5. Fasten flashing and trim around openings and similar elements with self-tapping screws.
 6. When two rows of panels are required, lap panels 4 inches, minimum. Locate panel splices over structural supports.
 7. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.
 8. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 9. Provide weather-resistant escutcheons for pipe and conduit penetrating exterior walls.
 10. Flash and seal wall panels with weather closures under eaves and rakes, along lower panel edges, and at perimeter of all openings.
 11. Apply elastomeric sealant continuously between metal base channel and concrete, and as required for waterproof construction. Handle and apply sealant and backup according to sealant manufacturer's written instructions.
 12. Use stainless steel fasteners for exterior applications and galvanized fasteners for interior applications.
 13. Locate and space fastenings in true vertical and horizontal alignment.
- B. Factory-Assembled, Insulated Panels: Install wall panels on exterior side of girts. Attach panels to supports at each panel joint with concealed clip and fasteners at maximum 42 inches on centers, but spaced not more than as recommended by manufacturer.

3.6 TRANSLUCENT PANEL INSTALLATION

- A. Translucent Panels: Attach plastic panels to structural framing as shown on approved Shop Drawings.
 - 1. Provide end laps of not less than 6 inches and side laps of not less than 1-1/2 inch corrugations for roof panels.
 - 2. Provide end laps of not less than 4 inches and side laps of not less than 1-1/2 inch corrugations for wall panels.
 - 3. Align horizontal laps with adjacent roof and wall panels.
 - 4. Seal intermediate end laps and side laps of translucent panels with translucent mastic.

3.7 FASCIA AND SOFFIT PANEL INSTALLATION

- A. General: Provide panels full width of fascia and soffits. Install panels perpendicular to support framing.
 - 1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Install panels with vertical edges plumb. Lap ribbed or fluted panels one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 - 2. Site-cutting of fascia and soffit panels with a torch is not permitted.
 - 3. Fasten flashing and trim around openings and similar elements with self-tapping screws.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 - 5. Use stainless steel fasteners for exterior applications and galvanized fasteners for interior applications.
 - 6. Locate and space fastenings in true vertical and horizontal alignment.
- B. Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fascia meet soffits, along lower panel edges, and at perimeter of all openings.
- C. Soffit Panels: Flash and seal panels with weather closures where soffit meets walls and at perimeter of all openings.

3.8 INSULATION INSTALLATION

- A. General: Install insulation concurrently with panel installation, according to manufacturer's written instructions and as follows:
- B. Blanket Insulation: Install blankets straight and true in one-piece lengths. Comply with the following installation method:

1. Between-Purlin Installation: Extend insulation between purlins. Hold in place with bands and crossbands below insulation.
2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.9 DOOR AND FRAME INSTALLATION

- A. General: Comply with manufacturer's written instructions for installing doors, hardware, operators, and other door components. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant as specified in Section 07920.
- B. Personnel Doors and Frames: Install doors and frames straight, level, and plumb. Securely anchor frames to building structure. Set units with maximum 1/8-inch clearance between door and frame at jambs and head and maximum 3/4-inch clearance between door and floor.
- C. Comply with requirements in Section 08120, Aluminum Doors and Frames
- D. Finish Hardware: Install finish hardware as specified in Section 08710.

3.10 AUXILIARY SYSTEM COMPONENTS AND ACCESSORY INSTALLATION

- A. General: Install gutters, downspouts, ventilators, louvers, and other accessories according to manufacturer's written instructions, with positive anchorage to building and weathertight mounting. Coordinate installation with flashings and other components.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3. Pipe Flashing: Form flashing around pipe penetration and roof panels. Fasten and seal to roof panel as recommended by manufacturer.
 4. Dissimilar Materials: Separate metal from incompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet on centers using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches on centers in between.
1. Provide elbow at base of downspout to direct water away from building.

3.11 SITE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform Site quality control testing.
- B. Extent and Testing Methodology: Testing and verification procedures will be required of high-strength bolted connections.
1. Bolted connections will be visually inspected.
 2. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A325 or A490 Bolts."
- C. Testing agency will report test results promptly and in writing to CONTRACTOR and ENGINEER.

3.12 ADJUSTING, CLEANING AND PROTECTION

- A. Doors: After completing installation, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion.
- B. Touchup Painting: Immediately after erection, clean, prepare, and prime or reprime welds, bolted connections, and abraded surfaces of prime-painted primary and secondary framing, accessories, and bearing plates, as specified in Section 09900.
- C. Roof and Wall Panels: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

1. Replace panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

+ + END OF SECTION + +

SECTION 13123

PRE-ENGINEERED SHELTER

PART 1: GENERAL

1.1 SUMMARY

- A. The work shall include furnishing the sealed architectural and structural plan sets as well as the structural building components as a complete, pre-designed packaged shelter as specified herein.

1.2 SCOPE

- A. Packaged shelter and all associated design and engineering, with all listed components supplied by the building supplier. The building supplier shall be a single source design, engineering, and manufacturer who shall supply the packaged shelter and meet all the following scope requirements.
- B. The Contractor is responsible for building installation, hereafter designated as the building installer. Building installer work will generally include: site preparation and grading, excavations for structures, backfill and/or structural backfill, foundation and pad installation, and building installation.
- C. The packaged shelter should be the latest standard product of a building supplier regularly engaged and having at least ten (10) years of experience in packaged shelter engineering, design, supply, and installation.
- D. The building supplier must meet or exceed the product specification.
- E. Alternate building suppliers shall demonstrate that they have designed, engineered, produced, delivered, and constructed at minimum ten (10) other functioning site-built shelters of similar type. Project completion date and a reference contact from the owner of each project must be provided.
- F. Alternate building suppliers must also disclose all instances of any prior municipal or engineer's rejection of the same or similar product as an "or equal" to the specified basis of design building package.
- G. The building and its concrete footings, foundation, and slab are to be engineered by the building supplier to meet site specific conditions including wind and snow loading, local frost depth, and ground conditions.
- H. Footings are to be dug by the building installer and poured on site to meet local code for permanent structures.

- I. Typical fasteners such as nails, staples, and screws shall be supplied by building installer. Atypical fasteners shall be supplied by building supplier.
- J. Building is to be designed and constructed on site to meet local codes and approvals for permanent structures. Any building that is temporary, permanently relocatable, prefabricated modular, an offsite constructed product, or pre-cast is not an accepted equal to permanent, on site, conventional installation.
- K. No outside entity approval will override the local building authority's codes and inspections. Seals meant for modular homes and production plant certifications will not be allowed in lieu of sealed plans from a licensed Professional Engineer and conventional inspection during installation.
- L. Building treatments, and roofing are to be as specified.
- M. The building supplier shall submit the packaged shelter preliminary Submittal, including the plan set drawings with all footings, foundations, slab, and structural details.
- N. The Submittal is reviewed by the necessary parties and returned to the building supplier with any revisions to the contractual language, product data sheets, and/or plan set drawings. The drawings shall be of sufficient detail for the Engineer(s) to review for conformity to the contract.
- O. The building supplier shall submit complete, code compliant building plans including plans, elevations, sections, and details.
- P. The building supplier shall submit complete structural calculations meeting code loads, design loads, and seismic design under seal of a licensed Professional Engineer with current license in the state where the project is located.
- Q. Once submittal approval is received, three (3) stamped sets of plans and structural calculations shall be issued.
- R. The building supplier does not provide a final site plan.
- S. The reviewing authority reserves the right to review or reject all submittals at their sole discretion.
- T. All work and materials shall comply with the latest industry building codes and regulations for the state where the project is located.
- U. The specific supplier is indicated for each item. Building supplier, building installer, and Owner supplied components are listed as such. Products not listed as building supplier or building installer supplied, are to be building installer supplied.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for pre-engineered structures.
- B. Shop Drawings: For pre-engineered structures; include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For pre-engineered structures with factory-applied color finishes.
- D. Samples for Verification: For exposed finishes, in manufacturer's standard sizes.
- E. Delegated-Design Submittal: For pre-engineered structures indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
 - 1. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - b. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - c. AWS D1.3, "Structural Welding Code - Sheet Steel."
- B. Warranty: Sample of special warranty.
- C. Preinstallation Conference: Conduct conference at Project site.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pre-engineered structures to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate installation of anchorages for pre-engineered structures. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in concrete. Deliver such items to Project site in time for installation.

1.7 WARRANTY

- A. The building and all its associated components shall be warranted against defects in materials and workmanship for a period of not less than one (1) year from date of final acceptance.

1.8 MAINTENANCE

- A. The building supplier does not supply maintenance for the packaged shelter.

PART 2: PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Romtec, Inc., Roseburg, OR.
- B. RCP Shelters, Inc., Stuart, FL.
- C. Polygon, by PorterCorp, Holland, MI.
- D. Or Equal.

2.2 SHELTER DESCRIPTION

- A. Refer to this specification for quantities, dimensions, locations, and installation methods for the materials and items described in this section.
- B. Shelter dimensions: Verify and coordinate dimensions with foundations shown in Contract Drawings.
 - 1. Size – Length x Width (centerline of column dimensions): 15- long by 10-feet wide by 12-feet high.
 - 2. Size – Height to the bottom of roof eave (clear height): 12-feet high.

2.3 STRUCTURE

- A. Steel 4-post shelter shall be supplied by building supplier.
 - 1. Steel truss with 4" x 4" or 6" x 6" steel columns as required to support the loads.
 - 2. Steel components to be powder coated gray.
 - 3. Entire roof structure will be pre-fabricated, delivered and installed as a single unit with structural pick points for installation and removal by a crane.
 - 4. Roof structure will be a gable shaped roof.

2.4 ROOFING

- A. Roof shall be supplied by building supplier except where noted.
 - 1. Roofing shall be Fabral, 29-gauge GrandRib3 roof panels with exposed fasteners. Roofing package shall include inside and outside foam closures, matching trim (eaves, gables and ridge) and fasteners, sheet metal flashing (all sides), and 30# felt (under metal).
 - 2. Roofing color to be selected by the Engineer from the manufacturer's standard or custom color chart.

PART 3 - BUILDING INSTALLER AND/OR OWNER SUPPLIED PRODUCTS

3.1 CAST IN-PLACE CONCRETE

- A. All equipment, labor, trades and materials shall be supplied by *building installer*.
 - 1. Includes all materials and labor for foundations/footings, interior slabs, exterior/entry slabs, and sidewalks.
- B. Engineered fill shall be 3/4" minus crushed aggregate around footings, foundations, and slabs as required.
- C. Slab vapor barrier shall be 6-mil continuous plastic under the concrete slab.
- D. The foundation shall be installed as designed with all cast in-place concrete poured to dimensions specified in final plans.
 - 1. Footings will be built to 24" depth.
 - 2. Minimum compressive strength of 3,000 psi at 28 days, 4+/-1" slump, with max 3/4" aggregate, cured in accordance with ACI 308.
 - 3. Slabs shall have a fine broom finish with joints required in flat work as shown on plans.
 - 4. Steel rebar shall be installed as specified in final plans.
- E. Concrete slab sealer shall be a water-based transparent curing, sealing and dust proofing compound with two (2) coats to be applied per manufacturer's instructions.
- F. Refer to drawings for sidewalks and entry slabs.
 - 1. Minimum concrete compressive strength of 2500 psi at 28 days.
 - 2. Remesh or rebar reinforcement shall be used in sidewalks.
 - 3. All sidewalks shall be finished with a fine broom with control joints installed per specification.

3.2 OTHER MATERIALS & EQUIPMENT

- A. Unless otherwise specified, the following products and materials are NOT supplied by building supplier.
 - 1. All items not listed in building supplier products.
 - 2. Any item listed as supplied by "installer", "Contractor", "Owner", or "others".
- B. Unless specified in the plans or submittals, building supplier does not supply the following:
 - 1. Building installation
 - 2. Asphalt paving
 - 3. Sidewalks
 - 4. Landscaping
 - 5. Site grading
 - 6. Cast-in-place concrete foundations, footings, interior slabs and exterior/entry slabs

7. Concrete slab sealer
8. Rebar
9. Typical fasteners; for example roofing nails, staples, etc.
10. Fasteners not included in product packaging
11. Gutters and downspouts
12. All other items indicated on final plans or required by building codes which are not specifically stated as supplied by building supplier.

PART 4 – EXECUTION

4.1 SPECIAL INSPECTION

- A. If required, special inspection shall be Owner supplied.
- B. If special inspection is required per the building department or other regulatory agencies, then the building supplier can assist but NOT provide this service.

4.2 INSTALLATION

- A. All components to be installed according to the plan sets and/or manufacturer's instructions.

4.3 OPERATION & MAINTENANCE MANUALS

- A. Upon installation, do not throw away the Operations & Maintenance manuals that are provided by some manufacturers in their packaging. Requests for additional copies from the *building supplier* will result in subsequent charges.

++ END OF SECTION ++

SECTION 13401

PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, calibrate, test, start-up and place in satisfactory operation a complete Process Control System (PCS) at the Long Beach Consolidation Pump Station (LBPS).
2. Contractor shall procure the services of a single Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, except for those services and materials specifically noted, required to achieve a fully integrated and operational PCS at the LBPS as specified herein and in other Specification Sections listed below.
3. The names South Shore Water Reclamation Facility (South Shore WRF) and Bay Park Sewage Treatment Plant (Bay Park STP) refer to the same location and are used indistinctively through the specifications.
4. The process instrumentation and control work includes the following major equipment and services:
 - a. Long Beach Consolidation Pump Station Main Control Panel (LBP_MCP), Long Beach Temporary Bypass Pump Station Control Panel (LBP_BCP), Remote Level Indicating Panel (LBP_LIP) and panel mounted instruments as specified herein.
 - b. Field-mounted instruments and devices. Including but not limited to narrow beam radars, floats, indicators and magnetic flowmeters, pressure gauges, etc.
 - c. Programmable Logic Controllers (PLC) and licensed software.
 - d. Operator Interface Terminals (OIT) and licensed software.
 - e. The PCSS shall be responsible for:
 1. Programming and configuration of the cellular radio, managed Ethernet switches at the LBPS.
 2. Programming and configuration of the existing Verizon MPN gateways as needed.
 3. Establishing a secure connection from the LBPS cellular modem to the South Shore WRF through the existing Verizon Wireless MPN.
 4. Establishing a secure connection from the LBPS cellular modem to the Cedar Creek Water Pollution Control Plant through the existing Verizon Wireless MPN.

5. Coordinating site IP addresses with Owner.
 6. Testing of communications link through the Mobile Private Network (MPN) between LBPS and the South Shore WRF plant-wide SCADA system, and between LBPS and the Cedar Creek Water Pollution Control Plant.
 7. Coordination with City of Long Beach and Client for proper configuration of the autodialer specified in 13440, Panel Mounted Instruments and Devices (Alarms to be notified, Telephone numbers to call, instant messages and email addresses of points of contact).
5. Items specifically excluded from the PCSS's scope of work include the following:
- a. Configuration of the existing Cimplicity SCADA System Human Machine Interface (HMI) software at the South Shore WRF to integrate LBPS into the existing Plant Wide SCADA network. HMI software configuration, database development, historical data collection, report development, and startup/training activities associated with the configured portions of the HMI system. These services shall be supplied by the Owner's Application Engineer (OAE) under a separate contract.
 - b. Configuration of the existing Proficy Historian SCADA software at the South Shore WRF to store all alarms and analog signals generated in LBPS. These services shall be supplied by OAE under a separate contract.
 - d. PLC programming, testing of PLC logic, and startup/training activities associated with programmed portions of the PLC. These services shall be supplied by OAE under a separate contract.
 - e. OIT graphics development, OIT software configuration, database development, and startup/training activities associated with the configured portions of the HMI system. These services shall be supplied by the OAE under a separate contract.
6. Input/Output (I/O) list:
- a. The I/O list in Section 13480, Input – Output Point List, identifies inputs and outputs required for the PCS. The I/O list is for coordinating signals between equipment provided by PCSS and other Suppliers, for coordinating termination points with the Electrical contractor, and identifying signals to be programmed by OAE.
 - b. Due to variations in vendor supplied equipment, PCSS shall provide Work for vendor-furnished control options not on the input/output list at no additional cost to the Owner.
7. Start-up and Field Testing Services:
- a. The Contractor shall comply with the requirements of this Section, Section 13403 (Process Control System Start-up and Field Testing), Section 01650 (Starting of Systems), Section 01700 (Maintenance of Plant Operations), and Section 01700a (Schedule of Shutdowns Maintenance of Plant Operations)

- b. The Contractor shall provide all materials, equipment, labor and services required for each project phase at no additional cost to the Owner.
 - c. The Contractor shall provide services of equipment manufacturers and vendors and PCSS at each phase at no additional cost to the Owner. Services of equipment manufacturers and vendors and PCSS shall include on-site services as specified.
- B. PCS shall monitor, store, display, and log process and equipment operating information; perform various process control functions; and generate various reports.
- C. The Contract Documents describe the required PCS functions and operational requirements.
- D. Coordination:
 - 1. Process Controls:
 - a. Some panels and equipment are furnished under other Specification Sections under this Contract. Coordinate with Suppliers of these panels and equipment to provide fully functional system in accordance with the Contract Documents and that interfaces with central computer system.
 - b. Turn over all software packages specified in Section 13451, Programmable Logic Controllers Hardware and Software, to the OAE no later than 30 days after submittal approval. It is required for configuration of the OIT and PLC.
 - c. Any software purchased for this project under Division 13 by the PCSS must be registered to the Owner at the time of purchase.
 - 2. To centralize responsibility, Instrumentation and Control (I&C) materials and equipment provided under this Contract shall be furnished by PCSS.
 - 3. The Contractor and PCSS shall assume the responsibility for adequacy and performance of materials and equipment provided under this Section.
 - 4. To the greatest extent possible, provide I&C materials and equipment from a single manufacturer.
 - 5. PCSS Responsibilities:
 - a. Preparing all process control equipment submittals in accordance with the Contract Documents.
 - b. Proper interfacing of instrumentation and control equipment with field equipment, instruments, devices, and panels, including required interfacing with packaged control systems furnished by other equipment Suppliers, and required interfacing with the Site's electrical system.
 - c. Review and coordination with manufacturers, other Suppliers, and other contracts of Shop Drawings and other Contractor submittals for equipment, valves, piping, and appurtenances for ensuring proper interfacing of hardware, and locations and installation requirements of inline devices and instrument taps.

- d. Direct, detailed oversight of installation of instruments, panels, consoles, cabinets, wiring and other components, and related wiring and piping connections.
- e. Calibrating, source quality control, field quality control, and start-up of the system.
- f. Coordinate with OAE the times to develop, test, troubleshoot, and train the Owner's personnel on the PLC and OIT systems. The coordination of PCSS and OAE shall be addressed during regular Contractor coordination meetings.
- g. Responsibility for correction period obligations for the PCS.
- h. Training operations and maintenance personnel in operation and maintenance (including calibration and troubleshooting) of the PCS.

F. Related Sections:

- 1. Section 13402, Process Control System Factory Testing.
- 2. Section 13403, Process Control System Start-up and Field Testing.
- 3. Section 13404, Process Control System Training.
- 4. Section 13420, Primary Sensors and Field Instruments.
- 5. Section 13430, Process Control Panels and Enclosures.
- 6. Section 13440, Panel Mounted Instruments and Devices.
- 7. Section 13451, Programmable Logic Controller Hardware and Software.
- 8. Section 13480, Input Output Point List.
- 9. Section 13491, Process Control Descriptions.
- 10. Division 16.

1.2 REFERENCES

A. Standards referenced in this Section are:

- 1. ANSI/ASQ Z1.4, Sampling Procedures and Tables For Inspection By Attributes.
- 2. ASTM A269, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- 3. ASTM A312, Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- 4. ASTM A403, Specification for Wrought Austenitic Stainless Steel Piping Fittings.
- 5. IEEE 802.1X, Port Based Network Access Control.
- 6. IEEE 802.3, Standards Defining Physical Layer and Data Link Layer Media Access Control (MAC) Sublayer of Wired Ethernet
- 7. ISA 5.1, Instrumentation Symbols and Identification.
- 8. ISA 5.4, Instrument Loop Diagrams.
- 9. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 10. NFPA 70 (NEC), Article 770, Optical Fiber Cables and Raceways.
- 11. NFPA 79, Electrical Standard for Industrial Machinery.

12. UL 50, Safety Enclosures for Electrical Equipment, Non-Environmental Considerations.
13. UL 508A, Industrial Control Panels.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. PCSS:
 - a. Shall be financially sound with at least five years of continuous experience in designing, implementing, supplying, and supporting process control systems for municipal wastewater treatment facilities comparable to PCS required for the Project, relative to hardware, software, cost, and complexity.
 - b. Shall have record of successful process control system equipment installations. Upon Engineer's request, submit record of experience for at least five projects, each with the following information: project name, owner name and contact information, name and contact information for contractor, name and contact information for engineer or architect, approximate and contract value of process control systems Work for which Supplier was responsible.
 - c. Shall have at time of Bid experienced engineering and technical staff capable of designing, supplying, implementing, and supporting the instrument and control system and complying with submittal and training requirements of the Contract Documents.
 - d. Shall be capable of training operations and maintenance personnel in PCS applications, and in operating, programming, and maintaining the control system and equipment.
 - e. Shall have UL-approved panel shop.
 - f. Possess a thorough, working knowledge of wastewater treatment processes and control philosophy in accordance with standard practices of the wastewater treatment industry.
 - g. Possess and maintain a documented program of failure analysis.
2. Manufacturers:
 - a. Manufacturers of instrumentation and control equipment furnished for the PCS shall be experienced producing similar equipment and shall have the following qualifications:
 - 1) Shall manufacture instrumentation and control system components that are fully-developed, field-proven, and of standardized designs.
 - 2) Shall have system of traceability of manufactured unit through production and testing in accordance with ANSI/ASQ Z1.4.
 - 3) Shall have guaranteed availability clause (99.99 percent, minimum for one year) for microprocessor-based components and appurtenances.

- 4) Shall have documented product safety policy relevant to materials and equipment proposed for the Work.
 3. Although several entities are involved to provide sub-systems as specified and shown, the CONTRACTOR shall be ultimately responsible for all the Work specified in this section. The CONTRACTOR shall be responsible for coordination of submittals, work and testing between the different entities and as described herein.
 4. Acceptable Process Control Systems Suppliers:
 - a. Select one of the following (list is in alphabetic order):
 - 1) Aaron Associates of Connecticut, Inc.
 - 2) A. K. De Rama Industrial Control Systems.
 - 3) NIC Systems Corporation.
 - 4) Optimum Controls Corporation (OCC).
 - 5) PCS Systems Integrators.
 - 6) Or approved equal.
- B. Component Supply and Compatibility:
1. PCS components shall be furnished by a PCSS who shall have responsibility for furnishing a complete and integrated system.
 2. PCSS shall have responsibility for adequacy and performance of all items furnished.
 3. PCSS shall prepare, review and approve, all Shop Drawings and other submittals for the PCS.
- C. Pre-submittal Conference
1. Schedule and conduct pre-submittal conference for instrumentation and control system within 15 days after acceptance of I&C Subcontractor by OWNER.
 2. Required attendance for pre-submittal conference: Contractor, PCSS, Engineer, and OWNER. Pre-submittal conference will be 2 hours. Conference will be held at South Shore WRF unless otherwise acceptable to the entities attending.
 3. Purpose of pre-submittal conference is to review manner in which I&C Subcontractor and PCSS intend to comply with requirements of the Contract Documents relative to PCS submittals before submittals are prepared.
 4. Bring to pre-submittal conference list of proposed personnel committed to assignment to the Project. List shall include PCSS project manager, project engineer, field representative, local service representative, and sales representative(s). Indicate addresses of personnel not based at Subcontractor's and Supplier's office nearest to the Site.
 5. Prepare items listed below for presentation at pre-submittal conference. Submit information to Engineer two weeks prior to pre-submittal conference.
 - a. List of major materials and equipment required for PCS, and manufacturer and model proposed for each item.

- b. List of currently-known requests for interpretations of which Contractor and PCSS are currently aware.
- c. List of proposed exceptions to the Contract Documents along with brief explanation of each.
- d. Proposed PCS network architecture diagram.
- e. Sample of each type of process control submittal required by the Contract Documents. These may be submittals prepared for other projects.
- f. Flow chart showing steps to be taken in preparing and coordinating PCS submittals.
- g. General outline of types of tests to be performed to verify that all sensors and transducers, instruments, and digital processing equipment are functioning properly.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Field Instruments:

- 1) Manufacturer's product name and complete model number of devices proposed for use, including manufacturer's name and address.
- 2) Instrument tag number in accordance with the Contract Documents.
- 3) Data sheets and manufacturer's catalog literature. Provide data sheets in accordance with ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets using a format similar to ISA 20.
- 4) Description of construction features.
- 5) Performance and operation data.
- 6) Installation, mounting, and calibration details; instructions and recommendations.
- 7) Service requirements.
- 8) Dimensions of instruments and details of mating flanges and locations of closed tanks, pipe sizes for insertion instruments, and upstream/downstream straight run pipe lengths required.
- 9) Range of each device and calibration information
- 10) Descriptions of materials of construction and listing of NEMA ratings for equipment

b. Panels, Consoles, and Cabinets:

1) Layout drawings that include:

- a) Front, rear, and internal panel views to scale.
- b) Tag number and functional name of components mounted in and on panel, console, or cabinet, as applicable.
- c) Product information on panel components.

- d) Nameplate location and legend including text, letter size and colors to be used.
 - e) Location of anchorage connections.
 - f) Location of external wiring and piping connections.
 - g) Mounting and installation details, coordinated with actual application.
 - h) Proposed layouts and sizes of operator interface graphic display panels and alarm annunciator panels.
 - i) Calculations for heating and cooling of panels
 - j) Subpanel layouts and mounting details for items located inside control panels.
- 2. Product information on panel components including:
 - a) Manufacturer's product name and complete model number of devices being provided, including manufacturer's name and address.
 - b) Instrument tag number in accordance with the Contract Documents.
 - c) Data sheets and catalog literature. Submit data sheets as shown in ISA 20 and annotated for features proposed for use. For instruments not included in ISA 20, submit data sheets with format similar to ISA 20.
 - d) Description of construction features and dimensions.
 - e) Performance and operation data.
 - f) Installation, mounting, and calibration details; instructions and recommendations.
 - g) Service requirements
- 3. Wiring and piping diagrams, including the following:
 - a) Name of each panel, console, or cabinet.
 - b) Wire sizes and types.
 - c) Pipe sizes and types.
 - d) Terminal strip and terminal numbers.
 - e) Wire color coding.
 - f) Functional name and manufacturer's designation for components to which wiring and piping are connected.
 - g) Lightning and surge protection grounding.
- 4. Electrical control schematics in accordance with NFPA 79. Drawings shall be in accordance with convention indicated in Annex D of the NFPA 79. Typical wiring diagrams that do not accurately reflect actual wiring to be furnished are unacceptable. Tables or charts for describing wire numbers are unacceptable.
- 5. Stock list or bill of materials for each panel including tag number, functional name, manufacturer's name, model number and quantity for components mounted in or on the panel or enclosure.
- 6. Detail showing anchorage plan of wire bundles between subpanels and front panel mounted devices.
- 7. Field wiring and piping diagrams, include the following:
 - a) Wire and pipe sizes and types.
 - b) Terminal numbers at field devices and in panels.

- c) Fiber optic termination designations in the field and in panels.
 - d) Color coding.
 - e) Conduit numbers in which wiring will be located.
 - f) Locations, functional names, and manufacturer's designations of items to which wiring or piping are connected.
8. Process Control System:
- a) Submit the following general information:
 - 1) Detailed block diagram showing system hardware configuration and identifying model numbers of system components.
 - 2) Software listings for operating system, applications, and OIT.
 - 3) Software language and organization.
 - 4) OIT interfacing details, licensing structure, and included functions.
 - 5) Control and failure modes.
 - 6) Online and offline capabilities for programming, system utilities, and diagnostics.
 - 7) Input/Output Information:
 - a) Input/output (I/O) point listing with I/O module cross-reference identification.
 - b) I/O module cross-reference identification based on I/O address list developed by I&C Subcontractor .
 - c) Database listing, including all I/O points.
 - 8) Hardware:
 - a) Layout drawings showing front, rear, end and plan views to scale of equipment, I/O components, power supplies, and peripheral devices.
 - b) Equipment ventilation requirements.
 - c) Interconnection diagrams, including termination details, cable identification list, and cable length.
 - d) Drawings showing equipment layout.
 - e) Installation requirements, instructions, and recommendations.
 - 9) Software:
 - a) Licensing agreement with name of licensee, renewal requirements, release and versions, expiration dates (if any) and upcoming releases scheduled before Project completion. When upcoming releases are expected, provide descriptions, when available, of features that differ from the proposed release.
 - b) Standard technical and instructional documentation covering software for utility, system support, system documentation, display, communications, data logging and storage and diagnostic functions. Submit this information on electronic media.
 - c) Standard technical documentation covering all aspects of the computer system software functions and capabilities, including instruction set description and programming procedures related to monitoring, display, logging, reporting and alarming functions.

- d) Documentation describing memory type, size and structure and listing size of system memory, I/O and Data Table memory and size of memory available for control programs.
- 10) System I/O Loop Wiring Diagrams: Prepare Shop Drawings on a module-by-module basis based on Input/Output list and include the following information:
- a) Rack numbers, module type and slot number, and module terminal point numbers. Include location and identification of intermediate panel and field terminal blocks and terminal numbers to which I/O wiring and power supply wiring is connected. Identify power supply circuits with designation numbers and ratings.
 - b) Wiring types, wire numbers, and color coding.
 - c) Designation of conduits in which field I/O wiring will be installed.
 - d) Location, functional name, tag numbers and manufacturer's module numbers of panel and field devices and instruments to which I/O wiring will be connected.
 - e) Prepare loop wiring diagrams in accordance with ISA 5.4.
11. Complete point-to-point interconnection wiring diagrams of field wiring associated with the system. Diagrams shall include the following:
- a) Field wiring between each equipment item, panel, instruments, and other devices, and wiring to control stations, panelboards, and motor starters. Some of this equipment may be specified in other Divisions, Contractor is responsible for providing complete point-to-point interconnection wiring diagrams for control and monitoring of that equipment.
 - b) Numbered terminal block and terminal identification for each wire termination.
 - c) Identification of assigned wire numbers for interconnections. Assign each wire a unique number.
 - d) Schedule showing the wiring numbers and the conduit number in which the numbered wire is installed.
 - e) Junction and pull boxes through which wiring will be routed.
 - f) Identification of equipment in accordance with the Contract Documents.
12. Product Data:
- a) Product data for panels, consoles, and cabinets in accordance with requirements for Shop Drawings in this Section.
 - b) Product data for field wiring and piping provided for instrumentation and control service and not included under other Sections or contracts.

- c) Product data for PCS, including software and hardware. Requirements for software product data are included in requirements for Shop Drawings under this Section.

13. Factory Acceptance Test Procedure: Submit factory testing procedures that will be performed to fulfill requirements of the Contract Documents. Test procedure shall include the following:

- a) Visual inspection of components and assembly.
- b) Description of hardware operational testing.
- c) Description of software demonstration.
- d) Description of testing equipment to be used.
- e) Sign-off sheets to be used at time of testing.

B. Informational Submittals: Submit the following:

1. Documents to be submitted prior to pre-submittal conference, in accordance with Article 1.3 of this specification.
2. Manufacturer's Instructions:
 - a. Shipping, handling, storage, installation, and start-up instructions.
 - b. Templates for anchorage devices for materials and equipment that will be anchored to concrete or masonry.
3. Source Quality Control Submittals:
 - a. Results of factory testing.
4. Special Procedure Submittals:
 - a. Notification to OWNER and Engineer at least 14 days before readiness to begin system checkout at the Site. Schedule system checkout on dates acceptable to OWNER and Engineer.
 - b. Written procedure for system checkout. Submit not less than 90 days prior to starting system checkout.
 - c. Ninety days prior to starting system checkout submit written procedure for start-up.
5. Field Quality Control Submittals:
 - a. Submit the following prior to commencing system checkout and start-up.
 - 1) Completed calibration sheets for each installed instrument showing five-point calibration (zero, 25, 50, 75, 100 percent of span), signed by factory-authorized serviceman.
 - b. Field calibration reports
 - c. Field testing reports.
6. Supplier's Reports:
 - a. Installation inspection and check-out report.
 - b. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
7. Qualifications Statements:

- a. PCSS.
- b. Manufacturers, when required by Engineer.

C. Closeout Submittals: Submit the following:

- 1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01730, Operation and Maintenance Data.
 - b. Include complete up-to-date system software documentation. Provide hardcopy and electronic copies.
 - c. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.
- 2. Record Documentation:
 - a. Prepare and submit record documents in accordance with Section 01720, Project Record Documents.
 - b. Revise all system Shop Drawing submittals to reflect as-built conditions in accordance with the following.
 - 1) Two copies of each revised Shop Drawings and documentation to replace outdated drawings and documentation contained in operation and maintenance manuals. Submit half-size black line drawings for each drawing larger than 11 inches by 17 inches. Include specific instructions for outdated drawing removal and replacement with record documents submittal.
 - 2) Half-size black line prints of wiring diagrams applicable to each control panel shall be placed in clear plastic envelopes and stored in a suitable print pocket or container inside each control panel.
 - 3) Submit CADD drawings of the point-to-point interconnection wiring diagrams updated to reflect final as-built equipment information and as-installed field installation information.

D. Maintenance Materials Submittals: Submit the following:

- 1. Spare Parts and Test Equipment
 - a. General
 - 1) Furnish the spare parts and test equipment as indicated below, identical to and interchangeable with similar equipment provided under this Section.
 - 2) Provide source quality control for spare parts as part of factory testing prior to shipment of control equipment.
 - 3) For process sensors and other analog instruments, Supplier shall submit a separate quotation for recommended list of spare parts and test equipment. Separately list and price each item recommended. Spare parts quotation shall include a statement that prices quoted are valid for a period of one year from date of equipment installation and that Supplier

understands that OWNER reserves the right to purchase none, any, or all parts quoted. Upon request, Supplier shall submit documentation that stock of spare parts and test equipment is obtainable within 48 hours of receipt of OWNER's order.

- b. Furnish the following spare parts:
 - 1) Five of each type of relay for each quantity of forty or fraction thereof provided under the Contract.
 - 2) One of each type of PLC communication cables.
 - 3) Two of each type of PLC processors.
 - 4) One of each type of Communication module.
 - 5) One of each type of redundant module and accessories.
 - 6) Two of each type of PLC input/output module or card used with accessories.
 - 7) Two of each type of PLC power supply.
 - 8) One of each type of PLC chassis.
 - 9) One of each type of OIT.
 - 10) Two replacement 24 vdc power supply for each type and size provided under the Contract.
 - 11) One-year supply of all expendable or consumable materials.
 - 12) Twelve of each type and size of fuse used in instruments.
 - 13) One of each type of cellular modem provided. Spare cellular modem shall be preconfigured and tested for communications through the Mobile Private Network to the wastewater treatment plants.
 - 14) One of each Pressure Gauge and Pressure Switch assembly with inline diaphragm seal provided.
 - 15) One of each Pressure Transmitter provided.
 - 16) One of each Level Switch provided.
 - 17) One of each Level Transducer provided.
- c. Furnish the following test equipment:
 - 1) One Fluke or equal (latest in series) digital Process meter with signal simulators (four to 20 mA DC; zero to ten VDC), test leads, case, and other recommended spares and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prior to packaging, each manufacturer or Supplier shall securely attach tag number and instructions for proper field handling and installation to each instrument.

PART 2 – PRODUCTS

2.1 PCS – GENERAL PROVISIONS FOR PRODUCTS

Long Beach WPCP Consolidation
Pump Station Conversion

13401-13

A. General:

1. All electrically powered equipment and devices shall be suitable for operation on 115 volt, ± 10 percent, 60 Hz, ± 2 Hz power. If a different voltage or closer regulation is required, a suitable regulator or transformer shall be provided at no additional cost to the Owner.
2. Provide appropriate power supplies for all two-wire transmitters, loops for monitoring discrete inputs and necessary outputs, and any field instrument requiring a power source less than 115 volts. Install power supplies mounted in enclosures, and install in appropriate control room or field panel.
3. Power supplies shall be suitable for minimum of 130 percent of the maximum simultaneous current draw.
4. Provide power on-off switch or air circuit breaker for each item requiring electrical power.
5. Provide isolation transformers, line voltage regulators and power distribution panels for the distributed digital portions of the PCS to eliminate electrical noise and/or transients entering on the primary power line.
6. Unless otherwise shown or indicated in the Contract Documents, control system shall be furnished to use 4 to 20 mA DC analog signals.
7. Provide signal converters and repeaters where required. Analog inputs to distributed control system shall be through appropriate repeaters to provide signal isolation where series-looped with other devices and to allow loop to maintain integrity even when distributed control system is out of service. Power supplies shall be adequate for signal converter and repeater loads.
8. Signals shall be isolated from ground.
9. Signals shall not have a transient DC voltage exceeding 300 volts over one millisecond nor a DC component over 300 volts.
10. PCS and associated input/output wiring will be used in a facility environment where there can be high-energy AC fields, DC control pulses, and varying ground potentials between the sensors/transducers or input contact locations and PCS components. PCS shall be adequate to provide proper protection against interferences from all such possible situations.
11. Instrumentation and PCS components shall be heavy-duty types, suitable for continuous service in a municipal wastewater treatment plant environment. Furnish products that are currently in production at the time products are shipped from the factory. All equipment furnished shall be of modular construction and be capable of field expansion through installation of plug-in circuit cards and additional cabinets as necessary. Logic and control loops shall be fail-safe.
12. Instrumentation and other PCS components shall return automatically to accurate measurement within 15 seconds upon restoration of power after a power failure, and when transferred to standby power supply.
13. Provide surge protection for instruments and all other PCS components that could be damaged by electrical surges.

14. Field-mounted instruments and PCS components shall be suitable for installation in humid and corrosive service conditions. Field-mounted instrument enclosures, junction boxes, and appurtenances shall comply with NEMA 4X requirements, unless otherwise shown or specified.
15. Relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are unacceptable.
16. Panel mounted instruments, switches, and other devices shall be selected and arranged to present a pleasing coordinated appearance. Front-of-panel-mounted devices shall be of the same manufacturer and model line.
17. All components furnished, including field-mounted and rear-of-panel instruments, shall be tagged with the item number and nomenclature as shown and the instrument index in the Contract Documents or, as applicable, the "data sheets" that are part of the Contract Documents.
18. Ranges and scales specified in the Contract Documents shall be coordinated to suit equipment actually furnished. Range, scale, and set point values specified in other Sections of Division 13 are for initial setting and configuration. Coordinate specified values with actual equipment furnished to implement proper and stable process action as systems are placed in operation.
19. Field-mounted devices shall be treated with an anti-fungus spray.
20. Field-mounted devices shall be protected from exposure to freezing temperatures.

B. Environmental Conditions:

1. PCS and its components shall be designed and constructed for continuous operation under the following temperature and humidity conditions:
 - a. Equipment and Devices Installed in Control Rooms:
 - 1) Ambient Temperature: 60 degrees F to 80 degrees F normal range; and 40 degrees F to 105 degrees F occasional maximum extremes.
 - 2) Relative Humidity: 80 percent, normal; 95 percent maximum.
 - b. Equipment and devices installed at indoor locations (other than control rooms) for digital processing equipment hardware, control panels, and instruments:
 - 1) Ambient Temperature: 40 degrees F to 120 degrees F.
 - 2) Relative Humidity: 98 percent maximum.
 - c. Equipment and Devices Installed Outdoors:
 - 1) Ambient Temperature: -10 degrees F to 120 degrees F.
 - 2) Relative Humidity: 100 percent maximum.

- C. Refer to Sections 13401 through 13491 for product requirements for materials and equipment that are part of the PCS.

PART 3 – EXECUTION

3.1 PCS – GENERAL PROVISIONS FOR EXECUTION

- A. Refer to Sections 13401 through 13491 for execution requirements for the PCS.

+ + END OF SECTION + +

SECTION 13402

PROCESS CONTROL SYSTEM FACTORY TESTING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

1. Contractor shall provide all labor, materials, equipment, and incidentals as specified and required for factory testing at the process control system manufacturer's facility to verify that system components function properly and comply with the functional and performance requirements of the Contract Documents.
2. As part of the requirements of this specification section, it is the responsibility of the Contractor to provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section.
3. Process Control System (PCS) Factory Testing shall include all hardware provided by Process Control System Supplier (PCSS), PLC programs and configured Human Machine Interface (HMI) software programmed by Owner's Application Engineer (OAE). Vendor furnished hardware shall not be included in the PCS Factory Testing. Contractor shall be responsible for resolving all hardware issues and fixing hardware failures encountered during the factory test. PCSS shall not be responsible for any programming issues or configuration failures encountered during the factory test.
4. PCS Factory Testing shall be a joint effort by the PCSS and OAE. All required equipment shall be tested at the PCSS's factory prior to shipment. At a minimum, the PCS Factory Testing shall include the following:
 - a. One (1) Unwitnessed Factory Test (UFT).
 - b. One (1) Witnessed Factory Test (WFT).
5. Unless otherwise specified in the individual specification sections, all equipment provided by PCSS shall be tested as a single fully integrated system. Perform factory testing of the following:
 - a. Long Beach Consolidation Pump Station Main Control Panel (LBP_MCP) and its cellular communications to the South Shore Water Reclamation Facility (South Shore WRF) Plant Wide SCADA system.
 - b. Long Beach Level Indicators Panel (LBP_LIP)
 - c. Long Beach Temporary Bypass Pump Station Control Panel (LBP_BCP).
6. Contractor shall advise Engineer in writing of the scheduled dates for process control systems factory testing; submit such notice not less than 28 days prior to the scheduled start of factory testing. Owner and Engineer will choose to be

present at factory testing facility during operational testing of the process control systems at the factory, either for individual units or for the integrated system. Presence of Owner and Engineer during testing does not relieve Contractor from complying with the Contract Documents and does not indicate or imply acceptance of the equipment. When factory tests have been successfully completed, submit a factory test report to Engineer.

7. One Owner representative and one Engineer representative shall attend the witness testing. Expenses and costs for witnessing shall be paid by Contractor, including the following:
 - a. Transportation of Owner and Engineer personnel to the factory test location and return via commercial airline, and ground transportation to and from airports as required.
 - b. Overnight accommodations (two single occupancy rooms) in a hotel in reasonable proximity to the factory testing location. Room quality to be standard business class.
 - c. Ground transportation between the hotel and factory testing location
 - d. Meals for the duration of the testing. Meal allowance shall not be less than U.S. Internal Revenue Service guidelines.
 - e. Should a factory test fail to comply with the Contract Documents, necessary changes and corrections shall be made and the entire system retested until acceptable results are achieved. Expenses and costs for Owner and Engineer witnessing such retesting shall be paid by Contractor.

B. Related Sections:

1. 13401, Process Control System General Provisions.

1.2 TESTING – GENERAL

- A. Each test shall use simulated field signals. Each input/output point shall be tested from field terminals in the panel to the workstation Human Machine Interface (HMI) display screen and the display on the Operator Interface Terminal (OIT). The tests shall verify that all panel hardware and internal panel wiring between components are functioning as intended.
- B. All tests shall be conducted in accordance with Engineer and/or Owner-approved procedures, forms, and all checklists as submitted by the PCSS under Article 1.3 of this Specification.
- C. Copies of the signed-off test procedures, forms, and checklists will constitute the required testing documentation.
- D. The PCSS shall provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it

is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. These simulation techniques shall be defined in the test procedures.

- E. The PCSS shall coordinate all required testing with the Contractor, all affected Subcontractors, Contractor, the Engineer, and the Owner.
- F. For all testing, the PCSS shall be responsible to furnish the following: the services of field service engineers, all special calibration and test equipment, and labor.
- G. The Engineer reserves the right to test or retest all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the specified requirements shall be performed at no additional cost to the Owner. The Engineer's decision shall be final regarding the acceptability and completeness of all testing.
- H. No equipment shall be shipped until the Engineer and/or Owner has received all test results and approved the system is ready for shipment.
- I. Correction of Deficiencies
 - 1. All deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to the Owner.
 - 2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until the specified requirements are met. This work shall be performed at no additional cost to the Owner.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Testing Plans:
 - a. Submit factory test procedures in accordance with Section 13401, Process Control System General Provisions, for all equipment identified in Paragraph 1.1.A of this Section. Obtain Engineer's acceptance of testing plan not less than 28 days prior to scheduled start of factory test.
- B. Informational Submittals: Submit the following:
 - 1. Source Quality Control Submittals:
 - a. Written results of factory testing for process control systems. Submit the complete factory test report within two weeks after completion of the factory test.

- C. Preparation of Testing Plan submittals shall be a joint effort by the PCSS and Contractor. Contractor shall provide process control description information required for testing plan submittals.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

- A. Prior to shipment of the equipment, the entire system, except primary elements, final control elements, and field-mounted transmitters, shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions, and control devices/functions.
- B. All panels, consoles, and assemblies shall be inspected and tested to verify their conformance with related submittals, Specifications, and Drawings.
- C. During the tests, all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.
- D. The UFT shall be run by the PCSS, and be conducted at the PCSS's facility. PCSS shall coordinate scheduling with the OAE.
- E. Tests to be performed shall include, but not be limited to, the following. Each of these tests shall be specifically addressed in the UFT Test Plan submittal.
 - 1. All panels and enclosures being provided shall undergo a thorough inspection to verify the integrity of the cabinet enclosures, frame structures, paint work and finish, etc. Review the panel drawings to ensure they accurately reflect the panel layout and wiring.
 - a. Inspection shall include, but not be limited to, the following:
 - 1) Nameplates and tags.
 - 2) Wire sizes and color coding.
 - 3) Terminal block contact ratings and numbers.
 - 4) Panel-mounted equipment and identification.
 - 5) External and internal panel layout.
 - 6) Proper wiring practices and grounding.
 - 7) Enclosure flatness, finish and color.
 - 8) NEMA rating and environmental control equipment.

- b. Correct materials and equipment that do not comply with the Contract Documents and submittals approved by Engineer, and re-inspect until compliance is verified.
 - 2. If applicable, UPSs shall be tested with all equipment connected to verify the UPSs have been sized correctly to maintain the specified run time.
 - 3. I/O Point Checkout:
 - a. To perform this test, the PCSS will need the PLC configuration files from the OAE. Prior to proceeding with the UFT, the OAE shall be responsible for downloading configuration files to the PLC and initial setup of the PLC for the UFT.
 - b. An I/O point checkout of each I/O type shall be performed to verify proper operation of the input/output points. The verification of the signals shall be accomplished via the use of the PLC programming software. At a minimum, the I/O checkout shall consist of the following four steps:
 - 1) Digital input signals shall be jumpered within the termination connections of the PLC panels and verification of proper alarming, statuses, etc., shall be performed utilizing the tools available in the PLC programming software.
 - 2) Analog input signals shall be connected to a signal generator at the termination connections and signals shall be verified at zero percent, 25 percent, 50 percent, 75 percent, and 100 percent of full scale. The appropriate scaled value shall be verified utilizing the tools available in the PLC programming software.
 - 3) Digital output signals shall be initiated by the user by writing to the signals utilizing the PLC programming software. Verification shall occur in the PLC panel by connecting a digital multimeter to measure the continuity at the terminations, thus verifying the command from the PLC has properly executed the contact closure.
 - 4) Analog output signals shall be initiated by the user by writing to the signals utilizing the PLC programming software. Verification shall occur in the PLC panel by utilizing a digital multimeter to measure the current/voltage generated at the termination points.
 - 4. 100 percent wiring and database address verification of panel components and process controller I/O as applicable.
 - 5. Demonstrate the data communication network and protocol for in-plant and remote site locations.
 - 6. Test system recovery from failure scenarios including cold boot, warm boot, communication loss, power failure, process failure, redundancy backup systems, etc.
- F. All control panels provided under the requirements of the related technical specification sections of Division 13 shall be included in these tests.

- G. Completion of Unwitnessed Factory Test (UFT):
 - 1. Upon successful completion of the UFT, the UFT Test Report shall be submitted to the Owner and Engineer.

3.3 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

- A. The PCSS shall coordinate the scheduling of the WFT with the OAE.
- B. Before scheduling the WFT, the PCSS shall be responsible to complete the UFT as specified above. The system will be ready for the WFT after the PCSS has determined through the UFT and through his internal quality assurance program that the equipment is ready for shipment to the job site.
- C. When the system is ready for the WFT, the PCSS shall notify the Engineer and Owner in writing. The Engineer and/or Owner shall schedule a test date within 14 days of receipt of the "Ready to Test" letter. At the time of notification, the PCSS shall submit the WFT Test Plan which shall include any revisions to the detailed test procedure previously approved by the Engineer and/or Owner.
- D. The purpose of the WFT is to allow the Engineer and Owner to witness the functionality, performance, and stability of the hardware and software. The software check will be limited to verifying that the software loads on the system and is functional on all hardware.
- E. The WFT shall be run by the OAE, and be conducted at the PCSS's facility. PCSS shall support the OAE as needed. The OAE shall be allotted one full day, at minimum, to load software programs and test communications prior to the start of the WFT.
- F. All system tests performed and specified for the UFT shall be repeated in the presence of the Engineer and Owner. For the I/O test, 100 percent of each type of I/O point shall be performed to demonstrate the I/O functionality.
- G. The system must operate continuously throughout the WFT without failure, except where initiated per the established test procedures. Any unanticipated failures may, at the Owner and/or Engineer's option, result in the overall WFT being deemed unsuccessful. WFT failure criteria shall include one or more of the following:
 - 1. Nonconformance to the items specified for WFT.
 - 2. Failure or nonfunctioning of any communication link.
 - 3. Failure of more than 10 internal panel wiring discrepancies per panel including I/O point cross wirings.
 - 4. More than 10 I/O point assignment errors against PLC database per panel.

- H. Successful completion of the WFT, as determined by the Owner and/or Engineer, shall be the basis for approval of the system to be shipped to the jobsite.
- I. The various tests performed during the WFT shall be designed to demonstrate that hardware and software fulfill all the requirements of the specifications and contract drawings. The test conditions shall resemble as closely as possible the actual installed conditions. Any additional hardware or software that may be required to successfully verify system operation shall be supplied at no cost to the Owner.
- J. Tests to be performed during the WFT shall include, but not be limited to, the following:
 - 1. Perform a system audit to verify all components have been staged for the test.
 - 2. Inspect the system inventory to verify all components have been documented properly with correct model numbers, serial numbers, mac addresses, etc.
 - 3. For each hardware enclosure, inspection shall include, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
 - 4. For each subpanel, inspection shall include, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
 - 5. Demonstrate operability of all equipment.
 - 6. 100 percent point check of I/O, including wiring. Analog signals shall include verification of zero percent, 25 percent, 50 percent, 75 percent, and 100 percent of scale. Additionally, out of range testing (over and under scale) shall be accomplished.
 - 7. Demonstrate communication failure and system restart.
 - 8. Demonstrate the failover capabilities of the redundant PLCs.
 - 9. Demonstrate the ability of the UPS's to meet the runtime requirements upon loss of power.
 - 10. Demonstrate logical failure conditions for control strategies (i.e., instrument failures, equipment failures, loss of communication between the Process I/O Server and the PLC, loss of peer-to-peer communication, etc.).
- K. During the test, for a period of time equal to at least 20 percent of the test duration, the Engineer's and/or Owner's representative shall have unrestricted access to the system to perform any additional testing desired or to re-test any previously tested components.
- L. All deficiencies identified during these tests shall be corrected and re-tested prior to completing the WFT as determined by the Owner/Engineer.

- M. Shipment of control panel(s) without successful WFT, as determined by the Engineer and/or Owner, shall be the cause to withhold payment of the complete cost of the panel until the panel is fully functional in the field for a duration of three months.
- N. The following documentation shall be made available to the Engineer and Owner at the test site both before and during the WFT:
 - 1. All Contract Drawings and Specifications, addenda, and change orders.
 - 2. Master copy of the test procedure.
 - 3. Bill of material of the computer/PLC/LAN equipment and software to be tested including make, model, and serial number.
 - 4. Design-related hardware submittal applicable to the equipment being tested.
 - 5. Software licenses.
 - 6. Software documentation submittal.
- O. The daily schedule during these tests shall be as follows:
 - 1. Morning meeting to review the day's test schedule.
 - 2. Scheduled tests and sign-offs.
 - 3. End of day meeting to review the day's test results and to review or revise the next day's test schedule.
 - 4. Unstructured testing period by the witnesses.
- P. Completion of Witnessed Factory Test (WFT):
 - 1. Upon completion of the WFT, the PCSS shall submit the WFT Test Report to the Owner and Engineer. Test Report shall include certified copies of all test data, logs, and procedures followed during testing.

+ + END OF SECTION + +

SECTION 13403

PROCESS CONTROL SYSTEM START-UP AND FIELD TESTING

PART 1 - GENERAL

1.1 SYSTEM CHECK-OUT AND START-UP RESPONSIBILITIES

- A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all Process Control System (PCS) equipment and coordinate all activities necessary to perform check-out and start-up of the equipment.
- B. Contractor shall retain the services of the Process Control Systems Supplier (PCSS) to supervise and/or perform check-out and start-up of all system components. As part of these services, the system Supplier shall include for those equipment items not manufactured by him the services of an authorized manufacturers' representative to check the equipment installation and place the equipment in operation. The manufacturers' representative shall be thoroughly knowledgeable about the installation, operation and maintenance of the equipment.
- C. Related Sections:
 - 1. Section 13401, Process Control System General Provisions

1.2 SUBMITTALS

- A. Comply with the requirements specified in Section 13401, Process Control System General Provisions, and the following:
 - 1. PCS Start-up and Field Testing Schedule of Submittals: Submit a complete list of all expected submittals provided under this Section. Schedule of Submittals shall be submitted as the first submittal provided under this Section. Schedule shall be in table format and include: Submittal Title, Specification Section and Article Reference Number, Description, Control Strategy Reference Number(s), and expected submission date. All Testing Plans/Procedures shall be submitted and approved before the start of the Field Testing.
 - 2. Operational Readiness Testing (ORT):
 - a. Submit ORT Testing Plan Submittal. Submittal shall include:
 - 1) Test description.
 - 2) Equipment required for testing.
 - 3) Test procedure.
 - 4) Sample Component Calibration Form.

- 5) Sample I/O Status Sign-off Form.
- b. Submit Loop/Component Inspections and Tests Submittal: Submittal shall include:
 - 1) Complete List of Loops.
 - 2) Component Calibration Form for each active Analog Subsystem element and each I/O module.
 - 3) Complete I/O Status Sign-off Form.
- c. Submit Installation Inspection Report:
 - 1) Report shall certify that all equipment has been installed correctly and is operating properly.
 - 2) Report shall include a complete record copy of all ORT test results.
 - 3) Report shall be signed by authorized representatives of the Contractor and PCSS.
3. Functional Demonstration Testing (FDT):
 - a. Submit FDT Test Procedure Submittal for each control strategy to be tested, as specified below.
 - b. Submit FDT Test Results Submittal for each FDT performed. Submittal shall include a record copy of the test results.
4. Site Acceptance Testing Submittals:
 - a. Submit Certification of Installation, as specified below.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 OPERATIONAL READINESS TEST (ORT)

- A. An ORT shall be performed as each panel is brought into operation. The ORT shall take place prior to startup.
- B. The purpose of the ORT is to check that the process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if the equipment is ready for operation.
- C. Following installation of the process control system components and prior to startup and the Functional Demonstration Test, the entire system shall be certified (inspected, wired, calibrated, tested, etc., and documented) that it is installed and ready for the ORT as defined below. Perform the following:
 1. Check and approve the installation of all PCS components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation.

2. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in this Work, they should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.
- D. Test Equipment: Provide all test equipment necessary to perform the testing during system checkout and start-up.
- E. Certified Calibration Reports: Furnish to the Engineer certified calibration reports for field instruments and devices specified in Section 13420, Primary Sensors and Field Instruments, and panel mounted devices specified in Section 13440, Panel Mounted Instruments and Devices, as soon as calibration is completed.
- F. Loop/Component Inspections and Tests:
1. The entire system shall be checked for proper installation, calibration, and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications.
 2. Submit the Loop/Component Inspections and Tests Submittal prior to initiating any testing.
 3. Loop/Component Inspections and Tests shall be performed using Engineer-approved forms and checklists.
- G. Loop Status Reports: Each loop shall have a Loop Status Report to organize and track its inspection, adjustment, and calibration. These reports shall include the following information and check-off items with spaces for sign-off by the system supplier:
1. Project Name, Test Date, PCSS Name, and Lead PCSS Technician Name.
 2. Loop Number.
 3. Tag Number for each component.
 4. Check-offs/sign-offs for each component: Tag/identification; installation; termination (wiring and tubing); scale, range, and setpoint as applicable; and calibration/adjustment (four-point for analog, set point for switches) rising and falling.
 5. Check-offs/sign-offs for the loop: Panel interface terminations; I/O interface terminations; I/O signal operation; inputs/outputs operational (received/sent, processed, adjusted); total loop operation; process controller scaling and adjustment; and space for comments.
 6. Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry, and a space for sign-off by the PCSS.
 - a. Project Name.
 - b. Loop Number.

- c. Component Tag Number of I/O Module Number.
 - d. Component Code Number Analog System.
 - e. Manufacturer (for Analog system element).
 - f. Model Number/Serial Number (for Analog system).
 - g. Summary of functional requirements shall include, but not be limited to, scale and chart ranges of indicators, recorders, and transmitters/converters; functions of computing elements; and parameters of controllers (i.e., proportional, integral, derivative, reverse/forward acting, etc.).
 - h. Calibrations shall include testing of analog input and output signals at zero, 10, 50, and 100 percent of span. Where appropriate, discrete input signals shall include details regarding actual trip points and reset points.
 - i. Space for comments.
 - j. Space for sign-off by the PCSS.
- H. Location of Loop Status Reports: The PCSS shall maintain the Loop Status Reports sheets at the job site and make them available to the Engineer/Owner at any time.
- I. Periodic Review of Loop Status Report: The Loop Status Reports shall be available for review at any time. The Engineer will review Loop Status Sheets and spot-check the PCSS test process periodically. Any deficiencies found shall be corrected by the PCSS prior to commencement of the Functional Acceptance Test.
- J. Loop Checks:
- 1. Prior to checkout of the I/O to the Operational Interface terminal (OIT) or Human Machine Interface (HMI), the PCSS shall thoroughly test all I/O from the field device to the PLC terminals, and verify the PLC is powered up and the PLC is communicating to the OIT and the South Shore Water Reclamation Facility (South Shore WRF) Supervisory Control And Data Acquisition (SCADA) system.
 - 2. After the PCSS has successfully tested all I/O from the field devices to the PLC terminals, the PCSS and Owner Application Engineer (OAE) shall jointly test all I/O from the field device to the PLC, OIT and SCADA Operator Workstation.
 - 3. Loop checks shall be documented using Engineer-approved Input/Output Status Sign-Off forms.
- K. Remote Manual Operation:
- 1. Remote Manual operation from OIT / HMI (including start/stop, open/close commands of all devices controlled by the SCADA system) shall be verified jointly by the PCSS and OAE.
 - 2. Subsequent to verification of Remote-Manual control, the PCSS may request from the Owner and Engineer permission to begin testing on the next process area. Simultaneously, the OAE may continue with automatic control strategy testing.

- K. Wire Tagging:
 - 1. All permanent wire tagging, including all signal and network cabling, shall be completed during Loop/Component Inspections and Tests.
 - 2. Request to schedule the FDT will not be accepted until all wire tagging is complete.
- M. Completion of Operational Readiness Test (ORT):
 - 1. Upon successful completion of the ORT, the PCSS shall submit an Installation Inspection Report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by authorized representatives of both Contractor and the Supplier.
 - 2. After submission of the Installation Inspection Report, the PCSS can then submit a request to schedule the Functional Demonstration Test (FDT) as noted in the following section.

3.2 FUNCTIONAL DEMONSTRATION TESTING (FDT)

- A. All preliminary testing, inspection, and calibration shall be complete as defined above for the ORT, prior to starting the FDT. Following the PCS checkout and initial operation, for each system, perform a complete system test to verify that all equipment and programmed software is operating properly as a fully integrated system, and that the intended monitoring and control functions are fully implemented and operational. Any defects or problems found during the test shall be corrected and then retested to demonstrate proper operation.
- B. Responsibilities: The FDT will be a joint test between the Contractor, PCSS and the OAE. The OAE will lead all software testing during the FDT.
- C. Procedure: A Functional Demonstration Test Procedure shall be submitted prior to testing, for each system to be tested. The OAE will prepare the software portion of the Functional Demonstration Test Procedure for each control strategy to be tested. Perform testing as specified under the Witnessed Factory Testing (as defined in Specification 13402), except that the entire installed system shall be tested and all functions demonstrated using actual equipment and real data (to the greatest extent possible). Any simulated testing in lieu of live testing must be specifically highlighted within the FDT Procedure for review and approval.
- D. Witness Testing: Once a system has been started up and is operating, a witnessed FDT shall be performed on that system to demonstrate that it is operating and is in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.

- E. Documentation: Updated versions of the documentation specified to be provided for during the factory tests shall be made available to the Engineer at the job site both before and during the tests. In addition, one copy of all O&M Manuals shall be available for reference at the job site, both before and during testing.
- F. Communication Testing: During the FDT, a demonstration of communication failure and recovery shall be accomplished. This test shall be scheduled and coordinated with Owner's personnel to minimize the impact on plant operations.
- G. Power Failure Testing: During the FDT, a demonstration of power failure and recovery shall be accomplished. This test shall be scheduled and coordinated with Owner's personnel to minimize the impact on plant operations.
- H. Corrective Action: Problem items and resolutions noted during the test shall be documented on the Punch list/Resolution form. In the event of rejection of any part or function during the testing, the PCSS shall perform repairs, replacement, and/or retest within 10 days.
- I. Following demonstration of all system functions, the PCS including field sensors/transducers and instruments shall be running and fully operational for a continuous 96 hour period. The Site Acceptance Test (SAT) specified below shall not begin until the continuous 96 hour integrated system test has been successfully completed and Owner and Engineer agree that the SAT can begin.
- J. Completion of the Functional Demonstration Testing:
 - 1. Upon successful completion of the FDT, the PCSS and OAE shall submit a record copy of the test results to the Owner and Engineer and request the scheduling of the SAT as noted in the following section.

3.3 SITE ACCEPTANCE TESTING (SAT)

- A. Site Acceptance Testing (SAT) shall begin following completion of all Functional Demonstration Testing as specified above and shall continue until a time frame has been achieved wherein the system (both hardware and software) availability meets or exceeds 99.7 percent for 30 consecutive days and no system failures have occurred which result in starting the SAT over again.
- B. During the SAT the system shall be available to Owner operating personnel for use in normal operation of the facility.
- C. During this test, plant operations and Contractor personnel shall be present as required to address any potential issues that would impact the overall system operation.

1. The PCSS is expected to provide personnel for this test who have an intimate knowledge of the hardware and software of the system.
 2. When PCSS personnel are not on-site, the PCSS shall provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within one hour of a request by operations staff.
- D. While this test is proceeding, the Engineer and Owner shall have full use of the system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain the responsibility of Owner and the decision of plant operators regarding plant operations shall be final.
- E. For the purpose of the SAT, the system will be defined as consisting of the following systems and components:
1. Hardware:
 - a. Instruments
 - b. Control Panels, including all PLC components
 - c. Operator Interfaces (OIT and HMI)
 - d. Network switches and cellular modems
 - e. Digital communication links
 - f. Power supplies and UPS
 2. Software:
 - a. PLC control strategy logic
 - b. OIT/HMI graphics configuration
- F. The conditions listed below shall constitute system failures which are considered critical to the operability and maintainability of the system. The SAT shall be terminated if one or more of these conditions occur. Following correction of the problem, a new SAT shall begin.
1. Failure to repair a hardware or vendor software problem (not logic configuration) within 24 consecutive hours from the time of notification of a system failure.
 2. Recurrent hardware or vendor software problem (not logic configuration) if the same type of problem occurs three times or more.
 3. Vendor software problem (not logic configuration) causing a processor to halt execution.
- G. The following conditions shall constitute a system failure in determining the system availability based on the equation specified below:
1. Failure of major equipment listed above.
 2. Loss of communications between devices on the communications network.
 3. Failure of one or more input/output components.
 4. Failures of any type affecting ten or more input/output points simultaneously.

5. Failure of any type affecting one or more regulatory control loops or sequential control strategies thereby causing a loss of the automatic control of the process variable or process sequence operation.
6. Failure of power supply. Where redundant power supplies are provided, failure of one power supply shall not constitute a system failure provided the backup power supply operates properly and maintains supply power. Failure of the backup supply to operate properly and maintain supply power shall constitute a system failure.
7. Failure of three or more primary sensors/transducers or field instruments simultaneously.
8. Control strategy logic or OIT/HMI graphics configuration are not included in the system failure determination.

H. The system availability shall be calculated based on the following equation:

$$A = \frac{TTO}{TTO + TTR} * 100 \text{ percent}$$

where, A = system availability in percent
 TTO = total time in operation
 TTR = total time to repair

- I. Time to repair shall be the period between the time that Contractor is notified of a system failure and the time that the system has been restored to proper operation in terms of hours with an allowance for the following dead times which shall not be counted as part of the time to repair period.
 1. Actual travel time for service personnel to get to the Site up to six hours per incident from the time Contractor is notified of a system failure.
 2. Time for receipt of spare parts to the plant site once requested up to 24 hours per incident. No work shall be done on the system while waiting for delivery of spare parts.
 3. Dead time shall not be counted as part of the system available period. The dead time shall be logged and the duration of the SAT extended for an amount of time equal to the total dead time.
- J. Any malfunction during the tests shall be analyzed and corrections made by the Contractor and PCSS. The Engineer and/or Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test. Upon completion of repairs by the PCSS, the SAT will be re-started from the date which the PCSS successfully corrected the malfunction(s) and the Owner and Engineer have accepted and signed off on the repairs.

- K. All parts and maintenance materials required to repair the system prior to completion of the SAT shall be supplied by Contractor at no additional cost to Owner. If parts are obtained from the required plant spare parts inventory, they shall be replaced to provide a full complement of parts as specified.
- L. A Plant Monitoring and Control System Malfunction/Repair Reporting Form shall be completed by the plant personnel and Engineer to document system failures, to record Contractor notification, arrival and repair times and Contractor repair actions. Format of the form shall be developed and agreed upon prior to the start of the SAT.
 - 1. Contractor shall coordinate with Owner and Engineer the names and emergency contact information (points of contact) of persons in charge. Contractor shall submit template of reporting procedures forms for review and in advance of OAD start. The report forms shall include date, time and length of occurrence, as well as detailed information of the problem, troubleshooting procedures taken and parties involved in the situation.
- M. OAE logic configuration:
 - 1. All data base, PLC logic, and OIT/HMI graphical interface systems are expected to be functioning as required per the specifications prior to the start of each test period.
 - 2. Any control strategy PLC logic or OIT/HMI configuration malfunction during the test will be analyzed and corrections made by the OAE.
- N. Throughout the duration of the SAT, no software or hardware modifications shall be made to the system without prior approval from the Owner and Engineer.
- O. Completion of a 30 consecutive day period without any restarts of the SAT and with a system availability in excess of 99.7 percent will constitute completion of the SAT. Upon successful completion of the 30-day operation test and subsequent review and approval by the Owner of complete system final documentation, the system shall be considered substantially complete and the warranty period shall commence.
- P. Certification of Installation:
 - 1. Following successful completion of the 30-day test, the PCSS shall issue a Certification of Installation. Certification shall be on PCSS corporate letterhead and signed by an officer of the firm. Certification shall state that the process control system has been completed in conformance with plans and specifications. Certification shall be submitted to the Engineer as specified herein.

+ + END OF SECTION + +

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SECTION 13404

PROCESS CONTROL SYSTEM TRAINING

PART 1 - GENERAL

1.1 REQUIREMENTS AND RESPONSIBILITIES

- A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to perform and coordinate all required training at times acceptable to Owner and Engineer.
- B. Contractor shall retain the services of the Process Control System Supplier (PCSS) to provide operation and maintenance training for all Process Control System PCS equipment as specified herein.
- C. For equipment items not manufactured by the PCSS, on-site training shall be provided by an authorized representative of the equipment manufacturer as part of the PCSS's services. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.
- D. Contractor shall be responsible for all costs, including cost of travel, meals and lodging, if required, associated with training, both on-site and at the PCSS's facilities, and shall provide all required materials, texts and required supplies. Engineer approval of quantity and type of material occurs during the submittal process and is described in Paragraph 1.2.A below.
- E. All training shall be conducted in the normal eight-hour working days until conclusion of the training course. For training at the PCSS's facility, the course instructor shall be assigned full time and shall not perform other duties throughout the period of the course.
- F. All training sessions shall be provided twice, as specified and shall be scheduled by the OWNER to accommodate their shift schedule.
- G. Related Sections:
 - 1. Section 01730, Operation and Maintenance Data.
 - 2. Section 13401, Process Control Systems General Provisions.

1.2 SUBMITTALS

- A. Within 90 days of the effective date of the Notice to Proceed, Contractor shall submit his plan for training. Included in the plan shall be course outlines and schedules for training to be provided at the Supplier's facilities.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 TRAINING SUMMARY

- A. The following training courses listed in the summary table shall, as a minimum, be provided:

Description	Minimum Course Duration (Hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audiences
On-Site Training:				
Control System Overview Seminar	Covered in OAE scope of work.			
Operator Control System Training	Covered in OAE scope of work.			
System Administrator Training	Covered in OAE scope of work.			
Installed Control System and Networking Hardware Training	4	8	2	Administrator, Maintenance
Network Hardware Manufacturer Training	4	8	2	Administrator, Maintenance
Instrument Manufacturer Training	16	8	2	Maintenance
Instrument Training	16	8	2	Maintenance
Instruments - Operator familiarity	8	8	2	Operations

- B. Definitions of audience roles:

1. Administrator - personnel responsible for maintaining the Human Machine Interface (HMI) and Supervisory Control And Data Acquisition (SCADA) system.
2. Maintenance - personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operator - personnel responsible for daily plant operations.

3.2 ON-SITE TRAINING

- A. Training personnel shall be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel shall command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and shall be capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

- B. Installed Control System and Networking Hardware Training:

1. Provide training for the Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed control system. Training shall be held immediately after the final Site Acceptance Test (SAT) of the entire system.
2. Training and instruction shall be specific to the system that is being supplied.
3. Training shall consist of classroom instructions and hands-on instruction utilizing the Owner's system.
4. Detailed training shall be provided on the actual configuration and implementation for this Contract. Training shall cover all aspects of the system that will allow the OWNER'S personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. The training shall cover the following subjects, as a minimum:
 - a. System overview.
 - b. System hardware components and specific equipment arrangements.
 - c. Periodic maintenance.
 - d. Troubleshooting and diagnosis.
 - e. Network configuration, communications, and operation.
 - f. TCP/IP addressing procedures for all Ethernet devices.

C. Network Hardware Manufacturer Training:

1. Provide manufacturer's standard training courses for the Owner's personnel in the configuration, maintenance, and troubleshooting of the Cellular Router and Managed Ethernet Switches hardware and software supplied.
2. This training shall be conducted after the final Site Acceptance Test (SAT) of the entire system.
3. Training shall be held at the project site.
4. Training shall cover the hardware and software components.
5. Training shall include, but not be limited to:
 - a. Fundamentals of Ethernet including the basic operation of switches and routers.
 - b. Network topologies.
 - c. Self-healing mechanisms.
 - d. Traffic Control - VLAN, Flow Control and Quality of Service.
 - e. Basics of security mechanisms such as RADIUS, Address Translation, Port Forwarding and Access Control Lists.
 - f. Router functionality including common unicast, multicast and DNP3 routing protocols.
 - g. Network configuration functions such as firmware management and backup & restore, port configuration, VLANs, Redundancy, Security and Diagnostics.
 - h. Network Management
6. Training shall be provided by a certified representative of the Cellular Router and Ethernet Switch manufacturer.

D. Instruments Manufacturer Training:

1. Provide on-site operation and maintenance training by Supplier and the equipment manufacturer representatives prior to placing the equipment in continuous operation. The services of equipment manufacturer's representatives shall be provided for a minimum of eight (8) hours for each type of instrument provided.
2. Training shall accomplish the following:
 - a. Provide instruction covering use and operation of the equipment to perform the intended functions.
 - b. Provide instruction covering procedures for routine, preventive and troubleshooting maintenance including equipment calibration.
 - c. Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall plant monitoring and control system.

E. Instrument Training:

1. Provide instruction on the maintenance of the field and panel instrumentation for the Owner's instrumentation technicians. This training shall be conducted before the SAT, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. As a minimum the following shall be included:
 - a. Training in standard hardware maintenance for the instruments provided.
 - b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
 - c. Test, adjustment, and calibration procedures.
 - d. Troubleshooting and diagnosis.
 - e. Periodic maintenance.

F. Instruments - Operator familiarity:

1. Provide operator level instruction on the use of the field and panel instrumentation for the Owner's operations staff. This training shall be conducted before the 30 day Site Acceptance Test, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. Include hands on demonstration of the information each transmitter indicates and the method used to retrieve any operator information from the transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

3.3 FOLLOW-UP TRAINING

A. Training following two months of regular system operations:

1. The Supplier shall provide follow-up operation and maintenance training covering all system equipment provided.
2. The training shall be of the same format, content and duration as the training described in Article 3.1 and Article 3.2, above, for On-Site Training. Training at the Supplier's facility shall not be required for follow-up training.

++ END OF SECTION ++

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SECTION 13420

PRIMARY SENSORS AND FIELD INSTRUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust and place into satisfactory operation all primary sensors and field instruments shown and specified herein.
2. Contract Documents illustrate and specify functional and general construction requirements of the sensors and field instruments and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. Contractor shall provide all components, piping, wiring, accessories and labor required for a complete, workable, and integrated system.
3. Contractor shall be responsible for carefully removing, storing and handing over to owner the existing 24" magnetic flow meter and its transmitter.
4. Contractor shall be responsible for installing all instrumentation as shown, and for providing the required taps in the process piping system for the installation of pressure sensing instrumentation.

B. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all components and systems.

C. Related Sections:

1. Section 05051, Anchor Systems
2. Section 13401, Process Control System General Provisions
3. Section 13403, Process Control System Startup and Field Testing.
4. Section 13404, Process Control System Training.
5. Section 13440, Panel Mounted Instruments and Devices
6. Section 13491, Process Control Descriptions
7. Section 15052, Exposed Piping Installation.
8. Section 15061, Ductile Iron Pipe.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 13401, General Requirements.

B. Acceptable Manufacturers:

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Pump Station Conversion

1. Furnish primary sensors and field instruments by the named manufacturers or equal equipment by other manufacturers.
2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.
3. Obtain all sensors and field instruments of a given type from the same manufacturer.

C. Responsibilities and Services:

1. Provide primary sensors and field instruments in accordance with the applicable general design requirements specified in Section 13401, General Requirements, and the detailed Specifications herein.
2. Field supervision, inspection, start-up and training in accordance with the requirements of Section 13403, Process Control System Startup and Field Testing, and Section 13404, Process Control System Training.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 13401, General Requirements.
- B. Primary sensors and field instruments shall not be delivered to the Site until all product information and system Shop Drawings for the sensors and instruments have been approved by the Engineer.

1.4 SUBMITTALS

- A. Comply with the requirements of Section 13401, General Requirements.

1.5 MATERIALS OF CONSTRUCTION FOR WETTABLE PARTS

- A. Provide compatible materials of construction for primary sensors and field instrument (wetted) parts that come in contact with the process fluids as listed in the Instrument Data Sheets.

1.6 IDENTIFICATION TAGS

- A. Tagging Requirements:
 1. Tag numbers of sensors and field instruments shall be as shown and as specified. For items not shown or specifically tagged, the item tag number shall be established by the Process Control System Supplier (PCSS). All instruments, whether field or panel mounted, shall have an identification tag.
 2. Information to be permanently engraved onto the tag shall include the identifying tag number, manufacturer, model number, service, and range.
 3. Identifying tag number shall be permanently etched or embossed onto a stainless steel tag which shall be fastened to the device with self-tapping stainless steel screws. Where fastening with screws cannot be accomplished the tags shall be

permanently attached to the device by a circlet of stranded stainless steel wire rope and clamp.

4. All sensors and field instruments mounted on or within control panels and enclosures shall have the identification tag installed so that the engravings are easily visible to service personnel. Devices mounted on the face of panels shall have the tags attached to the rear of the devices.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN REQUIREMENTS

A. Miscellaneous:

1. All instrumentation components shall be heavy-duty types, designed for continuous service. The system shall contain products of a single manufacturer, when possible, and consist of equipment models which are currently in production.
2. All field-mounted instruments and system components shall be designed for installation in humid and corrosive service conditions. All field mounted instrument enclosures, junction boxes and appurtenances shall conform to the NEMA ratings that meet hazardous rating requirements shown on Contract Drawings and on the Instrument Data Sheets.
3. Primary sensors and field instruments shall conform to the requirements of the Instrument Data Sheets provided after PART 3 of these specifications.
4. The named manufacturers have been specified to establish the standard of quality and performance of equipment to be supplied.

2.2 PROCESS TAPS, SENSING LINES AND ACCESSORIES

A. Air Pressure Sensing Lines and Accessories for Air Flow/Pressure Transmitters:

1. Material: Type 316 stainless steel tubing, ASTM A269, medium wall thickness.
2. Pressure Rating: 150 psi.
3. Size: 1/2-inch O.D. for air.
4. Connections: Type 316 stainless steel compression type, "Swagelok" by Crawford, or equal.
5. Shut-off Valves:
 - a. Type: Ball.
 - b. Pressure Rating: 150 psi.
 - c. Body, Ball and Stem: Type 316 stainless steel.
 - d. Packing: High density TFE.
 - e. Handle: Nylon with metal travel stops.
 - f. Support Rings: TFE coated Type 316 stainless steel.
 - g. End Connections: Removable "Swagelok", or equal.
 - h. Products and Manufacturers: Provide one of the following:
 - 1) 43 Series, as manufactured by Whitey, or equal.
6. Manifolds:

- a. Type: 5-valve and 3-valve meter manifolds.
 - b. Materials: Type 316 stainless steel body, bonnets and stems; delrin seats; teflon packing.
 - c. Products and Manufacturers: Provide one of the following:
 - 1) Anderson-Greenwood, or equal.
- B. Pressure Tap Sensing Lines and Accessories for Pressure Gauges and Pressure Switches:
- 1. For Process Sensing Taps in Ductile Iron, Steel and Stainless Steel Piping Systems:
 - a. Material and Fittings: Type 304 stainless steel pipe (ASTM A 312) and threaded fittings and adapters (ASTM A 403).
 - b. Sizes: 1/2-inch minimum for main sensing piping and 1/2-inch gauge and switch connections.
 - c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in the Exposed Piping Schedule in Section 15052, Exposed Piping Installation.
 - d. Accessories:
 - 1) For applications not requiring diaphragm seals, provide separate 1/2-inch Type 316 stainless steel threaded ball valve for each gauge and switch.
 - 2) For applications requiring diaphragm seals, provide a separate 1/2-inch threaded Type 316 stainless steel ball valve for seal process side shutoff.
 - 2. For Process Sensing Taps in Copper and Thermoplastic Piping Systems:
 - a. Pipe Material and Fittings: Use same type of pipe material and fittings as that used in the process piping system. PVC pipe and fittings shall be provided in accordance with the requirements of Section 15067, Thermoplastic Process Pipe.
 - b. Sizes: 1/2-inch minimum for main process sensing piping and 1/2-inch for gauge and switch connections.
 - c. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in Section 15052, Exposed Piping Installation.
 - d. Accessories:
 - 1) For copper piping system taps with or without seals, provide a separate 1/2-inch minimum threaded brass or bronze ball valve for each gauge and switch.
 - 2) For PVC piping systems with or without diaphragm seals, provide a separate 1/2-inch threaded ball valve for process sensing line shutoff.

2.3 FIELD INSTRUMENT AND GAUGE CASES (OUTDOOR)

- A. Function: Instrument and gauge enclosure protection shall house the instrument or gauge from malfunction due to exposure to low (-10°F) outdoor ambient temperature measured.
- B. Instrument and gauge cases shall meet the following requirements:

1. Case shall be compression molded from high-density polyurethane foam with integral ultra violet and radiation screen.
 2. Case shall be fire resistant and withstand exposure to heat up to +150°C without detrimental effects.
 3. Case shall include Plexiglas window for view of instrument indicator.
 4. Case shall be fully neoprene gasketed around all openings, including electrical penetrations.
 5. Provide Type 304 stainless steel latches and hinges.
 6. Provide for horizontal or vertical mounting based on respective instrument mounting.
 7. Case shall enclose entire instrument.
 8. Case heater shall be 100 watt, 115 VAC thermostat controlled flexible silicone heater mounted on a metal substrate with thermostat set at 50°F.
- C. Manufacturers: Provide products of one of the following:
1. O'Brien Corp.
 2. Thermon.
 3. Or equal.

2.4 PRIMARY SENSORS AND FIELD INSTRUMENTS

- A. General:
1. All primary sensors and field instruments specified in this Section shall conform to the requirements of the Instrument Data Sheets provided after PART 3 of these specifications.
 2. All primary sensors and field instruments provided under other Sections shall comply with the requirements of this Section.
 3. The named manufacturers have been specified to establish the standard of quality and performance of equipment to be supplied.
 4. Instruments and devices shall not be assembled in the panels until all product information and system shop drawings for respective components have been approved.
 5. Surge protection: Field mounted instruments shall be protected with screw-on surge protectors installed in an available conduit opening on process transmitters. Provide own stainless steel pipe-stub enclosure to protect one analog loop (4-20 mA) by mounting directly to the conduit. The surge protector shall be wired directly into the loop and shall integrate grounding disc for ease-of-installation.
 6. Existing 24in magnetic flowmeter shall be inspected and tested before its removal to confirm its correct operation and as recommended by the instrument manufacturer. The same inspection and testing procedure shall be conducted after the magmeter reinstallation. Any pre-existing condition or damage to the either the tube or its signal transmitter shall be noted in the initial testing report.
 - a. All inspection and testing procedures shall be witnessed by the Engineer.
 - b. Submit testing procedures at least 30 days before the instrument removal.

- c. Contractor shall replace the flowmeter tube or transmitter due to mishandling or damage during removal, storage, or reinstallation, and at no additional cost to the owner.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contractor shall require the system supplier to furnish the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.
- B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Transmitters and instruments, which require access for periodic calibration or maintenance, shall be mounted so they are accessible while standing on the floor. Care shall be taken in the installation to ensure sufficient space is provided between instruments and other equipment or piping to allow for easy removal and servicing.
- C. All items shall be mounted and anchored using stainless steel hardware, unless otherwise noted.
- D. All field instruments shall be rigidly secured to walls, stands or brackets as required by the manufacturer and as shown.
- E. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

3.2 START-UP, CALIBRATION, TESTING, AND TRAINING

- A. Comply with the requirements of Section 13401, Process Control System General Provisions, Section 13403, Process Control System Startup and Field Testing, and Section 13404, Process Control System Training.

3.3 TABLE 13420-A, DATA SHEETS

- A. Schedules, listed below, following "End of Section" designation, are part of this Specification section:
 - 1. Table 13420A, Data Sheets.

++ INSTRUMENT DATASHEETS BEGIN ON NEXT PAGE ++

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Flow Meter - Magnetic Flow Tube			SHEET	1	OF	1	
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO. 13420 - 3.3.A.1.1	ADDENDUM/C.O.			
TAG NO.		FE / FIT - 9504-BP	FE / FIT - 9504					
Ref. Dwg. No.:	1	I-03	I-05					
PROCESS								
Location:	2	Bypass P. S. Discharge Header	Flowmeter Vault					
Service:	3	Bypass Submersible Pumps	Submersible Pumps Header					
Vessel / Line No.:	4							
Fluid:	5	Screened Sewage	Grinded Sewage					
Temp. Min/Max:	6	32°F / 100°F	32°F / 100°F					
Flow Min/Max:	7							
PERFORMANCE								
Range:	8	-40 ft/s to 40 ft/s	-40 ft/s to 40 ft/s					
Maximum	9	0.2% of the measured value ± 1 mm/s	0.2% of the measured value ± 1 mm/s					
Measuring Error:								
Temperature:	10	23°F to 176°F.	23°F to 176°F.					
Repeatability:	11	±0.1% of measured value.	±0.1% of measured value.					
Fluid Conductivity:	12	Minimum Limit: 5 µS/cm.	Minimum Limit: 5 µS/cm.					
Impedance:	13	Minimum Pre-amp Input: 1012 ohms.	Minimum Pre-amp Input: 1012 ohms.					
Drift:	14	Complete zero stability.	Complete zero stability.					
FLOW TUBE								
Type:	15	Hard Rubber Lined Metal Flow Tube.	Hard Rubber Lined Metal Flow Tube.					
Element:	16	Conical or Elliptical Shaped Electrode.	Conical or Elliptical Shaped Electrode.					
Electrode/Liner:	17	Hastelloy C22 / Hard Rubber	Hastelloy C22 / Hard Rubber					
Line Size:	18	24"	24"					
Enclosure/Housing:	19	Die-cast, Low-copper Aluminum Alloy; IP68; Burial Coating Protection (subsoil coating).	Die-cast, Low-copper Aluminum Alloy; IP68; Polyurethane Coating.					
Mounting:	19	Flange End Connections.	Flange End Connections.					
ANSI Class:	20	ASME B 16.5 150	ASME B 16.5 150					
Additional Features:	21	Stainless Steel Grounding Rings/Straps.	Stainless Steel Grounding Rings/Straps.					
TRANSMITTER								
Type:	22	Pulsed DC Magnetic Flow Transmitter.	Pulsed DC Magnetic Flow Transmitter.					
Output:	23	4-20 mADC direct-acting, galvanically isolated; into 0-1000 ohms.	4-20 mADC direct-acting, galvanically isolated; into 0-1000 ohms.					
Power Supply:	24	120 VAC 60 Hz	120 VAC ±10%, 60 Hz ±3 Hz.					
Indication / Display:	25	Local LCD; Display Flow in Engineering Units; Provide Totalizer (See Notes, Line 39).	Local LCD; Display Flow in Engineering Units; Provide Totalizer (See Notes, Line 39).					
Enclosure/Housing:	26	NEMA 4X; Solid state construction.	NEMA 4X; Solid state construction.					
Mounting:	27	Wall Mount; 316 S.S. hardware.	Wall Mount; 316 S.S. hardware.					
Connections:	28	Electrical Conn.: 1/2inch NPT.	Electrical Conn.: 3/4 inch NPT.					
Commun. Cable:	29	Shielded Cable to flow tube.	Shielded Cable to flow tube.					
Area Classification:	30	Not Applicable	Not Applicable					
Additional Features:	31	Automatic zeroing.	Automatic zeroing.					
NOTES								
Function:	32	System shall monitor liquid flows, display monitored flow value, and output a signal proportional to monitored flow.						
Installation:	33	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.						
Calibration:	34	Provide ISO Factory Calibration Certificate. Provide one calibrator suitable to calibrate all flow tubes provided.						
Accuracy:	35	Accuracy shall be: <ul style="list-style-type: none"> - Unaffected by changes in fluid velocity, density, pressure, temp. or conductivity (above min. conductivity limits). - Verified by flow test curves. Submit flow test curves for furnished meters with a minimum of 10 equally spaced flow points, using water and a weight or volume tank. A "master meter" used as a reference standard is not acceptable. A test setup shall be submitted and approved prior to testing.						
Span Adjustment:	36	Unit shall have pre-calibrated continuous span adjustment over entire range. Provide direct reading thumbwheel switch or potentiometer for 1-31 ft/sec.						
Signal Conditioning:	37	Adjustable signal conditioning damping circuit with response times of 1-25 seconds minimum.						
Low Flow Cutoff:	38	Automatic low flow cutoff circuitry shall stop pulse output and local totalization when flow drops below 0.5% ±0.2% of calibrated upper range value.						
Totalizer:	39	Totalizer shall have 2 internal counters with a maximum 8 counter places.						
		<ul style="list-style-type: none"> - Integral with transmitter and visible through viewing window, or externally mounted adjacent to transmitter in a separate NEMA 4X enclosure or conduit with viewing window. 						
Spool Piece:	40	Provide a replacement spool piece for each size flow tube where no bypass piping is provided.						
	41							
MANUFACTURE		Provide products of one of the following, Or Equal:						
Manufacturer:	42	Krohne America, Inc.	Endress & Hauser	ABB				

Long Beach WPCP Consolidation
Pump Station Conversion

13420-7

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Transmitter - Radar Type			SHEET 1 OF 2
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO. 13420 - 3.3.A.1.2
TAG NO.		LE/LIT - 9502-02-BP	LE/LIT - 9502-01	LE/LIT - 9502-02
Ref. Dwg. No.:	1	I-03	I-04	I-04
PROCESS				
Location:	2	Bypass Pump Station	Grinder Forebay	Grinder Forebay
Service:	3	Wet Well	Grinder Forebay	Grinder Forebay
Vessel / Line No.:	4	N/A	N/A	N/A
Fluid:	5	Screened Sewage	Raw Sewage	Raw Sewage
Temp. Min/Max:	6	32°F/140°F	32°F/140°F	32°F/140°F
Level Min/Max:	7	EL -9.00 / EL 15.17	EL -9.00 / EL 15.17	EL -9.00 / EL 15.17
PERFORMANCE				
Range:	8	98.43 ft	98.43 ft	98.43 ft
Accuracy:	9	Deviation ≤ 1mm	Deviation ≤ 1mm	Deviation ≤ 1mm
Temperature:	10	-321°F to 392°F	-321°F to 392°F	-321°F to 392°F
Process Pressure:	11	14.5psig to 362.5psig	14.5psig to 362.5psig	14.5psig to 362.5psig
Vibration	12	20-2000 Hz.	20-2000 Hz.	20-2000 Hz.
Reaction Time:	13			
SENSOR				
Type:	14	Type Antenna.	Type Antenna.	Type Antenna.
Frequency:	15	80GHz; (See Notes, Line 35).	80GHz; (See Notes, Line 35).	80GHz; (See Notes, Line 35).
Blanking:	16	Adjustable Blanking Distance.	Adjustable Blanking Distance.	Adjustable Blanking Distance.
Mounting:	17	Integral Mount with Transmitter. Flange 6" 150lb FF, ASME / PP-GF30	Integral Mount with Transmitter. Flange 6" 150lb FF, ASME / PP-GF30	Integral Mount with Transmitter. Flange 6" 150lb FF, ASME / PP-GF30
Additional Features:	18			
TRANSMITTER				
Type:	19	Microprocessor based Transmitter.	Microprocessor based Transmitter.	Microprocessor based Transmitter.
Input:	20	Measuring Range.	Measuring Range.	Measuring Range.
Output:	21	4-20 mADC isolated, into 0-550 ohms.	4-20 mADC isolated, into 0-550 ohms.	4-20 mADC isolated, into 0-550 ohms.
Power Supply:	22	24 VDC Loop Power.	24 VDC Loop Power.	24 VDC Loop Power.
Relays:	23	As Required.	As Required.	As Required.
Indication / Display:	24	Local LCD; Level Indication in Engineering Units.	Local LCD; Level Indication in Engineering Units.	Local LCD; Level Indication in Engineering Units.
Software:	25	As Required by Manufacturer.	As Required by Manufacturer.	As Required by Manufacturer.
Enclosure/Housing:	26	Powder Coated Aluminum Enclosure.	Powder Coated Aluminum Enclosure.	Powder Coated Aluminum Enclosure.
Mounting:	27	Integral Mount with Transmitter. Flange 3" 150lb FF, ASME / PP-GF30	Integral Mount with Transmitter. Flange 3" 150lb FF, ASME / PP-GF30	Integral Mount with Transmitter. Flange 3" 150lb FF, ASME / PP-GF30
Connections:	28	Electrical Conn.: 1/2 inch NPT.	Electrical Conn.: 1/2 inch NPT.	Electrical Conn.: 1/2 inch NPT.
Area Classification:	29	FM (XP) CL I, DIV1, GP ABCD	FM (XP) CL I, DIV1, GP ABCD	FM (XP) CL I, DIV1, GP ABCD
Additional Features:	30	IP68	IP68	IP68
NOTES				
Function:	31	Microprocessor based, non-contacting, radar type continuous liquid level measuring system consisting of an antenna with attached transmitter shall produce an output signal linear with level.		
Installation:	32	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.		
Calibration:	33	Provide ISO Factory Calibration Certificate.		
Antenna Extension:	34	N/A		
Frequency:	35	80G Hz: Beam angle 3°		
	36			
	37			
	38			
MANUFACTURE		Provide products of one of the following, Or Equal:		
Manufacturer:	39	VEGAPULS 64	Rosemount	

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Transmitter - Radar Type			SHEET 2 OF 2
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO. 13420 - 3.3.A.1.2
TAG NO.		LE/LIT - 9502-03	LE/LIT - 9502-04	LE/LIT - 9502-05
Ref. Dwg. No.:	1	I-04	I-05	I-06
PROCESS				
Location:	2	Equalization Forebay	Wet Well No.1	Wet Well No.2
Service:	3	Equalization Forebay	Wet Well No.1	Wet Well No.2
Vessel / Line No.:	4	N/A	N/A	N/A
Fluid:	5	Grinded Sewage	Grinded Sewage	Grinded Sewage
Temp. Min/Max:	6	32°F/140°F	32°F/140°F	32°F/140°F
Level Min/Max:	7	EL -9.00 / EL 15.17	EL -9.00 / EL 15.17	EL -9.00 / EL 15.17
PERFORMANCE				
Range:	8	98.43 ft	98.43 ft	98.43 ft
Accuracy:	9	Deviation ≤ 1mm	Deviation ≤ 1mm	Deviation ≤ 1mm
Temperature:	10	-321°F to 392°F	-321°F to 392°F	-321°F to 392°F
Process Pressure:	11	14.5psig to 362.5psig	14.5psig to 362.5psig	14.5psig to 362.5psig
Vibration	12	20-2000 Hz.	20-2000 Hz.	20-2000 Hz.
Reaction Time:	13			
SENSOR				
Type:	14	Type Antenna.	Type Antenna.	Type Antenna.
Frequency:	15	80GHz; (See Notes, Line 35).	80GHz; (See Notes, Line 35).	80GHz; (See Notes, Line 35).
Blanking:	16	Adjustable Blanking Distance.	Adjustable Blanking Distance.	Adjustable Blanking Distance.
Mounting:	17	Integral Mount with Transmitter. Flange 6" 150lb FF, ASME / PP-GF30	Integral Mount with Transmitter. Flange 6" 150lb FF, ASME / PP-GF30	Integral Mount with Transmitter. Flange 6" 150lb FF, ASME / PP-GF30
Additional Features:	18			
TRANSMITTER				
Type:	19	Microprocessor based Transmitter.	Microprocessor based Transmitter.	Microprocessor based Transmitter.
Input:	20	Measuring Range.	Measuring Range.	Measuring Range.
Output:	21	4-20 mADC isolated, into 0-550 ohms.	4-20 mADC isolated, into 0-550 ohms.	4-20 mADC isolated, into 0-550 ohms.
Power Supply:	22	24 VDC Loop Power.	24 VDC Loop Power.	24 VDC Loop Power.
Relays:	23	As Required.	As Required.	As Required.
Indication / Display:	24	Local LCD; Level Indication in Engineering Units.	Local LCD; Level Indication in Engineering Units.	Local LCD; Level Indication in Engineering Units.
Software:	25	As Required by Manufacturer.	As Required by Manufacturer.	As Required by Manufacturer.
Enclosure/Housing:	26	Powder Coated Aluminum Enclosure.	Powder Coated Aluminum Enclosure.	Powder Coated Aluminum Enclosure.
Mounting:	27	Integral Mount with Transmitter. Flange 3" 150lb FF, ASME / PP-GF30	Integral Mount with Transmitter. Flange 3" 150lb FF, ASME / PP-GF30	Integral Mount with Transmitter. Flange 3" 150lb FF, ASME / PP-GF30
Connections:	28	Electrical Conn.: 1/2 inch NPT.	Electrical Conn.: 1/2 inch NPT.	Electrical Conn.: 1/2 inch NPT.
Area Classification:	29	FM (XP) CL I, DIV1, GP ABCD	FM (XP) CL I, DIV1, GP ABCD	FM (XP) CL I, DIV1, GP ABCD
Additional Features:	30	IP68	IP68	IP68
NOTES				
Function:	31	Microprocessor based, non-contacting, radar type continuous liquid level measuring system consisting of an antenna with attached transmitter shall produce an output signal linear with level.		
Installation:	32	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.		
Calibration:	33	Provide ISO Factory Calibration Certificate.		
Antenna Extension:	34	N/A		
Frequency:	35	80G Hz: Beam angle 3°		
	36			
	37			
	38			
MANUFACTURE		Provide products of one of the following, Or Equal:		
Manufacturer:	39	VEGAPULS 64	Rosemount	

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Switch - Float Type (Single Point)			SHEET	1	OF	5
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO. 13420 - 3.3.A.1.3	ADDENDUM/C.O.		
TAG NO.		LSLL-9502-03-BP	LSL-9502-03-BP	LSH-9502-03-BP			
Ref. Dwg. No.:	1	I-03	I-03	I-03			
PROCESS							
Location:	2	Bypass Pump Station	Bypass Pump Station	Bypass Pump Station			
Service:	3						
Vessel / Line No.:	4	Wet Well	Wet Well	Wet Well			
Fluid:	5	Screened Sewage	Screened Sewage	Screened Sewage			
Temp. Min/Max:	6	0°F - 100°F	0°F - 100°F	0°F - 100°F			
Level Min/Max:	7						
Density Min/Max:	8	45 lb/ft3 / 62.4lb/ft3	45 lb/ft3 / 62.4lb/ft3	45 lb/ft3 / 62.4lb/ft3			
PERFORMANCE							
Operating Temp.:	9	32°F/140°F	32°F/140°F	32°F/140°F			
SWITCH							
Type:	10	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.			
Relays:	11	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.			
Switch Action:	12	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.			
Setpoints:	13	Field Determined	Field Determined	Field Determined			
Enclosure/Housing:	14	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.			
Mounting:	15	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)			
Electrical Cable:	16	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.			
Area Classification:	17	Provide separate Intrinsically Safe Relays	Provide separate Intrinsically Safe Relays	Provide separate Intrinsically Safe Relays			
Additional Features:	18	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).			
NOTES							
General:	19	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.					
Installation:	20	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.					
Weight:	21	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.					
	22	Provide Cable Mounting Clip from same manufacturer.					
	23						
	24						
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	29						
	30						
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	32						
	33						
MANUFACTURE		Provide products of one of the following, Or Equal:					
Manufacturer:	34	CONTEGRA FS 90	FLYGT - Division of ITT Industries	STI			

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Switch - Float Type (Single Point)			SHEET	2	OF	5
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO. 13420 - 3.3.A.1.3	ADDENDUM/C.O.		
TAG NO.		LSHH-9502-03-BP	LSH - 9502-01	LSLL-9502-02			
Ref. Dwg. No.:	1	I-03	I-04	I-05			
PROCESS							
Location:	2	Bypass Pump Station	Pump Station	Pump Station			
Service:	3						
Vessel / Line No.:	4	Wet Well	Grinder Forabay	Wet Well No.1			
Fluid:	5	Screened Sewage	Raw Sewage	Grinded Sewage			
Temp. Min/Max:	6	0°F - 100°F	0°F - 100°F	0°F - 100°F			
Level Min/Max:	7						
Density Min/Max:	8	45 lb/ft3 / 62.4lb/ft3	45 lb/ft3 / 62.4lb/ft3	45 lb/ft3 / 62.4lb/ft3			
PERFORMANCE							
Operating Temp.:	9	32°F/140°F	32°F/140°F	32°F/140°F			
SWITCH							
Type:	10	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.			
Relays:	11	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.			
Switch Action:	12	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.			
Setpoints:	13	Field Determined	Field Determined	Field Determined			
Enclosure/Housing:	14	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.			
Mounting:	15	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)			
Electrical Cable:	16	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.			
Area Classification:	17	Provide separate Intrinsically Safe Relays	Provide separate Intrinsically Safe Relays	Provide separate Intrinsically Safe Relays			
Additional Features:	18	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).			
NOTES							
General:	19	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.					
Installation:	20	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.					
Weight:	21	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.					
	22	Provide Cable Mounting Clip from same manufacturer.					
	23						
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MANUFACTURE		Provide products of one of the following, Or Equal:					
Manufacturer:	34	CONTEGRA FS 90	FLYGT - Division of ITT Industries	STI			

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Switch - Float Type (Single Point)			SHEET	3	OF	5	
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO. 13420 - 3.3.A.1.3	ADDENDUM/C.O.			
TAG NO.		LSL-9502-02	LSH-9502-02	LSHH-9502-02				
Ref. Dwg. No.:	1	I-05	I-05	I-05				
PROCESS								
Location:	2	Pump Station	Pump Station	Pump Station				
Service:	3							
Vessel / Line No.:	4	Wet Well No.1	Wet Well No.1	Wet Well No.1				
Fluid:	5	Grinded Sewage	Grinded Sewage	Grinded Sewage				
Temp. Min/Max:	6	0°F - 100°F	0°F - 100°F	0°F - 100°F				
Level Min/Max:	7							
Density Min/Max:	8	45 lb/ft3 / 62.4lb/ft3	45 lb/ft3 / 62.4lb/ft3	45 lb/ft3 / 62.4lb/ft3				
PERFORMANCE								
Operating Temp.:	9	32°F/140°F	32°F/140°F	32°F/140°F				
SWITCH								
Type:	10	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.				
Relays:	11	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.				
Switch Action:	12	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.				
Setpoints:	13	Field Determined	Field Determined	Field Determined				
Enclosure/Housing:	14	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.				
Mounting:	15	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)				
Electrical Cable:	16	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.				
Area Classification:	17	Provide separate Intrinsically Safe Relays	Provide separate Intrinsically Safe Relays	Provide separate Intrinsically Safe Relays				
Additional Features:	18	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).				
NOTES								
General:	19	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.						
Installation:	20	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.						
Weight:	21	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.						
	22	Provide Cable Mounting Clip from same manufacturer.						
	23							
	24							
	25							
	26							
	27							
	28							
	29							
	30							
	31							
	32							
	33							
MANUFACTURE		Provide products of one of the following, Or Equal:						
Manufacturer:	34	CONTEGRA FS 90	FLYGT - Division of ITT Industries	STI				

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Switch - Float Type (Single Point)			SHEET	4	OF	5
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO. 13420 - 3.3.A.1.3	ADDENDUM/C.O.		
TAG NO.		LSLL-9502-03	LSL-9502-03	LSH-9502-03			
Ref. Dwg. No.:	1	I-06	I-06	I-06			
PROCESS							
Location:	2	Pump Station	Pump Station	Pump Station			
Service:	3						
Vessel / Line No.:	4	Wet Well No.2	Wet Well No.2	Wet Well No.2			
Fluid:	5	Grinded Sewage	Grinded Sewage	Grinded Sewage			
Temp. Min/Max:	6	0°F - 100°F	0°F - 100°F	0°F - 100°F			
Level Min/Max:	7						
Density Min/Max:	8	45 lb/ft3 / 62.4lb/ft3	45 lb/ft3 / 62.4lb/ft3	45 lb/ft3 / 62.4lb/ft3			
PERFORMANCE							
Operating Temp.:	9	32°F/140°F	32°F/140°F	32°F/140°F			
SWITCH							
Type:	10	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.			
Relays:	11	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.			
Switch Action:	12	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.			
Setpoints:	13	Field Determined	Field Determined	Field Determined			
Enclosure/Housing:	14	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.			
Mounting:	15	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)			
Electrical Cable:	16	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.			
Area Classification:	17	Provide separate Intrinsically Safe Relays	Provide separate Intrinsically Safe Relays	Provide separate Intrinsically Safe Relays			
Additional Features:	18	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).	Weight (See Notes, Line 21).			
NOTES							
General:	19	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.					
Installation:	20	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.					
Weight:	21	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.					
	22	Provide Cable Mounting Clip from same manufacturer.					
	23						
	24						
	25						
	26						
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	29						
	30						
	31						
	32						
	33						
MANUFACTURE		Provide products of one of the following, Or Equal:					
Manufacturer:	34	CONTEGRA FS 90	FLYGT - Division of ITT Industries	STI			

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Level Switch - Float Type (Single Point)			SHEET	5	OF	5
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO.	13420 - 3.3.A.1.3	ADDENDUM/C.O.	
TAG NO.		LSHH-9502-03					
Ref. Dwg. No.:	1	I-06					
PROCESS							
Location:	2	Pump Station					
Service:	3						
Vessel / Line No.:	4	Wet Well No.2					
Fluid:	5	Grinded Sewage					
Temp. Min/Max:	6	0°F - 100°F					
Level Min/Max:	7						
Density Min/Max:	8	45 lb/ft3 / 62.4lb/ft3					
PERFORMANCE							
Operating Temp.:	9	32°F/140°F					
SWITCH							
Type:	10	Displacement Type Liquid Level Sensor with Mechanical (Non-Mercury) Switch.					
Relays:	11	SPDT rated at 5A resistive at 30 VDC and 4A rating at 250VAC.					
Switch Action:	12	Switch Opens/Closes at predefined setpoint(s); Normally Closed contact.					
Setpoints:	13	Field Determined					
Enclosure/Housing:	14	Hollow hermetically sealed, 316 S.S 5 1/2" Diameter; Contains switch and weight.					
Mounting:	15	316 S.S Cable Mount; 316 S.S. Hardware. (See Notes, Line 22)					
Electrical Cable:	16	Heavy duty SEOW, 16 gauge, 4 cond. Rated "continuous service" Length as required.					
Area Classification:	17	Provide separate Intrinsically Safe Relays					
Additional Features:	18	Weight (See Notes, Line 21).					
NOTES							
General:	19	Direct acting, pear shaped, eccentric weighted, displacement type liquid level sensor.					
Installation:	20	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.					
Weight:	21	Provide eccentric metal weight to cause sensor to hang straight down from cable when not immersed and only allow float to pivot when immersed in liquid.					
	22	Provide Cable Mounting Clip from same manufacturer.					
	23						
	24						
	25						
	26						
	27						
	28						
	29						
	30						
	31						
	32						
	33						
MANUFACTURE		Provide products of one of the following, Or Equal:					
Manufacturer:	34	CONTEGRA FS 90	FLYGT - Division of ITT Industries	STI			

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Diaphragm Seal		SHEET	1	OF	1																																																																																												
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.		SPEC. NO. 13420 - 3.3.A.1.4	ADDENDUM/C.O.																																																																																														
DESCRIPTION																																																																																																		
	1	Furnish diaphragm seals for pressure gauges and switches as specified in this Section.																																																																																																
	2	The complete diaphragm seal assembly, including gauge, switch or transmitter, shall be factory assembled, filled and calibrated to the ranges and switch setpoints specified prior to shipment.																																																																																																
	3	System Supplier Manufacturer shall assure that the fill volumes and sensitivities of the supplied seals and diaphragms are suitable to provide the required gauge, switch or transmitter accuracy over the specified measurement range or at switch setpoints.																																																																																																
	4	Location and orientation of the gauges, switches and seal assemblies shall be coordinated with the actual piping and equipment installations so that gauges and indicators shall be easily read and accessed for maintenance by plant personnel.																																																																																																
	5	Where field mounting and orientation conflicts arise due to incomplete coordination with field changes in the process piping and equipment installation, assemblies shall be relocated, re-orientated, re-assembled and re-calibrated as directed by the ENGINEER.																																																																																																
GENERAL																																																																																																		
Filling Liquid:	6	Use silicone except for process fluids containing chlorine. When the process fluid contains chlorine, the filling liquid shall be Halocarbon 63 or Fluorolube 63.																																																																																																
Instrument Conn.:	7	1/4 inch NPT.																																																																																																
Process Conn.:	8	1/2 inch NPT.																																																																																																
Flushing Conn.:	9	1/4 inch NPT.																																																																																																
Pressure Rating:	10	Working Pressure Rating shall be equal to or greater than the attached gauge or switch operating pressure specified in the Exposed Piping Schedule in "Exposed Piping" Section; Install whichever is greater.																																																																																																
MATERIALS																																																																																																		
Top Housing:	11	316 S.S.																																																																																																
Process Side	12	316L S.S. for metallic piping; PVC or CPVC to match non-metallic piping.																																																																																																
Bolting:	13	316 S.S.																																																																																																
Other:	14																																																																																																	
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Fill/bleed Screw:	15	Provide fill/bleed screw to permit filling of instrument and diaphragm seal.																																																																																																
Clean-Out Ring:	16	Provide a clean-out ring which holds the diaphragm captive in the upper housing to allow the upper housing assembly to be removed for recalibration or cleaning of the process side housing without the loss of filling liquid or change in calibration.																																																																																																
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NOTES																																																																																																		
General:	19	For Water Service with Copper Pipe, provide Buna-N diaphragm and Brass Housing.																																																																																																
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		Ashcroft	WIKA Instrument Corp.	Ametek																																																																																														

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Pressure Gauge - Bourdon Type			SHEET	1	OF	1
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.			SPEC. NO.	13420 - 3.3.A.1.5	ADDENDUM/C.O.	
GAUGE	Type:	1	Liquid Filled Gauge for pressure ranges >15 psi and vacuum ranges <30 inches-Hg.				
	Element:	2	316 S.S. Bourdon Tube and Socket; Heliarc Welded, unless otherwise specified.				
	Accuracy:	3	±0.5% of span.				
	Diaphragm Seal:	4	A diaphragm seal is required for all mediums except air or potable water. Diaphragm material shall be compatible with the process fluid. Refer to Diaphragm Seal Data Sheet for requirements.				
	Pressure Snubber:	5	Provide sintered stainless steel or brass (for copper pipe) pressure snubber threaded into gauge socket or in external steel housing with 1/4 inch NPT male and female connections.				
	Indication / Display:	6	Glass window; White and Black markings on Dial; 300 series S.S. movement; Built-In overload/underload stops; Rotary geared with Teflon S coating, or cam and roller type.				
	Enclosure/Housing:	7	4-1/2 inch Black Case; Solid front design constructed of glass filled polyester; Full blowout back for overpressure protection.				
	Mounting:	8	Stem Mounting; 1/4 inch male NPT connection on bottom.				
	Additional Features:	9	Threaded, glass filled polyester ring.				
NOTES	General:	10	All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart.				
	Installation:	11	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.				
	Calibration:	12	Adjustable pointer and externally accessible zero adjustment; Provide ISO Factory Calibration Certificate.				
	Process Isolation:	13	Provide all valves for process isolation in accordance with specifications in this Section.				
	Fill Fluid:	14	Use silicone except for process fluids containing chlorine. When the process fluid contains chlorine, the filling liquid shall be Halocarbon 63 or Fluorolube 63.				
		15	Pressure indicator and diaphragm seal shall be of the same manufacturer and factory assembled. Provide factory assembly certificate.				
		16					
		17					
MANUFACTURE	Manufacturer:	18	Provide products of one of the following, Or Equal:				
			Ashcroft	Ametek	WIKA Instrument Corporation		
INSTRUMENT LIST	Requirements specified above shall apply to all instrument tag numbers listed below.						
			Tag No.	Process Fluid	Area Classification Process Press. Min/Max	Performance Range	Location / Service Reference Drawing No.
	1	PI-9503-01-BP	Screened Sewage	0 - 100PSI	0-80 PSI	Bypass Sewage Pump No.1 I-03	
	2	PI-9503-02-BP	Screened Sewage	0 - 100PSI	0-80 PSI	Bypass Sewage Pump No.2 I-03	
	3	PI-9503-03-BP	Screened Sewage	0 - 100PSI	0-80 PSI	Bypass Sewage Pump No.3 I-03	
	4	PI-9503-01	Grinded Sewage	0 - 100PSI	0-80 PSI	Sewage Pump No.1 I-05	
	5	PI-9503-02	Grinded Sewage	0 - 100PSI	0-80 PSI	Sewage Pump No.2 I-05	
	6	PI-9503-03	Grinded Sewage	0 - 100PSI	0-80 PSI	Sewage Pump No.3 I-05	
	7	PI-9503-04	Grinded Sewage	0 - 100PSI	0-80 PSI	Sewage Pump No.4 I-06	
	8	PI-9503-05	Grinded Sewage	0 - 100PSI	0-80 PSI	Sewage Pump No.5 I-06	
	9	PI-9503-06	Grinded Sewage	0 - 100PSI	0-80 PSI	Sewage Pump No.6 I-06	
	10						
	11						
	12						
	13						
	14						
	15						

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Pressure Transmitter		SHEET	1	OF	1
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.		SPEC. NO. 13420 - 3.3.A.1.6	ADDENDUM/C.O.		
TAG NO.		PIT-9504				
Ref. Dwg. No.:	1	I-05				
PROCESS						
Location:	2	Valve Chamber				
Service:	3	Sewage Pumps Discharge Header				
Vessel / Line No.:	4	24" discharge line				
Fluid:	5	Screened sewage				
Temp. Min/Max:	6	32°F/140°F				
Press. Min/Max:	7					
PERFORMANCE						
Range:	8	-300 to 300 PSI				
Accuracy:	9	±0.1% of calibrated span (includes effects of linearity, hysteresis, and repeatability).				
Temperature:	10	-20 to 180 °F; (See Notes, Line 35).				
Repeatability:	11	±0.05% of calibrated span.				
Damping:	12	Internal Adjustment.				
Hysteresis:	13	±0.05% of calibrated span.				
Stability:	14	Less than ±0.25% of Transmitter upper range limit (drift over 6 month period).				
Overrange Protec.:	15	Positive overrange protection: At least 1.25 times maximum span limit.				
SENSOR						
Type:	16	Pressure Gauge.				
Element:	17	Transducer.				
Diaphragm Seal:	18	(See Notes, Line 40).				
Capillary Tubing:	19	Not Required				
Mounting:	20	2" ANSI/SME B16.5 Class 150 SST Flange / Process Port Mount.				
Area Classification:	21	FM Explosion-proof. Dust Ignition-proof				
Additional Features:	22	Class I, Div 1, Groups A, B, C and D				
TRANSMITTER						
Type:	23	Solid state, 2-wire, Differential Capacitance or Resonant Wire Type Transmitter.				
Output:	24	4-20 mADC; (See Notes, Line 36).				
Power Supply:	25	24 VDC; Operates on power from receiver or remote power supply.				
Indication / Display:	26	Integral LCD Indication for Pressure in Engineering Units.				
Enclosure/Housing:	27	NEMA 4X; Epoxy painted; Die-cast low copper aluminum alloy housing; Covers threaded and seated on O-rings.				
Mounting:	28	Integral to sensor.				
Connections:	29	Electrical Conn.: 1/2"-14 NPT.				
Area Classification:	30	Class I, Div 1, Groups A, B, C and D				
Additional Features:	31	Built-In Surge and RFI protection.				
NOTES						
General:	32	All wetted parts shall be compatible with the process fluid. Refer to Materials Compatibility Chart.				
Installation:	33	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.				
Calibration:	34	Zero and Span (coarse & fine) adjustments in electronics compartment. Provide Zero Elevation and Suppression so that the extent of suppression plus the calibration span does not exceed the upper range limits of the sensor.				
Amb. Temp. Effect:	35	Total Error per 100 deg. F change between Ambient Temperature Limits: < ±1.0% transmitter range limit (max. span).				
Output:	36	Digital process variable signal superimposed on 4-20 mADC signal without compromising loop integrity.				
Shutoff Valve:	37	Provide a single shutoff ball valve at each process line tap to enable live process removal of transmitter.				
Calibration Valve:	38	For each unit, provide an additional calibration valve port.				
Hand-held Unit:	39	Provide a hand held interface with keyboard and LED display for easy configuration and testing of transmitter.				
Diaphragm Seal:	40	A diaphragm seal is required for all mediums except clean air or potable water. Diaphragm material shall be compatible with the process fluid. Refer to Diaphragm Seal Data Sheet for requirements.				
	41					
MANUFACTURE		Provide products of one of the following, Or Equal:				
Manufacturer:	42	Rosemount - Division of Emerson	Endress and Hauser	Invensys - Division of Foxboro		

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

PRODUCT	Temperature Transmitter - RTD Type		SHEET	1	OF	1
PROJECT	DEPARTMENT OF PUBLIC WORKS - NASSAU COUNTY, NY - LONG BEACH CONSOLIDATION PUMP STATION CONVERSION.		SPEC. NO. 13420 - 3.3.A.1.7	ADDENDUM/C.O.		
TAG NO.		TIT-9509-05				
Ref. Dwg. No.:	1	I-07				
PROCESS						
Location:	2	Electrical Room				
Service:	3	Pump Station				
Vessel / Line No.:	4	Not Applicable				
Fluid:	5	Ambient Air				
Temp. Min/Max:	6	0°F/140°F				
PERFORMANCE						
Range:	7	0°F/140°F				
Sensor Accuracy:	8	±0.5 deg F or ±0.5% of actual temp greater of two from 32-1200 deg F.				
Trans. Accuracy:	9	±0.2% of calibrated span, including repeatability and linearity.				
Stability:	10	<0.1 deg F shift from initial calibration in 1 year.				
Resistance:	11	100 ohms at 32 degrees F; 0.22 ohms per degree F change.				
SENSOR						
Type:	12	3 Wire RTD Type, Suitable for Measurement of Room Air temperature.				
Element:	13	Platinum RTD element.				
Sheath:	14	316S.S.; Sheath Length, diameter and grounding state as recommended by manufacturer.				
Thermowell:	15	Not Applicable.				
Enclosure/Housing:	16	Waterproof Housing.				
Mounting:	17	Wall Mount or Integral to Transmitter.				
Commun. Cable:	18	As required.				
Additional Features:	19					
TRANSMITTER						
Type:	20	Solid-State Electronic Transmitter.				
Input:	21	Input isolation.				
Output:	22	4-20mA DC direct acting isolated, 0-600 ohms.				
Power Supply:	23	24 VDC; (See Notes, Line 34).				
Relays:	24	As required.				
Indication / Display:	25	3-1/2 digit LCD visible through enclosure window; Engineering Units.				
Enclosure/Housing:	26	NEMA 4X; Die Cast, Low Copper aluminum enclosure.				
Mounting:	27	Wall Mount.				
Connections:	28	3/4 inch internal NPT; Barrier terminal strip wiring connections.				
Area Classification:	29	Not Applicable.				
Additional Features:	30	Temperature Effect (See Notes, Line 36); Built in EMI and RFI protection.				
NOTES						
Function:	31	Sensor shall create electrical resistance proportional to process medium temperature. Transmitter shall condition and convert resistance to provide a DC analog output signal linearly proportional to process medium temperature.				
Installation:	32	Refer to Contract Drawing Installation Details and manufacturer's recommendations for installation.				
Calibration:	33	Provide ISO Factory Calibration Certificate. Unit shall be factory calibrated for operating temperature and field adjustable for span and zero settings.				
Thermowell:	34	Thermowells provide isolation between temperature sensor and environment allowing removal/replacement of temperature sensor without compromising ambient region or process. Thermowell material shall be compatible with the process fluid.				
Power Supply	35	Transmitter Power Supply Effect: Maximum of ± 0.005% of span per one VDC change in power supply.				
Temperature Effect:	36	Transmitter Ambient Temperature Effect: Not more than ±0.5% span for a 50 deg. C change in ambient temperature within operative limits. .				
	37					
MANUFACTURE		Provide products of one of the following, Or Equal:				
Manufacturer:	38	Rosemount - Division of Emerson	Invensys - Division of Foxboro	Endress+Houser		

DATA SHEETS - PRIMARY SENSORS AND FIELD INSTRUMENTS

REFERENCES: Materials Compatibility and Area Classification Charts

MATERIALS COMPATIBILITY CHART

<u>Process Fluid</u>	<u>Diaphragm</u>	<u>O-Ring</u>	<u>Gasket</u>			
Wastewater / Sludge	316 SS	Buna-N	Buna-N			
Potassium	Carpenter 20	Viton	Viton			
Sodium Hypochlorite	Teflon	Teflon	Teflon			
Polymer	316 SS	Buna-N	Buna-N			
Phosphoric Acid	316 SS	Buna-N	Buna-N			
Alum	316 SS	Teflon	Teflon			
Chlorine Gas	Teflon	Teflon	Teflon			
Chlorine Solution	Teflon	Teflon	Teflon			
Sodium Chloride	Teflon	Teflon	Teflon			
Ammonia	316 SS	Teflon	Teflon			
Methanol	316 SS	Teflon	Teflon			
Carbon	316 SS	Buna-N	Buna-N			
Lime	316 SS	Teflon	Teflon			
Ferric Chloride	Teflon	Teflon	Teflon			
Caustic Soda	Teflon	Teflon	Teflon			
Sodium Bisulfite	Teflon	Teflon	Teflon			
Sodium Hydroxide	Teflon	Teflon	Teflon			
Scrubber Solution	Teflon	Teflon	Teflon			
Fluoride	Hastelloy C	Viton	Viton			
Phosphate	316 SS	Teflon	Teflon			

AREA CLASSIFICATION CHART

<u>Location</u>	<u>Description</u>
Class 1	Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.
Class 1, Division 1	A location (1) In which ignitable concentrations of flammable gases or vapors can exist under normal operating conditions; or (2) In which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or (3) In which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors and might also cause simultaneous failure of electrical equipment in such a way as to directly cause the electrical equipment to become a source of ignition.
Class 1, Division 2	A location (1) In which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or (2) In which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation and might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) That is adjacent to a Class I, Division 1 location, and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.
Class 2	Class II locations are those that are hazardous because of the presence of combustible dust.
Class 2, Division 1	A location (1) In which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures; or (2) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, through operation of protection devices, or from other causes; or (3) In which Group E combustible dusts may be present in quantities sufficient to be hazardous.
Class 2, Division 2	A location (1) In which combustible dusts due to abnormal operations may be present in the air in quantities sufficient to produce explosive or ignitable mixtures; or (2) Where combustible dust accumulations are present but are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but could as a result of infrequent malfunctioning of handling or processing equipment become suspended in the air; or (3) In which combustible dust accumulations on, in, or in the vicinity of the electrical equipment could be sufficient to interfere with the safe dissipation of heat from electrical equipment, or could be ignitable by abnormal operation or failure of electrical equipment.
Class 3	Class III locations are those that are hazardous because of the presence of easily ignitable fibers or filings, but in which such fibers or filings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.
Class 3, Division 1	A location in which easily ignitable fibers or materials producing filings are handled, manufactured or used.
Class 3, Division 2	A location in which easily ignitable fibers are stored or handled (except in the process of manufacture).

* Source: NEC 2005 Edition - Article 500

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SECTION 13430

PROCESS CONTROL SYSTEM PANELS AND ENCLOSURES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, start-up and place into satisfactory operation the control panels and enclosures required for a fully functional PCS.
2. Major Panels/Enclosures/Cabinets specified under this Section include but are not limited to:
 - a. Long Beach Consolidation Pump Station Main Control Panel (LBP_MCP) (NEMA 12)
 - b. Long Beach Remote Level Indicators Panel (LBP_LIP) (NEMA 12)
 - c. Long Beach Temporary Bypass Pump Station Control Panel (LBP_BCP) (NEMA 4X)

B. Related Sections:

1. Section 03300, Cast-In-Place Concrete.
2. Section 05051, Anchor Systems.
3. Section 13401, Process Control System General Provisions.
4. Section 13402, Process Control System Factory Testing.
5. Section 13403, Process Control System Start up and Field Testing.
6. Section 13440, Panel Mounted Instruments and Devices.
7. Section 13451, PLC Hardware and Software.
9. Division 11, Equipment.
10. Division 16, Electrical.

1.2 QUALITY ASSURANCE

A. Standards, Codes and Regulations:

1. Construction of panels and the installation and interconnection of all equipment and devices mounted within shall comply with applicable provisions of the following standards, codes and regulations:
 - a. National Fire Protection Association 79, Annex "D" Standards, (NFPA).
 - b. National Electrical Code, (NEC).
 - c. National Electrical Manufacturer's Association Standards, (NEMA).
 - d. American Society for Testing and Materials, (ASTM).
 - e. Operational Safety and Health Administration Regulations, (OSHA).
 - f. Underwriters' Laboratory, Inc., (UL).

- g. State and Local code requirements.
 - h. Where any conflict arises between codes or standards, the more stringent requirement shall apply.
 - 2. All materials and equipment shall be new and all panels shall be built in an Underwriters' Laboratory, Inc. (UL) approved panel shop and bear the UL label.
- B. General Design Requirements:
- 1. Comply with the requirements of Section 13401, Process Control System General Provisions.
- C. Factory Assembly and Testing:
- 1. Comply with the requirements of Section 13402, Process Control System Factory Testing.

1.3 SUBMITTALS

- A. Comply with the requirements of Section 13401, Process Control System General Provisions.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 13401, Process Control System General Provisions.
- B. Contractor shall coordinate with other trades to ensure that the Control Panels are not damaged during their mobilization and installation in their final locations.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION REQUIREMENTS

- A. Provide all electrical and/or pneumatic components and devices, support hardware, fasteners, interconnecting wiring and/or piping required to make the control panels and/or enclosures complete and operational.
- B. Locate and install all devices and components so that connections can be easily made and that there is ample room for servicing each item.
- C. Components for installation on panel exterior shall be located generally as shown. Layouts shall be submitted for review in accordance with Section 13401, Process Control System General Provisions.
- D. Panels and enclosures shall have full height front access doors.

- E. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.
- F. Provide sub-panels for installation of all relays and other internally mounted components.
- G. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.
- H. Provide copper grounding studs for all panel equipment.
- I. Provide the following convenience accessories inside of each control panel:
 - 1. One 120 VAC, 20A duplex, DIN-rail mount GFCI type receptacle.
 - 2. One or more 120 VAC fluorescent light fixtures with 40 watt lamp and protective plastic shield to span across the width of the panel but not less than two-thirds the width of the panel, as a minimum. Include snap switch, to turn on the light
 - 3. One 120 VAC, 20A, DIN-rail mount type receptacle for UPS connection.
 - 4. One Make Before Break Switch as UPS bypass switch.
 - 4. Service light with switch and duplex receptacle shall have its own circuit breaker and separate power feed.
- J. The bottom 12-inches of free standing panels shall be free of all devices, including terminal strips, to provide ease of installation and testing.
- K. No device shall be mounted less than 36-inches above the operating floor level, unless otherwise specified.

2.2 IDENTIFICATION

- A. Provide laminated plastic nameplates for identification of panels and components mounted thereon as follows:
 - 1. Nameplates shall be of 3/32-inch thick laminated phenolic type with white matte finish surface and black letter engraving.
 - 2. Panel identification nameplates to have 1/2-inch high letter engravings.
 - 3. Panel mounted component (e.g., control devices, indicating lights, selector switches, etc.) identification nameplates to have 1/4-inch high letter engravings.
 - 4. Nameplates shall be attached to the panel face with two stainless steel self-tapping screws. When use of self-tapping screws degrade panel's NEMA rating, retain NEMA rating intact by using gaskets on each side of panel surface and use retaining plate on the panel back that is same size as nameplate. When gaskets and retaining plate are used, use full penetration screws with nuts.
 - 5. Panels: Identify panel with nameplate engraved with panel name as provided on the drawings or as specified. Locate panel nameplate at top, center of the panel on the front face. Nameplate engravings shall include the full name of the panel and the panel abbreviation. Panel abbreviation shall be enclosed in parentheses

and on a separate line below the full panel name. Refer to the following example for line format:

Panel Identification Nameplate Line Format Example:

Long Beach Consolidation Pump Station Main Control Panel (LBP MCP)
--

6. Front Panel Mounted Devices: Identify front panel-mounted devices with nameplates engraved with functional description of the device. Nameplate engravings shall include the instrument or equipment tag number and descriptive title as shown and specified.
- B. Tag all internally mounted instruments in accordance with the following requirements:
 1. Tag numbers shall be as listed in the Instrument Index.
 2. The identifying tag number shall be permanently etched or embossed onto a laminated phenolic tag with white matte finish surface which shall be fastened to the device housing with stainless steel rivets or self-tapping screws of appropriate size.
 3. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter stainless steel wire rope.
 4. Identification tag shall be installed so that the numbers are easily visible to service personnel.
 5. Front of panel mounted instruments shall have the tag attached to rear of device.
 - C. Tag electric components and devices mounted within panels with high adhesive labels.
 - D. Identify terminal strips with nameplate engraved as "TB-XX" where "XX" is the numerical identification of terminal strip.
 - E. Identify terminals within each terminal strip with sequential numbers and wire numbers.
 - F. Tagging of the following items shall be accomplished with the use of adhesive plastic Brady USA, Inc. labels, or equal.
 1. All electrical devices (e.g., relays, timers, power supplies) mounted within control panels and enclosures.
 2. Tag all pneumatic lines.
 3. Numerically tag all terminal blocks on terminal strips.
 - G. Internal panel wiring shall be color-coded and numerically identified with unique wire numbers affixed at each end of each wire. Color coding shall be in accordance with panel wiring color code table, specified herein. Tagging shall be accomplished with the use of heat shrinkable plastic Brady USA, Inc. labels, or equal.
 1. Color code and numerically tag wiring at each end.

Color coding shall be as per the Panel Wiring Color Code Table below:

DESCRIPTION	COLOR
110 VAC PANEL POWER BEFORE AND FUSES OR BREAKERS	BLACK
CONTROLLED 110VAC POWER (i.e., AFTER RELAY CONTACTS, SELECTOR SWITCH CONTACTS, etc.)	RED
110 VAC POWER SOURCE FROM DEVICES EXTERNAL TTO PANEL	YELLOW
110 VAC NEUTRAL	WHITE
24 VDC POSITIVE POWER FROM POWER SUPPLIES	BROWN
24 VDC NEGATIVE POWER FROM POWER SUPPLIES	Not defined
CONTROLLED 24 VDC POWER (i.e., AFTER PLC OUTPUT CONTACTS, RELAY CONTACTS, etc.)	BLUE
24 VDC POSITIVE POWER FROM DEVICES EXTERNAL TO PANEL	ORANGE
24 VDC NEGATIVE POWER FROM DEVICES EXTERNAL TO PANEL	Not defined
24 VDC 4-20 mADC SIGNAL CABLE	GREY WITH RED POSITIVE, CLEAR NEGATIVE
GROUNDING WIRE	GREEN

2.3 PANELS AND ENCLOSURES

A. General:

1. Panels and enclosures shall meet the NEMA requirements for the type specified.
2. Sizes shown are estimates. Contractor shall furnish panels and enclosures amply sized to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring, tubing and other components installed within, as required.

B. Construction Features:

1. Control panels located inside control or electrical room areas shall be NEMA 12 rated.
 - a. Fabricate enclosures using minimum 14-gage steel for wall or frame mounted enclosures and minimum 12-gage for free standing enclosures. Steel shall be free of pitting and surface blemishes.

- b. Continuously weld all exterior seams and grind smooth. Also, surface grind complete removal of corrosion, burrs, sharp edges and mill scale.
- c. Reinforce sheet steel with steel angles where necessary to adequately support equipment and ensure rigidity and to preclude resonant vibrations.
- d. Panel shall be flat within 1/16-inch over a 24-inch by 24-inch area, or flat within 1/8-inch for a larger surface. Flatness shall be checked by using a 72-inch long straight edge. Out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.
- e. Use pan type construction for doors. Door widths shall not exceed 36-inches.
- f. Mount doors with full-length heavy-duty piano hinge with stainless steel hinge pins.
- g. Provide oil resistant gasket completely around each door or opening.
- h. Provide handle-operated, oil-tight, key-lockable three-point stainless steel latching system with rollers on latch-rods for easy door closing.
- i. Use stainless steel fasteners throughout.
- j. Provide interior mounting panels and shelves constructed of minimum 12-gage steel with a white enamel finish.
- k. Provide steel print pocket with white enamel finish.
- l. Provide enclosure mounting supports as required for floor, frame, or wall mounting.
- m. Provide all holes and cutouts for installation of conduit and equipment. Cable and piping to enter the enclosure through the bottom, unless otherwise noted. All conduit and piping openings and all conduits shall be sealed watertight.
- n. Completely clean all interior and exterior surfaces so they are free of corrosive residue, oil, grease and dirt. Zinc phosphatize for corrosion protection.
- o. One coat of primer shall be applied to all interior and exterior surfaces immediately after corrosion protection has been applied. Exterior surfaces shall then be given sufficient coats of primer surfacer, applied with sanding and cleaning between coats, until a Grade 1 finish can be produced on the finish coat.
- p. All interior surfaces shall be painted with two coats of semi-gloss white polyurethane enamel.
- q. All exterior surfaces shall be painted with a minimum of three finish coats of polyurethane enamel to ultimately produce a Grade 1 finish (super smooth; completely free of imperfections). Color to be selected by Engineer from complete selection of standard and custom color charts furnished by the manufacturer. Provide one extra quart of touch-up paint for each exterior finish color.
- r. Primer and finish paint shall be compatible and shall be a low VOC, high solids polyurethane enamel, Hi-Solids Polyurethane B65 W300 Series as manufactured by Sherwin-Williams, Inc. or equal.

- s. Provide one extra quart of touch-up paint for each exterior finish color.
- t. Control panels mounted outside and exposed to the elements shall have a sloping top enclosure to prevent accumulation of snow or water. Additionally, Operator Interface Terminal (OIT) screens shall be protected from direct exposure to UV light from the sun.
- 2. Control panels or Local Control Stations located in field shall be NEMA 4X rated.
 - a. Panels shall be Type 316L stainless steel construction with a minimum thickness of 12-gage for all surfaces (except those areas requiring reinforcement) having a smooth brushed finish.
 - b. Stainless steel screw clamp assemblies on three sides of each door.
 - c. Rolled lip around three sides of door and along top of enclosure opening.
 - d. Hasp and staple for padlocking.
 - e. Provide a clear plastic, gasketed lockable hinged door to encompass all non-NEMA 4 front of panel instruments.
 - f. Provide 3-inch high channel base assembly, with solid bottom, drilled to mate the panel to its floor pad.
 - g. Floor Pad: Refer to Part 3 of this Section.
- 3. Field Panels or Local Control Stations in classified areas (NEMA 7):
 - a. General: Explosion-proof control enclosures shall be used to house control, monitoring and measuring devices in hazardous environments. Enclosures shall be suitable for use in NEC Class 1, Groups C and D or Class II, Groups E, F and G applications and comply with UL and CSA standards.
 - b. Required Features:
 - 1) Light weight and corrosion resistant copper-free aluminum.
 - 2) Integral, cast-on mounting lugs.
 - 3) Left side door hinges.
 - 4) Viewing windows sized to suit internally mounted components.
 - 5) Stainless steel cover bolts.
 - 6) Cad-plated steel mounting pans.
 - c. Manufacturers: Provide explosion-proof control enclosures of one of the following:
 - 1. Adalet.
 - 2. Or equal.
- 4. Where the application applies and with the approval of Engineer, wall mounted enclosures may be provided. The enclosure shall comply with Paragraph B.1., B.2. or B.3.

C. Electrical Systems:

- 1. Control of Environment:
 - a. Indoor Panels:
 - 1) Provide adequately sized, automatically controlled 120 VAC strip heaters to maintain temperature 10°F above ambient for condensation prevention inside panels.

- 2) Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure.
Air conditioner shall have a minimum capacity of 4,000 BTU.
 - 3) Provide heat load calculations as supporting documentation if any of the above is deemed unnecessary.
2. Power Source and Internal Power Distribution:
 - a. General: Control panel power supply source, type, voltage, number of circuits and circuit ratings shall be as shown.
 - b. Panels shall be provided with an internal 120 VAC power distribution panel with number of circuits and separate circuit breakers sized as required to distribute power to the panel components and field instruments. Distribution panel shall contain two spare breakers, minimum.
 3. Wiring:
 - a. Internal wiring shall be Type MTW and THW stranded copper wire with thermoplastic insulation rated for 600 V at 90°C for single conductors, color coded and labeled with wire identification.
 - b. For DC panel signal wiring, use No. 18 minimum AWG shielded.
 - c. For DC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 14 minimum AWG. For wiring carrying more than 15 A, use sizes required by NEC standards.
 - d. Separate and shield low voltage signal wiring from power and control wiring by a minimum of 6-inches.
 - e. Group or bundle parallel runs of wire using covered troughs. Maximum bundle size to be 1-inch. Troughs shall have 40 percent spare capacity.
 - f. Install wire troughs as shown on panel layout drawing. Wire trough spacing and layout shall present a neat appearance. Angled runs are not acceptable.
 - g. Adequately support and restrain all wiring runs to prevent sagging or other movement.
 - h. Terminate all internal panel wiring using screw type terminal blocks mounted on DIN rails. Fused terminal blocks shall have LED blown fuse indication. Terminal blocks for 4-20 mA signals shall be fused and knife disconnect terminal blocks. Terminal strips shall be identified as specified in 2.2.C.3. Identifiers shall be self-stick, plastic tape strips with permanent type, machine printed numbers. Hand-written labels are not acceptable.
 - i. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device.
 - j. Within the enclosure all I/O racks, processor racks, and power supplies shall be grounded and mounted to meet the manufacturer's specifications.
 - k. Provide interposing relays for all 24 volt and 120 volt PLC outputs.
 - l. Provide individual fuses for all analog and digital inputs and all analog outputs. Fuses shall be capable of being inspected without removal of and replaced without disassembly of the terminal block. Blown fuse LED status indicators shall be provided.

- m. All alarms generated external to the panel, spare alarm, and repeat contacts shall be wired out to terminal blocks.
 - n. For internal component-to-component wiring only, compression type terminal blocks are acceptable.
 - o. Provide spare terminals equal in number to 20 percent of the terminals used for each type of wiring (e.g., DC signal and AC power).
 - p. Provide a separate terminal for grounding each shielded cable.
 - q. Use separate 5/16-inch diameter copper grounding studs for instrument signal cable shields and AC power.
 - r. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.
 - s. When DC power and/or low voltage AC power is required, provide and install the necessary power supplies and transformers in the panel.
 - t. Provide circuit breakers to protect each circuit, with no more than two instruments on a single circuit.
 - u. Common, push to test circuitry shall be provided for each panel with more than six indicating lights to simultaneously test all indicating lights on the panel using a single pushbutton.
 - v. Provide complete wiring diagram showing "as-built" circuitry. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.
4. Corrosion Control:
- a. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model AHCI; or equal.
5. Surge Protection:
- a. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20 μ s impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground.
 - b. Provide protection of all analog signal (4-20 mA) circuits. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in the conduit or on the instrument itself, no separate enclosures shall be provided. At the control system end, Units shall be pluggable, din-rail mounted. Units shall include local and remote fail indication. Provide a Phoenix Contact or approved equal.

- c. Provide protection of all 120 vac power feeds at outdoor field mounted devices control panels, instruments, and control room equipment. Protection devices located near the transmitter shall be mounted in the conduit or on the instrument itself, no separate enclosures shall be provided. At the control system end, Units shall be pluggable, din-rail mounted. Units shall include local and remote fail indication. Provide a Phoenix Contact or approved equal.
- d. Non-Fiber Based Data Highway – Provide protection on all data highway circuits (e.g. DeviceNet) that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in conformance with NEC.
- B. Unless otherwise noted, install indoor panels on 4-inch concrete pad. Extend pad 4-inches beyond outside dimensions of base, front and sides. Lay grout after panel sills have been securely fastened down.
- C. Unless otherwise noted, install outdoor NEMA 4X panels on a reinforced concrete pedestal:
 - 1. Minimum Thickness: Eight-inches with No. 4 steel reinforcing bars at 12-inches on centers, each way.
 - 2. Minimum Size: Twelve-inches larger than outer dimensions of base, all sides.
 - 3. Provide excavation and backfill work in conformance with Section 02200, Earthwork.
 - 4. Provide concrete work in conformance with Section 03300, Cast-In-Place Concrete.
- D. Install anchor bolts and anchor in accordance with Section 05051, Anchor Systems.
- E. Install and interconnect all equipment, devices, electrical hardware, instrumentation and controls and process controller components into and out of and among the enclosures as indicated on the Drawings.

3.2 TESTING AND ADJUSTMENTS

- A. Perform system testing and make any adjustments necessary in accordance with this Section, Section 13401, Process Control System General Provisions, Section 13402, Process Control System Factory Testing, and Section 13403, Process Control System Start up and Field Testing.

- B. Perform power supply, voltage adjustments to tolerances required by the appurtenant equipment.

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SECTION 13440

PANEL MOUNTED INSTRUMENTS AND DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust and place into satisfactory operation panel instruments and devices.
2. Contract Documents illustrate and specify functional and general construction requirements of the panel instruments and do not necessarily show or specify all wiring, piping and accessories required to make a completely integrated system. Contractor shall provide all piping, wiring, accessories and labor required for a complete, workable and integrated system that meets the functional requirements shown and specified.

B. Coordination:

1. Coordinate the installation and interface requirements of all items specified herein and required with the manufacturer of equipment specified in other sections to ensure the complete and proper interfacing of all the components and systems.
2. Comply with the requirements of Section 13401, Process Control System General Provisions.
3. Provide Programmable Logic Controllers (PLC), Operator Interface Terminals (OIT) and associated software in accordance with specification Section 13451, PLC Hardware and Software.

C. Related Sections:

1. Section 13401, Process Control System General Provisions.
2. Section 13402, Process Control System Start-up and Field Testing.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 13401, Process Control System General Provisions.

B. Acceptable Manufacturers:

1. Furnish instruments and devices by the named manufacturers or approved equal equipment by other manufacturers.
2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Obtain all instruments or devices of a given type from the same manufacturer.

C. Manufacturers' Responsibilities and Services:

1. Design and manufacture panels with the instruments and devices installed in accordance with the applicable general design requirements specified in Section 13401, Process Control System General Provisions, and the detailed Specifications herein.
2. Field supervision, inspection, start-up and training in accordance with the requirements of Section 13403, Process Control System Start up and Field Testing, and Section 13404, Process Control System Training.

1.3 SUBMITTALS

A. Comply with the requirements of Section 13401, Process Control System General Provisions, and the following:

1. Shop drawings for uninterruptible power system (UPS) shall include the power ratings of all associated equipment the system shall provide power to. Information shall be in list form and include: equipment name and power rating at maximum load, in Watts, for each item. The list shall tally the power ratings and clearly display that the proposed UPS meets the required output capacity, including specified percent spare, for the specified time requirements. A separate list shall be provided for each required UPS.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements specified in Section 13401, Process Control System General Provisions.
- B. Instruments and devices shall not be assembled in the panels until all product information and system Shop Drawings for respective components have been approved.

1.5 IDENTIFICATION TAGS

A. All panel instruments and devices shall have an identification tag meeting the following requirements:

1. Tag numbers shall be as listed in the Instrument Datasheets.
2. Identifying tag number shall be permanently etched or embossed onto a plastic tag which shall be fastened to the device housing with stainless steel rivets or self-tapping screws of appropriate size.
3. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter stainless steel wire rope.
4. All instruments and devices mounted within panels shall have identification tags, which comply with the requirements specified in Section 13430, Process Control Panels and Enclosures, Article 2.2.C.
5. Tags shall be installed so that the numbers are easily visible to service personnel. Front of panel mounted components shall have the tag attached to the rear of the device.

6. Front of panel mounted components shall have nameplates, which comply with the requirements specified in Section 13430, Process Control Panels and Enclosures.

PART 2 - PRODUCTS

2.1 POWER SUPPLIES

- A. Provide a 24 VDC redundant power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.
- B. The 24 VDC power supply shall meet the following requirements:
 1. Input power: 115 vac, plus or minus 10 percent, 60 Hz.
 2. Output voltage: 24 vdc.
 3. Output voltage adjustment: 5 percent.
 4. Line regulation: 0.05 percent for 10 V line change.
 5. Load regulation: 0.15 percent no load to full load.
 6. Ripple: 3 mV RMS.
 7. Operating temperature: 32 to 140 degrees Fahrenheit.
 8. DIN rail mounting.
 9. Integrated Selective Fused Breaking
- C. Size the 24 vdc power supply to accommodate the design load plus a minimum 25 percent spare capacity. Contractor shall provide respective power sizing calculations.
- D. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
- E. Mount the 24 vdc power supply such that dissipated heat does not adversely affect other panel components.
- F. Provide a Power Supply Diode Redundancy module from the same manufacturer of the power supplies.
- F. Manufacturer(s):
 1. Phoenix Contact
 2. Allen Bradley.
 3. Moxa.
 4. Or approved equal.

2.2 MAIN AND BRANCH CIRCUIT BREAKER

A. General:

1. Circuit breakers shall be furnished and installed in control panels to provide automatically operated switch protection in an electrical circuit from damage caused by an overload or short circuit.
2. Branch circuit breakers shall be approved for branch circuit applications in the United States.

B. Features:

1. Type: High Density Circuit Breaker.
2. Provide Single Pole 120/240V breakers within the control panels.
3. Rating: Provide breakers with proper amp rating to protect the circuit it serves. Normal operating load of each circuit shall be noted on the panel power distribution wiring drawing. Refer to specification Section 13430, Process Control Panels and Enclosures, for internal panel wiring design requirement.
4. Insulation Resistance: 100M-ohm at 500VDC.
5. Terminal Type: Tubular screw with self-lifting box lug.
6. Push-to-set mechanism for circuit actuation.
7. Manual trip button.
8. DIN rail mounted.
9. Status on/off indicator lights
10. Compliance: UL 1077 Listed, CSA C22.2 No. 235, EN/IEC 60934.

C. Products and Manufacturers: Provide one of the following:

1. Allen Bradley.
2. Or approved equal.

2.3 UNINTERRUPTIBLE POWER SYSTEM (SINGLE PHASE)

A. General:

1. Uninterruptible Power System (UPS) shall be furnished to provide a reliable source of uninterruptible power with no break in AC output power during a complete or partial interruption of incoming line power. UPS shall include audio/visual alarms. UPS shall be UL listed.
2. A UPS shall be provided for each control panel (LBP_BCP and LBP_MCP) and the Level Indicators Panel (LBP_LIP).

B. Description: On line dual track power conditioner and true (0 ms transfer time) uninterruptible power supply providing isolation, line regulation and conditioning, using sealed 48 VDC maintenance free batteries and switch mode power supply for uninterrupted power with 0.5 to 0.7 power factor and 2.7 to 3.5 crest factor.

C. Features:

1. Unit shall provide uninterrupted conditioned power, under fully loaded conditions, for 20 minutes. Unit shall be sized to accommodate power requirements for all

equipment it is to power for the required length of time and shall provide ten percent spare output capacity at minimum. Contractor shall provide respective power sizing calculations.

2. Rating: 1.4KVA/1.0KW minimum.
3. Lighting and Surge Protection: Inherent 2000: One spike attenuation.
4. Regulation: One to three percent load regulation with less than 2pF effective coupling capacitance for line to load.
5. Output Waveform: Computer grade sine wave with three percent maximum single harmonic and five percent maximum total harmonic distortion.
6. Output Frequency: 60 Hz \pm 0.5 Hz.
7. Operating Temperature: 1°C to 40°C.
8. Relative Humidity: Five to 90 percent non-condensing.
9. Normally Closed contact output for Battery Low alarm to be connected to a PLC discrete input.
10. Input Protection: Independent battery charger fuse and DC fuses.
11. Output Protection: Inherently current limited ferro-resonant transformer.
12. Battery Charger: Two-step charger, 8 A and 2 A.
13. AC Input: 120VAC, 60Hz, single phase, +15 percent, -20 percent.
14. AC Output: 120VAC, 60Hz, single phase, +3 percent, -3 percent.

D. Products and Manufacturers: Provide one of the following:

1. Best Power Technology, Ferrups FE Series.
2. American Power Conversion Corp. (APC)
3. Eaton.
4. Or approved equal.

2.4 SELECTOR SWITCHES, PUSHBUTTONS AND INDICATING LIGHTS

A. General:

1. Selector switches, pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type.
2. Type:
 - a. Heavy duty, oil tight.
3. Provide legend plate for indication of switch, pushbutton or light function (e.g., "OPEN-CLOSED", "HAND-OFF-AUTO").
4. Mounting: Flush mounted on control panel front, unless otherwise noted.
5. NEMA rated to match panel in which mounted.

B. Selector Switches:

1. Type: Provide selector switches with number of positions as required to perform intended functions as shown and specified.
2. Contacts:
 - a. Provide number and arrangement of contacts as required to perform intended functions specified, but not less than two single pole, double throw contact.

- b. Type: Double break, silver contacts with movable contact blade providing scrubbing action.
 - c. Rating: Compatible with AC or DC current with devices simultaneously operated by the switch contacts, but not less than 10 A resistive at 120 VAC or DC continuous.
 - 3. Switch Operator: Standard black knob.
- C. Pushbuttons (Standard or Illuminated):
- 1. Type: Provide momentary lighted and/or unlighted, single and/or dual type pushbuttons as required to perform intended functions specified and shown.
 - 2. Contacts: Comply with the requirements specified for selector switches.
- D. Indicating Lights:
- 1. Type: High Intensity Light-Emitting Diode (LED).
 - 2. Lamps: 2.2 volt, long life (20,000 hours minimum).
- E. Button and Lens Colors:
- 1. See table below

INDICATION	COLOR
Open, On, Running	Red
Closed, Off, Stopped	Green
Equipment Malfunction, Process Trouble and (e.g., "HIGH LEVEL", "LOW LEVEL", etc.)	Amber
Power On	White
Informational (e.g. Backwash, Ready, etc.)	Blue

- F. Products and Manufacturers: Provide one of the following:
- 1. Allen Bradley.
 - 2. Eaton Corp.
 - 3. Or approved equal.

2.5 CONTROL RELAY

- A. Type: General purpose, plug-in type rated for continuous duty.
- B. Construction Features:
- 1. Coil Voltages: 24 VDC or 120 VAC, as required.
 - 2. Contacts: DPDT or 4PDT.
 - a. Silver cadmium oxide rated not less than 8 A resistive at 120 VAC or 24 VDC continuous.
 - b. For switching low energy circuits (less than 200 mA) fine silver, gold flashed contacts rated not less than 3 A resistive at 120 VAC or 28 VDC continuous shall be provided.
 - 3. Relays to have clear plastic dust cover.

4. Relays to have pilot light to show energized coil.
 5. Relays to be UL recognized.
- C. Products and Manufacturers: Provide one of the following:
1. Allen Bradley, 700 Series.
 2. Square D Company,
 3. Or approved equal.

2.6 INTRINSICALLY SAFE RELAY

- A. General: Intrinsically Safe Relay shall electrically isolate circuits extending into Class I, Division I (Group A, B, C and D) hazardous areas from circuits in non-rated areas. Failures of the circuit within the hazardous area shall be indicated by illuminating a light emitting diode (LED) located on the face of the relay. To be used with the High-High and Low-Low level Floats in the sump.
- B. Required Features:
1. Contact design: one Normally Open (NO) and one Normally Close (NC), isolated contacts.
 2. Contacts Rating: 8A at 110 VAC resistive, 5A at 30VDC resistive
 3. Contact Cycle Rating:
 - a. Mechanical 10,000,000 operations.
 - b. Electrical: 100,000 operations minimum at rated load.
 4. Electronic Module: Solid state components epoxy encapsulated in nylon shell.
 5. Supply Voltage: 115 VAC 50/60Hz.
 6. Supply Current: Relays energized, 1.7 VA.
 7. Sensitivity: 0-470,000 ohms Maximum specific resistance.
 8. Operation Temperature: -40°F to 150°F.
 9. Time delay: 0.5 seconds rising level, 3 seconds lowering level.
- C. Products and Manufacturers: Provide one of the following:
1. Phoenix Contact.
 2. IDEC,
 3. Or approved equal.

2.7. ETHERNET SWITCH

- A. General:
1. Furnish and install modular, managed Ethernet switches for connecting devices on the network. The use of hubs is not permitted.
 - a. Managed type Ethernet switch shall have a full set of management features, including Command Line Interface, SNMP agent, and web interface.
In addition, managed switches shall have features to manipulate configurations, such as the ability to display, modify, backup and restore configurations.
 - b. Provide equipment to operate on 115 VAC, single phase, 60-hertz electrical service.

- c. Provide all necessary items for installation, including mounting brackets, interconnecting cables, hardware, and appurtenances.
- d. Label each switch with the switch name as shown on the contract drawings. Label shall be clearly visible and shall be in accordance with Section 13430, Process Control Systems Panels and Enclosures, Article 2.2.
- e. Configure switch for Modbus TCP/IP or DNP3 Communication protocol as required.

B. Features:

- 1. 10/100/1000 base-T, auto-negotiation 802.3u.
- 2. Minimum Port count:
 - a. 4 RJ-45 ports, Fast Ethernet.
 - b. 2 Fiber Optic ports (Small Form-Factor Pluggable – SFP), (Fiber-Optic LC Connectors for future use)
- 3. Minimum of two (2) fiber optic ports for one (1) fiber pair. Fiber optic ports shall be expanded as needed to interconnect all system components.
- 4. Layer 2 switching capability.
- 5. 256 MB Dram with ECC memory
- 6. IEEE 1588v2 FPGA
- 7. 64 MB on-board flash memory
- 8. 1GB removable SD flash memory card
- 9. Mini-USB connector
- 10. Alarm I/O: Two alarm inputs to detect dry contact open or close; one alarm output relay.
- 11. Support for the use of IGMP for multicast traffic.
- 12. Support for VLAN as defined in IEEE802.1Q.
- 13. Support for the use of SNMP management.
- 14. LED for indicating port status.
- 15. Failsafe output relay to indicate malfunction with unit.
- 16. FCC Part 15, Class A compliant.
- 17. Provide management software for multilevel security, web based configuration and remote monitoring.
- 18. Powered by circuit on Uninterruptible Power Supply.
- 19. Operating temperature of -20°C to 55 C.
- 20. Internal Panel mounting kit.

C. Product and Manufacturer:

- 1. Phoenix Contact
- 2. NTron
- 3. Moxa
- 4. Or approved equal

2.8 CELLULAR ROUTER

A. Cellular router shall have the following features:

- 1. Multicarrier 4G LTE Connectivity. Coordinate carrier selection with Owner.

2. Communication Ports:
 - a. One RS-232 DB9 serial Port 115200bps,
 - b. Five 10/100 Base-T RJ-45 Ethernet Ports.
 - c. One USB mini port
 - d. Two SMA antenna connectors
 3. Environmental:
 - a. Operating Temperature: -40°F to 167°F
 - b. Humidity: 5 to 95% non-condensing.
 4. DIN rail mountable
 5. SSL, GRE and VPN services
 6. Tunneling: IPsec, GRE, OpenVPN
 7. Routing Protocols: OSPF, BGP, RIP.
 8. IP: NAT, Port Forwarding, Dynamic DNS, DHCP Stateful Inspection Firewall, IP Transparency.
 9. Power Input:
 - a. Input Voltage: 8-30 VDC (12 or 24 VDC nominal)
 - b. Standby Power: 1.4W - 3.3W (typical)
 - c. Transmitting:
 1. 690x: 2.6W – 6.9W
 2. 6921: 4.3W – 8.7W
 - d. IEEE 802.3af compliant
- B. Provide Ethernet communication CAT6 patch cables for all required internal panel connections.
- C. Product and Manufacturer:
1. Red Lion IndustrialPro 6000 Series
 2. MDS Orbit MCR
 3. Sierra Wireless
 4. Or approved equal.

2.9 MIMO ANTENNA

- A. General: Outdoor antenna shall be used to connect via cellular communication to the Nassau County plant-wide SCADA system at the South Shore Water Reclamation Facility (South Shore WRF). The antenna shall be mounted on a pole and at greater elevation than the Electrical Building rooftop highest point. Contractor to verify in the field best mounting location to provide reliable communication with the cellular service provider.
- B. Omni-directional antenna:
1. Frequency: 694-960 MHz & 1700-2700 MHz
 2. Gain: 694-960 MHz 5 dBi / 700-2700 MHz 7 dBi
 3. VSWR: <2:1 max over range
 4. Impedance: 50 Ohm (nominal)

5. Max power: 20 watts
 6. Beam width: 694-960 MHz / 25° Vertical & 1700-2700 MHz / 20° Vertical
 7. Wind Survivability: 200 mph minimum.
 8. Operating Temp: -40 to +80° C
 9. Lightning protection: External
 10. Dimensions: 50 1/2"(128 cm) Height , Radome 2"(5.1cm) Diameter
Aluminum body 2.5"(6.3cm) Diameter
 11. Material: Fiberglass, White
 12. Mounting: Two heavy duty mounting brackets provided
 13. Connectors: Two N Jack connectors exit back of antenna.
 14. In-line coaxial cable surge protector shall be furnished for each cable and mounted inside the Control Panel. Furnish Polyphaser or equal
- C. Provide antenna cables type and lengths as recommended by the manufacturer to connect to Cellular Router specified herein.
- D. Provide coil inductor type lightning arresters on each antenna cable. Gas tube type protectors are not acceptable. Polyphaser or as recommended by the Cellular Router manufacturer.
- E. Product and Manufacturer:
1. MobileMark DOD7 series
 2. Wilson.
 3. Or approved equal.

2.9 DIGITAL INDICATOR

- A. General: The digital indicator shall accept an analog input and convert it to scaled numerical characters for digital display and also provide up to two alarm outputs.
- B. Required Features:
1. Display Height: 0.70-inch.
 2. Display Capacity: 5 digits with Level Indicator Bar Graph.
 3. Display Type: Seven segment, LED.
 4. Display Update Rate: Ambient > -25°C: 2 Updates/Second. Ambient < -25°C: 1 Update/5 Seconds.
 5. Accuracy: ± 0.03% of calibrated span.
 6. User selectable decimal point.
 7. Analog Input: 4 to 20 mA DC.
 8. Excitation Output: 15 VDC for powering transmitter.
 9. Operating Temperature Range: -40 to 75°C.
 10. Storage Temperature Range: -40 to 75°C.
 11. Relative Humidity: 0 to 90% non-condensing
 12. Temperature Range: 0°C to 60°C.
 13. Power: 24 VDC, .5W loop powered.
 14. Enclosure: NEMA 4X

15. Non-Volatile Memory: All programmed settings are stored in non-volatile memory for a minimum of ten years if power is lost.
16. Password: Programmable password restricts modification of programmed settings
17. Mounting and Enclosure: To be mounted on the wall, inside electrical room as shown.

C. Manufacturers: Provide one of the following:

1. Precision Digital, PD8-6000
2. Yokogawa YPP6801
3. Or approved equal

2.10 CURRENT SPLITTER

- A. General: The splitter unit shall be a four wire powered device. It shall accept a 4 to 20 mADC input signal and deliver two identical isolated a 4 to 20 mADC output signals. Each channel shall operate independently and shall be isolated from the each other to prevent interaction between channels. Signal splitter shall not be powered from LBP_MCP and shall be provided with its own UPS.
- B. Required Features:
 1. Power requirements: 90-250V AC. Four-wire isolated transmitter
 2. Repeatability: \pm One percent of span.
 3. Ambient Temperature Range: 0°C to 60°C.
 4. Ambient Humidity Range: 5 to 95 percent, non-condensing.
 5. Electromagnetic Field Immunity (EMI): Less than \pm 0.25% of output span effect under the influence of electromagnetic fields. Meets Immunity Standards Per EN50082-1.
 6. Accuracy: \pm 0.05% of output span.
 7. Hazardous Locations: Class I: Div. 2; Groups A, B, C, D
 8. Enclosure Case: Self-extinguishing NYLON type 6.6 polyamide thermoplastic UL94 V-2 NEMA Type 1 enclosure.
 9. Provide one spare current splitter.
- C. Mounting / Enclosure:
 1. To be mounted inside LBP_MCP as shown.
- D. Products and Manufacturers: Provide one of the following:
 1. Acromag
 2. Omega
 3. Or approved equal

2.11 AUTODIALER

- A. General:
 1. The Temporary Bypass Pump Station shall be provided with an automatic dialer with a battery backup to alarm conditions of high-water level in the wet well (LSHH-9502-03-BP activation, and radar transducer hi-high level alarm LAHH-9502-02-BP signals). The alarm system must be capable of full

operation in the absence of electrical power and must provide redundancy in case of alarm system component failure.

B. Required Features:

1. Inputs

- a. The system shall come standard with 12 universal input channels. All input channels shall be user-configurable as:
 1. NO or NC digital dry contact, using internal 3.3V source voltage
 2. Temperature from thermistor, using 2.8K or 10K devices
 3. 4–20mA analog, using custom look-up table
 4. NO or NC Pulse Count with configurable multiplier
 5. NO or NC Run-Time Accumulator
- b. The system shall have the following additional monitoring features:
 1. Built-in AC power failure detection
 2. Low battery detection
 3. Device Offline detection
- c. All monitored channels, including built-in monitoring features, shall allow configurable programming of pertinent operational data including:
 1. Zone Name
 2. Zone Type (NO/NC, 2.8K/10K thermistor, 4-20mA, pulse count, run-time accumulator)
 3. Zone Calibration
 4. High and Low Alarm Limits (-2,000,000 to 2,000,000)
 5. Alarm Recognition Time (0 seconds to 8 hours)
 6. Alarm Hold Time (1 second to 60 minutes)
 7. Alarm Reset Time (1 minute to 8 hours)
 8. Alarm on Return-to-Normal
 9. Alarm Delivery Contact List (Phone numbers, text numbers, email addresses, etc...) for each zone
 10. Alarm Delivery Enable/Disable for each channel to send notifications for alarms
 11. Zone Enable/Disable

2. Outputs:

- a. The system shall have two built-in SPST 1A 30VDC/VAC relay outputs. The outputs may be programmed to switch either manually or automatically using one of the following modes:
 1. Activate or deactivate as soon as one or more selected zones exceeds the alarm limits (regardless of recognition time). Reverts when the alarm condition no longer exists.
 2. Activate or deactivate when one or more selected zones becomes an alarm (recognition time enforced). Reverts when the alarm condition no longer exists.
 3. Activate or deactivate while one or more selected zones has an unacknowledged alarm. Reverts once the alarm is acknowledged.
 4. Activate when a selected zone is either greater than, less than, or equal to a user configurable value and deactivate when a selected zone is either greater than, less than, or equal to a user configurable value.

3. Cellular Communications

- a. The System shall contain a battery-backed 4G/LTE cellular modem with an

external antenna for communication to the Autodialer server system. The system shall be configured to operate with either AT&T or Verizon cellular service at the time of order. The System shall require a continuous cellular connection in order to operate. In areas with a poor cellular signal an optional high gain antenna shall be available. The System shall require a cellular subscription plan with the manufacturer to operate. LED indicators on the unit shall be provided to indicate when the unit is online with the manufacturer's server system.

- b. Provide cellular antenna as recommended by manufacturer of the unit. Do not drill mount antenna directly on Long Beach Temporary Bypass Control Panel (LBP_BPC) enclosure to maintain its NEMA 4X Rating.
4. Programming:
 - a. The System shall be fully programmable through the manufacturer's website. A mobile App for Android and IOS shall be provided to permit live system status as well as limited programmability.
5. Alarm Notification:
 - a. The system shall send alarm notification messages via email, text message and/or voice telephone call with a paid cellular subscription. Alarm messages will be delivered in English. Alarm messages sent via telephone shall be delivered in digitized human voice using text-to-speech technology. The system will continue to call telephone numbers and send text and email messages in succession until a positive acknowledgment of the alarm message is received. Acknowledgment is accomplished by entering a numeric code from the called telephone, or by replying to a text or email message, or by logging-in to the website or App and requesting acknowledgement. The alarm may also be acknowledged by pressing the 'Acknowledge' button on the device itself. The system will call each programmed telephone number up to 4 times. Once the alarm is acknowledged the system shall
 - b. halt the dialing process. The system shall allow for an unlimited number of users with an unlimited number of contact methods
 - c. per user. The system shall allow for tiered alarm delivery schedules so that a time delay may be inserted between tiers.
6. Device Supervision
 - a. The device shall be supervised by the manufacturer's server system. If a device stops communicating with the server for a specified period of time the system will notify selected users of the problem. When the device resumes communication with the server an optional 'return-to-normal' message will be sent.
7. Data Logs
 - a. The system shall allow monitored zone values to be periodically stored in system memory at a programmable interval from 1 minute to 24 hours. Stored values shall be uploaded to the Manufacturer's server system on a periodic basis (approximately once per hour) for permanent storage. Users shall have the capability of querying logged data values from the Manufacturer's website and downloading the displayed data. The device shall be capable of storing up to

- 2.9 million data points in internal memory.
8. Alarm History Logs
 - a. The Manufacturer's server system shall maintain a log of all alarm events. The system shall also maintain a log of all alarm notifications including the users name, type of delivery (email, phone, text), and telephone number/email address.
 9. Power
 - a. The system shall be provided with a UL/CSA listed 12VDC power transformer with USA style blades that the user may plug into a 100-240VAC outlet, 50/60HZ. The system shall monitor for the presence of primary 12VDC power and shall be capable of generating an alarm if main power should fail. The system shall also contain a power management controller to distribute power to the unit, modem, and battery backup system. The controller shall maintain the proper charge level to the modem backup battery.
 10. Battery Backup
 - a. The system shall have two rechargeable battery systems. A nickel-metal-hydride battery pack shall be included within the metallic enclosure. This battery shall provide up to 8 hours of continuous operation of the unit in the absence of AC power. (Actual battery backup performance is dependent upon the age of the battery, the ambient temperature, and the charge condition). The unit shall also contain a long-life lithium battery (type CR2) to maintain the system clock, as well as certain dynamic zone values such as pulse count, runtime, and min/max values. The lithium battery shall last 4 years or more depending on use. A 12V 3AH SLA rechargeable battery shall be included to provide backup power to the cellular modem. The 12V SLA battery shall provide up to 8 hours of continuous operation of the modem in the absence of AC power.
 11. Visual Indicators
 - a. Each zone input shall have a corresponding LED that will indicate the alarm and acknowledgment status of each zone. The system shall also have a 'Power' led to indicate if the device is powered on. An 'Online' LED shall be included to indicate if the device is online with the manufacturer's server system. A 'Standby' LED shall be included to indicate if the device is operating in Standby mode.
 12. Standby
 - a. The system shall be capable of operating in Standby mode. In Standby mode any detected alarms will be ignored, however, monitored values will continue to be displayed on the website and on the mobile Apps. The data logger will continue to store values while in Standby mode. Standby mode can be configured to run for a preconfigured time period in which case it will return to normal mode automatically, or it may operate in 'untimed' mode in which case it must manually be returned to normal mode.
 - b. Users shall be able to enter or exit Standby mode through the website, the mobile App, or using the Standby button on the front panel of the device.
 13. Enclosure And Environmental

- a. Enclosure
 - 1. The unit shall be housed inside the Long Beach Temporary Bypass Control Panel (LBP_BPC).
- b. Electrical Protection
 - 1. The Power input shall be protected against voltage surges with a metal oxide varistor. The Ethernet port shall be protected against voltage transients with low capacitance transient suppressors. The zone inputs shall be protected against voltage surges using metal oxide varistors and low-voltage diode clamping circuits.
- c. Environmental
 - 1. The system shall function over an operating range of 32°F - 122°F (0° - 50° C) at up to 0-90% RH, non-condensing. The system may be stored over the temperature range of 32° - 140°F (0° - 60° C).
 - 2. Power requirements: 90-250V AC. Four-wire isolated transmitter
- C. Products and Manufacturers: Provide one of the following:
 - 1. Sensaphone Sentinel Pro
 - 2. Antx Messenger
 - 3. Or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents.
- B. All items shall be mounted and anchored in compliance with Section 13430, Process Control Panels and Enclosures.

3.2 START-UP, CALIBRATION, TESTING AND TRAINING

- A. Comply with the requirements of Section 13403, Process Control System Start up and Field Testing, and Section 13404, Process Control System Training.

++ END OF SECTION ++

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SECTION 13451

PROGRAMMABLE LOGIC CONTROLLERS HARDWARE AND SOFTWARE

PART 1 – GENERAL

1.1 DESCRIPTION

A. SCOPE:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish, install, calibrate, test, startup, and place into satisfactory operation all Programmable Controllers (PLCs) provided under this contract.
2. The Owner's Application Engineer (OAE) will configure, develop, load, test document and place in satisfactory operation all software associated with the PLC, as described herein, required by other Sections, as shown and as required to provide a properly operating system. The OAE will not be programming any vendor PLC equipment.
3. The hardware required for the PLC is shown on the PLC block diagram and is comprised of the following types of major monitoring processing and control equipment units:
 - a. Redundant and non-redundant fault tolerant programmable logical controller(s) with local or remote I/O subsystem.
 - b. I/O drivers to communicate with PLC's.
 - c. Network communication devices.
 - d. Power Supplies.
 - e. I/O Cards.
 - f. I/O Chassis and Cabling.

. Related Sections:

1. Section 13401, Process Control System General Provisions
2. Section 13402, Process Control System Factory Testing.
3. Section 13403, Process Control System Start-Up and Field Testing.
4. Section 13404, Process Control System Training.
5. Section 13430, Process Control System Panels and Enclosures
6. Section 13440, Panel Mounted Instruments and Devices
7. Section 13480, Input Output Point List
8. Section 13491, Process Control Descriptions.

1.2 TERMS

A. The terms listed below are used throughout this section and are defined as such:

1. Human Machine Interface (HMI): Operator Interface to control system. Allows operator intervention and monitoring of all systems and subsystems connected to

the PLC system; usually a desktop computer/workstation or industrial hardened computer.

2. Operator Interface Terminal (OIT): Standalone intelligent device for graphical display.
3. Programmable Logic Controller (PLC): The controlling device used to control and monitor hardware connected to it by way of networks or I/O cards.
4. I/O Cards: Can be either analog or discrete cards that interface between field devices and PLC.
5. PLC System: Includes all parts listed above.

1.3 QUALITY ASSURANCE

- A. CONTRACTOR shall engage the services of a PLC manufacturer to provide all equipment listed in this Section. The System manufacturer shall demonstrate a minimum of five years of experience providing PLC systems and be able to show evidence of at least five installations of equal or greater size to the one being specified.
- B. All materials and equipment furnished shall be new, free from defects, and of first quality, produced by manufacturers who have been regularly engaged in the manufacture of these products.
- C. Where there is more than one item of similar equipment required under the Contract, all such similar equipment shall be the product of one manufacturer.
- D. All material furnished under this Contract shall be determined safe by either underwriters laboratories, inc., or factory mutual engineering corporation and all material shall be labeled, certified, or listed by the testing agency.
- E. Custom made equipment or related installation which is constructed specially for this project shall not be acceptable. Equipment furnished within this contract shall be standard products furnished by a supplier regularly engaged in the manufacture of such products.

1.4 SUBMITTALS

- A. General: The Contractor shall submit working drawings, shop drawings and material specifications for all equipment and work provided, for the approval of Arcadis in accordance with the requirements of Section 01300, Submittals.
- B. Working Drawings: The Contractor shall submit to Arcadis for approval, working drawings to substantiate conformance with the requirements set forth on the Contract Drawings and in these specifications.
- C. All working drawing shall include, but not be limited to:

1. Equipment specifications and data sheets identifying all equipment and materials used and methods of fabrication.
2. Complete assembly and layout drawings with clearly marked dimensions.
3. Equipment cross sections and mounting details.
4. Weights of all component parts, assembled weight of units and approximate total shipping weights.
5. Interconnecting wiring diagrams.
6. List of spare parts.
7. List of special tools.
8. Storage instructions.
9. Installation instructions.
10. Preliminary operation and maintenance manuals.
11. Load, backup time and cooling calculations based on each proposed installation.

PART 2 – PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLERS (PLC) – REDUNDANT TYPE

A. General:

1. Provide redundant Programmable Logic Controllers (PLC) for Long Beach Consolidation Pump Station Main Control Panel (LBP_MCP) and as specified herein.
2. Redundant PLC shall be configured as hot standby. Redundant CPUs, redundant DNP modules and redundant power supplies, shall be provided.
3. Products specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance.
4. PLC shall be provided with all necessary components to accomplish the requirements described herein. Provide a dedicated Ethernet network card for communications between the PLCs and its OIT, and as shown on the Contract Drawings.
5. The PLC shall be configured by Owners Application engineer to perform functions shown and specified.
6. The PLC hardware shall be handed to the OAE at least 120 days before Factory Acceptance Test procedures.
7. Functions to be performed by the PLC include but are not necessarily limited to the following:
 - a. Alarm and status indication.
 - b. PID control and arithmetic functions.
 - c. Interlock and sequential logic control of processes and equipment operations.
 - d. Collection and transmission of data and control parameters to and from other PLCs.
 - e. Provide a dry contact rated 2 Amperes at 120 Volts AC for remote indication of processor failure.

8. The PLC shall be electronic type furnished with all necessary relays, timers, counters, and latches as data manipulative functions and arranged into the format required to accomplish the functions shown and specified.
9. The PLC shall be designed and constructed for the demanding requirements of real-time process management and control on a continuous basis for use in a municipal plant.
10. The manipulative functions shall have the capability of being rearranged into any desired format while the controller is performing other control tasks.
11. Expansion of the controller by the input/output points, internal data manipulative functions, and relays, timers and counters shall be accomplished by reprogramming.
12. The control programs and applications memory of the PLC shall be capable of being remotely (off-line) and locally (on-line) monitored, programmed, modified and displayed by use of a personal computer and documentation software which shall be provided as part of this contract. In addition, the PLC shall be capable of being programmed by an external PC compatible host device via an Ethernet communication port. The host communication interface shall allow controlled access for authorized users via password protection to all registers, I/O system fault status and I/O override.
13. The logic shall be entered and displayed in ladder diagram and functional block format. The ladder diagram format shall contain a complete cross- reference with each coil referred to in logic and identified as normally open or normally closed. Mnemonic information shall be added to each coil and to both real and internal I/O points. Alphanumeric titles and descriptions shall appear on the screen.
14. Any restructuring of the control logic shall be done at the PLC installation and shall not necessitate any removal of the main frame to another location.
15. The controller main frame shall be arranged in modular type design. All inputs, outputs, and logic control interface units shall be easily removed for ease in replacement or restructuring the hardware arrangement. Shut down of the processor control logic (halting of program scan) shall not occur when remote input/output modules are removed.
16. A self-diagnostics package to determine proper processor operation shall be included. Diagnostic LED shall be provided in clear view on the front of the PLC enclosure.
17. Changing an online control logic process operation shall not necessitate the halting of the processor.
18. The primary interface to the process equipment and field devices shall be provided by the input/output system consisting of I/O modules installed in mounting racks. The input/output system hardware shall be designed with the following features
 - a. Noise immunity and filtering.
 - b. IEEE surge withstand rating to IEEE 472.
 - c. Electrical isolation for all inputs and outputs to provide controller logic protection.
 - d. No on board pots requiring adjustment or maintenance.

- e. Any card, any slot, plug in packaging, with locking bars and/or screws to hold I/O modules in place.
- f. Terminal strip design shall use Modicon Telefast ABE7 prewired system. Cord sets shall have a 25-way Sub-D connector to enable direct connection to the Modicon Telefast passive connection sub-base.
- g. Front of module LED status indicators for each individual input and output point to indicate when power is applied at I/O terminals.
- h. Individually fused output circuits for all output modules. Fuses shall be capable of being inspected without removal of and replaced without disassembly of the output module. For individually isolated output modules, front of module blown fuse LED status indicators shall be provided for each output point. For non-isolated (common output power source) output modules, common blown fuse LED status indicators shall be provided for a maximum of every four points.
- i. All outputs for contactors and relays shall be rated for a minimum of 2.0 Amps continuous at 120 VAC. Higher rated outputs and/or interposing relays inside the control center shall be provided in order to assure that ratings of the output contacts are not exceeded. Coordinate with equipment being controlled by the respective outputs.
- j. For outputs to motor contactors and other equipment type load relays, provide transient and inrush surge suppressor connected across the output contact terminal and the neutral common terminal inside the control center to suppress the switching surge transient to lower than the continuous rating of the output contacts.
- k. The maximum number of points per I/O module shall be as follows:
 - 1) Discrete: 16.
 - 2) Analog: 8.
- l. The following types of I/O modules shall be provided as required for use with the supplied PLC System:
 - 1) Analog Inputs (16 bits minimum):
 - a. 1-5VDC.
 - b. 4-20 mA DC (250 Ohms maximum impedance).
 - c. Millivolt signals.
 - 2) Analog Outputs (12 bits minimum):
 - a. 4-20 mA DC (load of 750 Ohms minimum).
 - b. 1-5 VDC.
 - 3) Register Inputs and Outputs (16 bit):
 - a. Single BCD.
 - b. Multiplexed BCD.
 - 4) Discrete Inputs:
 - a. 120 VAC/DC in both isolated and common circuit types.
 - b. TTL Logic.
 - 5) Discrete Outputs:
 - a. 120 VAC in both isolated and common circuit types.
 - b. 12-120 VDC.

- c. Form C Relay Contacts.
 - d. TTL Logic.
19. Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board disables only one loop or piece of equipment.
 20. Interposing relays shall be provided for all discrete outputs.
 21. Communication Module when required: Ethernet/Serial RTU Module with two RJ45/10BASE-T/100BASE-TX ports. 128MB memory flash card. DNP/DNP3 IP protocol. Bandwidth management. Modbus TCP messaging. IEC 60870-5 -101/-104 protocol. Time stamped events management. External modem management (serial, PSTN, GSM, GPRS/3G). Data logging in CSV files. Email/SMS notifications. Web server, rack viewer, data editor. BootP, DHCP, FDR client. SMTP server, FTP client/server, NTP client, SNMP agent, Automatic events backup on power loss. Multi-protocols support in a single module (master and slave). Transparent events routing from remote slaves to SCADA.

B. Required Features:

1. Construction: Modular printed circuit boards.
2. Type: Electronic components with central processing unit and software reprogramming capabilities.
3. PLCs shall collect data, perform process control functions and communicate with associated devices (e.g. remote I/O, Operator Interface Terminal, Drives, other PLCs, and/or SCADA servers) as required to exchange process information along the network(s) as specified or shown within the Contract Documents.
4. PLCs shall be modular in design and capable of scalable expansion by adding modules of various functions (e.g. input/output signal modules, power supplies, communication modules, etc.).
5. All PLCs shall be of the same manufacturer and of the same series or product line unless specifically shown or specified otherwise within the Contract Documents. Processors, input/output hardware, communications modules, specialty modules, etc. shall be interchangeable among all PMCS' control panels and interconnected process systems furnished. Third party PLC modules and hardware by other manufacturers shall be only acceptable if the PLC manufacturer does not offer suitable modules and hardware for the same functions.
6. Input / Output Signal Arrangement: Unless specifically stated otherwise, the order and arrangement of i/o signals shall not be as shown as listed within the contract documents, but shall be arranged to minimize failures of multiple equipment trains due to the failure of a single PLC module.
 - a. Be modular, field expandable design. The capability shall exist to allow for the expansion of the system by addition of hardware or software.

- b. Be able to 'hot swap' input/output modules while under power without impacting operation of PLC system or causing destruction of PLC modules, racks, power supplies.
- 7. Environmental Requirements: PLCs shall meet or exceed the following environmental requirements regardless of the service conditions they are installed in.
 - a. PLC systems shall be suitable for harsh environments and shall have conformal coating protection, providing increased resistance to condensation, dusty atmospheres and chemical corrosion.
 - b. Operating temperature: -13 to +158°F
 - c. Storage Temperature: -40°F to 185°F
 - d. Relative humidity: 30 to 95% non-condensing.
 - e. Operation at Altitudes: 0-6,500 feet minimum
 - f. Degree of protection: NEMA 1 (IP20)
 - g. Vibration resistance in accordance with at least one of the following:
 - 1. Installed rating:
 - a. DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz, and
 - b. Panel or plate mounted PLC: 2-25 Hz, amplitude 1.6mm, acceleration 25-200 Hz.
 - h. Shock resistance: 147m/s² for 11ms.
- 8. In compliance with IEC 60068 and IEC 61131.
- 9. Memory card shall be supplied and enabled for the following:
 - a. Backing up the application (program, symbols and constants)
 - b. Activating a standard Web server for the Transparent Ready class B10 integrated Ethernet port.
- 10. Language Format: Ladder type diagrams and functional blocks
- 11. Provide type and quantity of I/O as required to perform the operational and functional requirements plus 20 percent spare (minimum of one module) for each type of I/O module used. Spare points shall be mounted and wired ready for use and shall require only field wiring connections and software configuration to place the point in service.
- 12. Internal Functions: Relays, timers, counters, latches, internal storage registers, and other functions as required to perform specified functional requirements plus 25 percent spare capacity
- 13. Report Generation: Processor shall have the capability to store and automatically communicate up to 198 ASCII status/ alarm/diagnostic type messages to a peripheral display device via the RS 232C output port at rates up to 19.2 K bits/second
- 14. Security Features: Key switch interlock on PLC and/or security password protection through system programmer terminal to prevent tampering of logic sequences and unauthorized programming.
- 15. Operating Temperature: -14°F to 158°F.
- 16. Storage Temperature: Minus 40°F to 185°F.

17. Power Supply: 120 VAC, 10 percent with fuse or circuit breaker protection. Supplies shall be sized for a minimum of 130 percent of maximum simultaneous current draw in accordance with the General Electrical Requirements in Section 16010.
18. Clock: Time synchronization based on Network Time Protocol (NTP).
19. The discrete I/O modules shall provide the following functions:
 - a. Hot swapping: I/O modules shall be able to be removed or added while the power is on
 - b. I/O assignment: The channels of discrete I/O modules shall be able to be grouped into blocks of 4, 8 or 16 consecutive channels depending on the type of module.
 - c. Protection of DC inputs: The 24 VAC inputs shall be constant-current type.
 - d. Protection of DC outputs: Active transistor outputs shall withstand overloads, short-circuits, reverse polarity and inductive over-voltage.
 - e. Reactivation of DC outputs: If a line fault causes an output to trip, the output shall be automatically reactivated using this parameter if no other terminal line fault is present.
 - f. RUN/STOP command: An input shall be configured to control the RUN/STOP changeover for the PLC.
 - g. Output fallback: This parameter defines the fallback mode used by the DC transistor outputs when the PLC stops. It can assume the “fallback” value at state 0 or state 1 for the corresponding group of 8 channels or the “maintain” value representing the state of the outputs before the PLC stops.
 - h. I/O module diagnostics: Each discrete I/O module shall be equipped with a display block on the front panel centralizing the information necessary for module control, diagnostics and maintenance.
 1. Diagnostics:
Local diagnostics on the module front panel shall be complemented by system diagnostics based on predefined screens at global hardware configuration level, module level and channel level.
 2. Remote diagnostics using a web browser on a PC:
In addition, the diagnostics described above shall be available remotely using a simple web browser.
 - i. Furnish ruggedized modules, within a range of operating temperatures from - 13 to + 158 °F
20. The analog I/O modules shall provide the following functions:
 - a. Hot swapping: I/O modules shall be able to be removed or added while the power is on.
 - b. The power supply for the analog functions shall be supplied from the backplane bus.
 - c. Furnish ruggedized modules, within a range of operating temperatures from - 13 to + 158 °F
21. No more than one word shall be required for each contact or coil including address, no more than one word for a branch, no words for spaces or connects, and no words shall be required to begin a new rung. Scan time refers to nominal

memory scan time of words of relay ladder logic, with an "immediate I/O update" command to operate on instantaneous alarm information. Unprogrammed memory shall not be scanned.

22. Description: A chassis mount PLC designed for up to 6144 discrete points and 1536 analog points. Additional I/O shall be interfaced to the PLC via remote I/O or distributed I/O.
23. Executive firmware shall be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site. The firmware download shall be performed by connecting to either of the following:
 - a. The CPU mini-B USB connector
 - b. The CPU Service Port
 - c. The Ethernet network
24. The PLC shall utilize Ethernet protocols that meet the following criteria:
 - a. Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).
 - b. Protocols that are supported by the Open DeviceNet Vendors Association (ODVA)
 - c. Shall not rely on third party vendors to meet the above criteria.
25. Central Processors:
 - a. The processor shall be:
 1. Open architecture with direct Ethernet connection on the backplane allowing transparent access to data
 2. Simple and flexible
 3. Able to change configuration on the fly without stopping the process
 4. Able to add or remove I/O modules on local or Remote IO drop without stopping the process
 5. Modify channel configuration parameters
 6. Automatic reconfiguration of modules on hotswap
 7. Online application changes during runtime including adding new variables shared with HMI (Human-Machine Interfaces).
 8. Able to mix remote I/O and distributed equipment and other devices on the same Ethernet field network with complete software integration
 9. Capable to access and manage HART I/O data
 10. Natively deterministic
 11. Flexible in architecture design through fiber or wireless connections through the embedded in-rack converter modules.
 12. Cyber security ready with Achilles Level 2 certification and advanced built-in cyber security feature as defined by standard IEC 62443
 - b. The Processor shall have:
 1. A mini-B USB terminal port for programming.
 2. An RJ45 Ethernet port that allows diagnostic of Ethernet ports and provides access to external tools, devices and distributed I/O devices.
 3. Dual RJ45 Ethernet ports for connection to the remote I/O drops (EIO) and distributed equipment (DIO) through dual redundant switches (DRS).

The 2 device network ports shall support a wired star or ring architecture (daisy chain loop). Dual Ethernet ports shall support RSTP to enable all remote I/O devices located on the ring to recover from a communication disruption within 50ms.

4. An embedded web server for web access. Additional modules for this function are not acceptable.
 5. An embedded remote I/O scanner service allowing scanning of remote I/O drops (X80 I/O) and distributed I/O.
 6. The PLC shall have a configurable alarming capability. Each alarm point can be configured to display an alphanumeric message in the alarm buffer. The buffer can be displayed via a web page, or on an operator interface screen
 7. A 4GB SD memory card. This card shall be capable of storing, at a minimum application files, data files, PDF files, CAD files, Microsoft office files.
 8. On board status lights to indicate the following various functions:
 - a. Green RUN lamp that illuminates while program is executing.
 - b. RED ERR lamp that illuminates while program is executing
 - c. Red I/O lamp that illuminates upon an I/O failure or configuration fault.
 - d. Green DL lamp that illuminates while the firmware download is in progress
 - e. Red BACKUP lamp that illuminates on memory backup
 - f. Green/Red ETH MS lamp shall indicate the Ethernet port configuration status
 - g. Green/Red ETH NS lamp shall indicate the Ethernet connection status
 - c. Processor shall have 16 MB of internal user RAM, capable of supporting up to 8 local racks, 16 remote I/O drops and 64 distributed I/O devices. Capable of handling 4096 Discrete I/O and 1024 Analog I/O. Processor performance shall be rated at least 30,000 instructions per millisecond at a program make up of 65% Boolean and 35% numerical.
 - d. Upon power loss, the PLC shall insure memory is transferred to flash memory before PLC RAM powers down. PLCs with a battery backup are not acceptable.
26. High Availability:
- a. The Processor shall include a processor designed to be part of a redundant architecture, obeying a principle of redundant controllers which guarantees a switchover without loss of control of the process on occurrence of a failure
 - b. The implementation of the redundant solution shall be "plug & play" by design.
 - c. The data exchanges between the two redundant processors (Primary and Standby), shall use a high speed link of 1 Gbps.
 - d. The redundant system shall be seen by the SCADA as a single PLC (one IP address). The system manages in all transparency and automatically the IP address swapping of the Ethernet couplers.

- e. To connect with the engineering tool continuously, the redundant controllers shall have their own IP addresses that never swap.
 - f. The system components internal firmware shall have the ability of being updated while the system is running, without losing the redundant functionality.
 - g. The redundant power supplies shall provide a transparent status of their redundancy without extra hardware or wiring and shall be mounted in local or remote backplanes.
 - h. The redundant power supplies must natively provide information about their ageing, to be able to be replaced before failure (preventive maintenance.)
 - i. The redundant power supplies shall use a true redundant technology (one active at a time, the other ready to take full load if needed), not using load sharing technology.
27. Ethernet Remote I/O (RIO)
- a. The PLC shall be capable of communicating to Remote I/O and shall be capable of being configured in both linear ‘daisy-chain’ or self-healing ring topologies.
 - b. The Remote I/O adapter module shall consist of a dual Ethernet ports, labeled as “Device Network”, and a service port. Two Ethernet ports shall be used for linking the head and the drops together.
 - c. The RIO system shall be based on Ethernet/IP technology.
 - d. The Remote I/O adapter shall support Time Stamping at 10 ms.
28. Distributed I/O
- a. The PLC platform can also be used as I/O for Distributed I/O applications. The system shall have a Distributed I/O Interface Module. This processor can be used to store logic that would be executed on a loss of communication, or limited independent logic.
29. Specialized I/O Cards: The PLC shall have a series of application specific I/O cards. These shall have the following characteristics:
- a. High speed counter card: Eight (8) channels at 10 KHz, 16 bits. Two (2) inputs at 24VDC per channel. The card shall also be capable of handling four (4) incremental encoders in 32 bit.
 - b. High performance high speed counter card: 2 channels at 60 KHz at 32 bits. Six (6) inputs at 24VDC and Two (2) reflex outputs per channel.
 - c. Eight (8) channels input HART module
 - d. Four (4) channels output HART module
30. Communication Capabilities: The PLC shall support the following protocols without the need of third party modules:
- a. DNP3
 - b. ASi V3 Master
 - c. Serial protocols including Modbus, Uni-Telway, and ASCII.
 - d. CANopen
 - e. The PLC shall offer an Ethernet card with Three (3) ports. Each port shall be capable of communicating both Modbus TCP, and Ethernet I/P

simultaneously. Cards requiring that the port be configured for one protocol shall not be accepted. The card shall support the following functions:

1. Ring topologies using RSTP (Rapid Spanning Tree Protocol)
2. Priority of Ethernet packets using QoS (Quality of Service)
3. Automatic module configuration recovery using FDR (Fast Device Replacement)
4. Embedded Web Server for application monitoring and module diagnostic. Additional modules for this function shall not be accepted.
5. Sharing data between PLCs
6. Network management using SNMP (Simple Network Management Protocol).
7. Power Supplies: The PLC shall have chassis mounted power supplies to provide power for the processor and applicable modules. The power supplies shall be available in both 24 VDC and 115 VAC models. The available power ratings shall be from 16 to 36W.
8. Ethernet backplanes: The chassis shall come in 4, 8, and 12 position configurations. The cards shall be secured to the chassis via a screw connection.
9. Product and Manufacturer:
 - a. Modicon M580 Series
 - b. Allen-Bradley ControlLogix
 - c. Or equal.

2.2 PROGRAMMABLE LOGIC CONTROLLERS (PLC) – NON-REDUNDANT TYPE

A. General:

1. Provide Programmable Logic Controllers (PLC) for Long Beach Temporary Bypass Pump Station Control Panel (LBP_BCP) and as specified herein.
2. Products specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance.
3. PLC shall be provided with all necessary components to accomplish the requirements described herein. Provide a dedicated Ethernet network card for communications between the PLCs and its OIT, and as shown on the Contract Drawings.
4. The PLC shall be configured by Owners Application Engineer (OAE) to perform functions shown and specified.
5. The PLC hardware shall be handed to the OAE at least 120 days before Factory Acceptance Test procedures.

B. Description: A chassis mount PLC designed for up to 1024 discrete points and 256 analog points. Additional I/O will be interfaced to the PLC via distributed I/O.

C. Executive firmware shall be stored in Flash memory and shall be able to be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.

D. Non-redundant PLCs shall utilize Ethernet protocols that meet the following criteria:

1. Protocols that are assigned to port 502 of the TCP/IP stack by the IANA (Internet Assigned Numbers Authority).
 2. Protocols that are supported by the Open DeviceNet Vendors Association (ODVA)
 3. Will not rely on third party vendors to meet the above criteria.
- E. Processors:
1. The Processor shall have:
 - a) A mini-B USB terminal port for programming.
 - b) An embedded web server for web access. Additional modules for this function will not be accepted.
 - c) An 8MB SD memory card. This card shall be capable of storing, at a minimum application files, data files, PDF files, CAD files, Microsoft office files.
 - d) The PLC shall have on board status lights to indicate the following various functions:
 - 1) Green RUN lamp that illuminates while program is executing.
 - 2) Red ERR lamp that illuminates when a fault occurs in the processor.
 - 3) Red I/O lamp that illuminates upon an I/O failure or configuration fault.
 - 4) Yellow SER COM lamp that illuminates when activity is present on the serial port
 - 5) Red CARDERR lamp that illuminates when memory card is absent or not recognized.
 - 6) Green CAN RUN lamp that illuminates while CANopen network is operational.
 - 7) Green ETH STS lamp that illuminates when Ethernet communication is OK.
 2. Processors shall have 4096 Kb of internal user RAM, capable of supporting up to 4 local racks. Capable of handling 1,024 Discrete I/O and 256 Analog I/O. Processor performance shall be rated at least 6,400 instructions per millisecond at a program make up of 65% Boolean and 35% numerical. Processor shall have a serial port and an Ethernet port.
 3. Upon power loss, the PLC shall insure memory is transferred to flash memory before PLC RAM powers down. PLCs with a battery backup are not acceptable.
- F. Distributed I/O
1. Small PLC platforms can also be used as I/O for Distributed I/O applications. The system will have a Distributed I/O Interface Module. This processor can be used to store logic that would be executed on a loss of communication, or limited independent logic.
 2. The Distributed I/O interface module shall be able to support 4 total racks on I/O including the rack that holds the interface module.
 3. The Distributed I/O interface module shall communicate to Modicon PLC's via Ethernet.
 4. The Distributed I/O interface module shall consist of a single Ethernet port.

- G. Specialized I/O Cards: PLCs shall have a series of application specific I/O cards. These will be as follows:
1. High speed counter card: Eight (8) channels at 10 KHz, 16 bits. Two (2) inputs at 24VDC per channel. The card shall also be capable of handling four (4) incremental encoders in 32 bit.
 2. High performance high speed counter card: 2 channels at 60 KHz at 32 bits. Six (6) inputs at 24VDC and Two (2) reflex outputs per channel.
 3. Eight (8) channels input HART module
 4. Four (4) channels output HART module.
- H. Communication Capabilities: PLCs shall support the following without the need for third party modules:
1. 10/100 MB Ethernet with Fast Device Replacement (FDR) capability, Ethernet scanner capabilities (64 devices per card), Global Data, Network Time Protocol support, standard web page and custom web page capability. A memory card shall be available to store web pages and data.
 2. ASi V2 Master
 3. Serial protocols including Modbus, Unitelway, and ASCII.
 4. DNP3
 5. CANopen
 6. The PLC shall have an Ethernet card with four (4) ports. Each port shall be capable of communicating both with Modbus TCP, and Ethernet I/P simultaneously. Cards requiring that the port be configured for one protocol are not acceptable. The card shall also support the following functions:
 - a) Ring topologies using RSTP (Rapid Spanning Tree Protocol)
 - b) Priority of Ethernet packets using QoS (Quality of Service) service
 - c) Automatic module configuration recovery using FDR (Fast Device Replacement)
 - d) Embedded Web Server for application monitoring and module diagnostic
 - e) Sharing data between PLCs
 - f) Network management using SNMP (Simple Network Management Protocol)
- I. Power Supplies: PLCs shall have chassis mounted power supplies to provide power for the processor and applicable modules. The power supplies shall be available in both 24 VDC and 115 VAC models. The available power ratings will be from 16 to 36W.
- J. Chassis: The chassis shall come in 4, 6, 8, and 12 position configurations. The cards shall be secured to the chassis via a screw connection.
- K. Product and Manufacturer:
1. Modicon M340 Series
 2. Allen-Bradley Compact
 3. Or equal.

2.3 PLC PROGRAMMING SOFTWARE

- A. All specified PLC platforms shall be programmed using the same programming software package. PLCs that use multiple software programming packages under similar trade names are not acceptable.
- B. The programming software shall support five IEC61131-3 languages: Instruction List (IL), Structured Text (ST), Ladder Diagram (FD), Function Block Diagram (FDB) and Sequential Function Chart (SFC) and User Derived Function blocks (DFB). The system shall be designed to execute all languages without a significant decrease in processing speed.
- C. Programming software shall have:
 - 1. Embedded PLC simulator for debugging and program validation.
 - 2. Embedded network configuration tools that utilize FDT/DTM technologies. PLC's that use separate programming, communication, simulation and network configuration software shall not be accepted.
- D. Software shall support the development of the PLC ladder logic derived from process control strategies as specified herein. Software shall utilize traditional relay logic as well as modular, function block type of control elements, which are familiar to control engineers, instrumentation technicians and electricians. The function blocks shall be; computational blocks for performing arithmetic, operational blocks for performing such functions as move and convert values, file to file operations, communication blocks for communicating with other PLCs and system resources, special algorithm blocks for advanced control procedures such as shift register, and PID functions. The PID shall use traditional strategies such as proportional, integral derivative (PID) controllers, feed forward, cascaded controllers, etc. shall be provided. Tuning constants shall be easily set from operator consoles. For each analog loop, software to allow provision of status of the manual backup control to be monitored and an alarm generated when switch is not in automatic mode.
- E. PLC programming/documentation software package shall be fully menu-driven and self-prompting. Programming package shall provide fully integrated ladder diagram programming and documentation. The programming software shall allow 3 lines of mnemonics per ladder element with 6 characters per line minimum. It shall also provide for the inclusion of the following documentation information for ladder diagram contacts and coils:
 - 1) Panel I/O wiring list
 - 2) Rack number
 - 3) Module position slot number.
 - 4) I/O module type.
 - 5) Terminal number and wire number.
 - 6) Electrical and Mechanical Drawing Reference Number.
 - 7) Description of up to 240 characters in length for each element.

The programming/documentation software displays shall allow the user to flip between documentation and the uncommented rung as it resides in the controller. Software shall also allow selection of single rung and continuous ladder diagram printouts.

- F. Integrator shall provide and configure internal diagnostics alarms for the PLC hardware. Alarms shall be suitable to verify proper and to alert operators when alarm conditions occurs. This includes but is not limited to annunciation blown fuse indication for all I/O, watchdogs for communications failure with any system processor or I/O address, and communications failure with existing third party equipment. For each sequence or logic control loop, a disagreement alarm shall be triggered when a command (start-stop, etc.) is initiated and confirmation is not received.
- G. PLC software shall allow for editing of comments and other PLC documentation using traditional editors such as Notepad.
- H. PLC software shall include as easy to use file and printing management module.
- I. The PLC software shall include a report generation module for system information use. The reporting module should allow for user-configured reports.
- J. The PLC software shall use intuitive, menu-driver environment and base package platform. These easy-to-use graphical user interfaces (GUI) packages shall perform configuration and maintenance operations.
- K. The PLC software shall be compatible with Windows 10, 64-bit operating systems.
- L. All software and licenses shall be turned over to the OWNER at the end of the project.

2.4 OPERATOR INTERFACE TERMINAL

- A. Operator Interface: Modular HMI panel, NEMA 4X rated. Capacitive touch monitor. OIT shall be provided with the following features and functions:
 - 1. Screen:
 - a. 15.6 " Color TFT LCD Display.
 - b. Resolution: 1366 x 768 pixels.
 - c. Backlight lifespan: 50,000 hours
 - e. Bezel: Stainless steel.
 - 2. Processor: RISC CPU
 - 3. Storage: 256 MB RAM Internal, 512kb NVRAM backup memory
 - 4. Cooling: Natural convection
 - 5. Interface Ports:
 - a. Ethernet 2 x 10/100/1000 Mbps (isolated).
 - b. COM1 serial link RJ45 RS485 110...115200 bit/s
 - c. COM1 serial link RJ45 RS485 187.5 kbit/s
 - d. COM2 serial link SUB-D 9 RS232C/RS422/RS485 110...115200 bit/s
 - e. COM2 serial link SUB-D 9 RS232C/RS422/RS485 187.5 kbit/s

- f. Auxiliary port terminal block
 - g. Expansion unit fieldbus card
 - h. USB 2.0 port 2 USB type A
 - i. USB 2.0 port mini B USB
 - 6. Accessories:
 - a. Protective cover.
 - 7. Communication Protocol:
 - a. Modbus
 - b. Modbus TCP/IP
 - 8. Operating Temperature: 32°F to 140°F.
 - 9. Storage Temperature: -20°F to 140°F.
 - 10. Operating Humidity: 5 to 90% non-condensing
 - 11. Input Voltage 12-24 VDC
 - 12. Agencies: UL
 - 13. Include all programming software needed to configure the OIT as specified herein.
- B. Product and Manufacturer:
- 1. Schneider Electric Magelis Harmony GTU and Premium Box base unit.
 - 2. Allen-Bradley PanelView Plus 7
 - 3. Or equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor shall install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents.
- B. Contractor shall coordinate with Owners Application Engineer (OAE) installation of PLC components as necessary.

3.2 START-UP, CALIBRATION, AND TESTING AND TRAINING

- A. The Contractor shall comply with the requirements of Section 13402, Process Control System Factory Testing; Section 13403, Process Control System Start-Up and Field Testing; and Section 13404, Process Control System Training.

+ + END OF SECTION + +

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SECTION 13480
INPUT/OUTPUT POINT LIST

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. This Section describes the input/output (I/O) point list, which follows this Section and requirements for configuring the control system database.
- B. Related Sections:
 - 1. Section 13401, Process Control System General Provisions
 - 2. Section 13491, Process Control Descriptions.
 - 3. Section 13451, Programmable Logic Controllers Hardware and Software.
- C. Contractor may obtain the system I/O list from the Engineer on electronic media. Contractor shall allow 30 days from the date of request for delivery.

1.2 SUBMITTALS

- A. For each I/O attribute listed in the I/O list that cannot be used exactly as listed, submit an explanation of the reason for the deviation and propose a method to modify the I/O list information. Do not proceed with any configuration until a method of resolving deviations is accepted by the Engineer.
- B. Include the control system I/O database information in the PLC specific submittals for Section 13451, Programmable Logic Controllers Hardware and Software.

1.3 I/O POINT LIST DESCRIPTION

- A. The I/O point list contains the information necessary to configure the PLC I/O interface hardware and to indicate range conversion or signal functions.
- B. “TAG” is an alphanumeric character string. For example, the point LB-PI-9503-01A represents:
 - 1. The first two letter character string (LB) identifies the facility as follows “LB” for Long Beach Consolidation Pump Station or the Long Beach Temporary Bypass Pump Station.
 - 2. The second two (or three) letter character string (PI):
 - a. The first alpha character is the functional identifier and follows ANSI/ISA-S5.1. In the example, the “P” represents Pressure.

- b. The next alpha character (I) is the function identifier. In the example, the “I” represents an analog input
- 3. The four-digit number (9503) identifies the loop or field device according to the instrument’s process area location:

Loop #	Pump Station Process Area
9501	Comminutors/Grinders
9502	Wet Well/Pot Level Devices
9503	Pumps
9504	Discharge Flow
9505	Discharge Pressure
9506	Emergency Generator
9507	Fire Alarm Equipment
9508	Gas Detection Equipment
9509	Misc. Equipment

- 4. The two-digit number (03) is a unique identifier used when several instruments of the same type are installed within the same area.
- 5. The final character (A) is used as required, as a suffix to differentiate multiple points in the same loop.
- 6. -BP after the final character indicates component belongs to the Temporary Bypass Pump Station component.

C. “DESCRIPTION” is an alphanumeric character string that describes the I/O point. Points described as “SPARE” denote pre-wired I/O.

D. “SIGNAL TYPE” is one of the following:

- 1. AI designates an analog input.
- 2. DI designates a discrete input.
- 3. AO designates an analog output.
- 4. DO designates a momentary, maintained or latched discrete output.
- 5. DNT designates DeviceNet communication.

E. “RANGE” is a numeric value denoting the minimum and maximum signal value of the controlled variable. Information in this column is provided only for analog points. Information in this column shall be provided by Contractor. For all instrumentation, RANGE information shall be provided after the associated instrument is calibrated.

F. “EngineerING UNITS” denotes the unit type as it applies to the RANGE. Information in this column shall be provided by Contractor.

G. “POWER FROM” indicates where power for the instrument/device producing the signal originates from.

H. “SIGNAL FROM DEVICE” indicates the instrument/device which produces the signal.

- I. "SIGNAL FROM TB" is the terminal block number where the signal wire is terminated. Information in this column shall be provided by Contractor.
- J. "SIGNAL FROM TERMINAL #" is the terminal number where the signal wire is terminated. Information in this column shall be provided by Contractor.
- K. "SIGNAL FROM TERMINAL #" is the terminal number where the signal wire is terminated. Information in this column shall be provided by Contractor.
- L. "SIGNAL TO DEVICE" indicates the instrument/device which receives the signal.
- M. "SIGNAL TO TB." is the terminal block number where the signal wire is terminated. Information in this column shall be provided by Contractor.
- N. "SIGNAL TO TERMINAL #" is the terminal number where the signal wire is terminated. Information in this column shall be provided by Contractor.
- O. "SIGNAL TO TERMINAL #" is the terminal number where the signal wire is terminated. Information in this column shall be provided by Contractor.
- P. "PLC ADDRESS" indicates the device/channel number of the point. Information in this column shall be provided by Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 I/O CONFIGURATION

- A. Implement the control system database fields in a consistent manner by using the following procedures:
 - 1. Use abbreviations and acronyms already established in the Contract Documents. In particular, use the information in the I/O Point List.
 - 2. Use only abbreviation or acronym for a word or group of words, respectively.
 - 3. Use the same subject and word order within data fields.
 - 4. Use the same term (either phrase, word or acronym) to denote the same meaning. Do not use multiple terms for a single meaning.
 - 5. Use the point names, descriptions, logic state descriptions, ranges and units of measurement exactly the same wherever the point is referenced.
 - 6. Show point names and descriptions for all point references on documentation.
 - 7. Spell correctly.
 - 8. Maintain lists of acronyms and abbreviations used.

3.2 I/O HARDWARE CONFIGURATION

- A. Partition the I/O among cards within an I/O enclosure to provide control loop integrity.
 - 1. Put all inputs of the same I/O type associated with a device (e.g. pump, blower, clarifier or other piece of equipment) on the same card.
 - 2. Put all inputs of the same I/O type for devices arranged in process trains (e.g. a pump, its inlet valve and its outlet valve, or a pump and its associated macerator) on the same card or cards if more than one card is required to accommodate the points.
 - 3. Put all outputs of the same I/O type associated with a device or group of devices in a process train on the same card or cards if more than one card is required to accommodate the points.
 - 4. Where the preceding requirements specified in this paragraph would cause more than 20 percent spare points on a card, points for a device or process train may be split between two consecutive cards.
 - 5. Make unused terminals resulting from partitioning the I/O into pre-wired spares. Provide pre-wired spare points with all cabling and termination internal to the DCU as done for other I/O points.

3.3 POINT DATA FIELDS

- A. I/O point data fields may be subject to review and modification by the Engineer during the Shop Drawing review phase. Incorporate changes directed by the Engineer completely into the entire system, at no additional cost to Owner, subject to the following limitations:
 - 1. Limit the total number of modifications to 20 percent of the total number of I/O points.
 - 2. Each unique change will count as one modification. For example, modifying the description, range, and engineering unit on an analog input count as three modifications.
 - 3. Analog input alarm limit definition will not be counted as a modification.

++ INPUT/OUTPUT POINT LIST BEGINS ON NEXT PAGE ++

INPUT-OUTPUT LIST

TAG	DESCRIPTION	DRAWING NO.	SIGNAL TYPE	RANGE /SETPOINT	UNITS	POWER FROM	SIGNAL FROM	SIGNAL TO
							DEVICE	DEVICE
LONG BEACH TEMPORARY BYPASS PUMP STATION CONTROL PANEL (LBP_BCP)								
LBP-UA-9509-02A-BP	Bypass Control Panel Surge Supressor Blown	I-03	DI					LBP_BCP
LBP-UA-9509-02B-BP	Bypass Control Panel UPS On Battery	I-03	DI					LBP_BCP
LBP-UA-9509-02C-BP	Bypass Control Panel UPS in Bypass Mode	I-03	DI					LBP_BCP
LBP-UA-9509-02D-BP	Bypass Control Panel UPS Low Battery	I-03	DI					LBP_BCP
LBP-JA-9509-02A-BP	Bypass Control Panel 120V Power Fail	I-03	DI					LBP_BCP
LBP-JA-9509-02B-BP	Bypass Control Panel 24V Power Fail	I-03	DI					LBP_BCP
LBP-LI-9502-03-BP	Bypass Wet Well Level	I-03	AI	0-30 (Aprox)	ft	LBP_BCP	LY-9502-03-BP	LBP_BCP
LBP-LALL-9502-03-BP	Bypass Wet Well Low Low Level	I-03	DI			LBP-BCP	LSL-9502-02-BP (ISR)	LBP_BCP
LBP-LAL-9502-03-BP	Bypass Wet Well Low Level	I-03	DI			LBP-BCP	LSL-9502-02-BP (ISR)	LBP_BCP
LBP-LAH-9502-03-BP	Bypass Wet Well High Level	I-03	DI			LBP-BCP	LSH-9502-02-BP (ISR)	LBP_BCP
LBP-LAHH-9502-03-BP	Bypass Wet Well High High Level	I-03	DI			LBP-BCP	LSH-9502-02-BP (ISR)	LBP_BCP
LBP-ZIL-9503-01-BP	Pump No.1 Not in Remote	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-HS-9503-01B-BP	Pump No.1 Start/Stop	I-03	DO				LBP_BCP	Pump 1 VFD
LBP-YIL-9503-01-BP	Pump No.1 Run	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-LIC-9503-01-BP	Pump No.1 Level Controller	I-03	AO				LBP_BCP	Pump 1 VFD
LBP-SI-9503-01-BP	Pump No.1 Speed Feedback	I-03	AI	0-100	%		Pump 1 VFD	LBP_BCP
LBP-UA-9503-01-BP	Pump No.1 Fault	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-TAH-9503-01A-BP	Pump No.1 High Winding Temperature	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-MAH-9503-01A-BP	Pump No.1 Motor Stator Leak Detection	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-YA-9503-01-BP	Pump No.1 Estop	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-ZAC-9503-01-BP	Pump No.1 Check Valve Closed	I-03	DI				Check Valve No.1 Limit Switch	LBP_BCP
LBP-TAH-9503-01B-BP	Pump No.1 High Bearing Temperature	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-MAH-9503-01B-BP	Pump No.1 Power Cable Leak Detection	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-VSH-9503-01-BP	Pump No.1 High Vibration	I-03	DI				Pump 1 VFD	LBP_BCP
LBP-ZIL-9503-02-BP	Pump No.2 Not in Remote	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-HS-9503-02-BP	Pump No.2 Start/Stop	I-03	DO				LBP_BCP	Pump 2 VFD
LBP-YIL-9503-02-BP	Pump No.2 Run	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-LIC-9503-02-BP	Pump No.2 Level Controller	I-03	AO				LBP_BCP	Pump 2 VFD
LBP-SI-9503-02-BP	Pump No.2 Speed Feedback	I-03	AI	0-100	%		Pump 2 VFD	LBP_BCP
LBP-UA-9503-02-BP	Pump No.2 Fault	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-TAH-9503-02A-BP	Pump No.2 High Winding Temperature	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-MAH-9503-02A-BP	Pump No.2 Motor Stator Leak Detection	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-YA-9503-02-BP	Pump No.2 Estop	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-ZAC-9503-02-BP	Pump No.2 Check Valve Closed	I-03	DI				Check Valve No.2 Limit Switch	LBP_BCP
LBP-TAH-9503-02B-BP	Pump No.2 High Bearing Temperature	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-MAH-9503-02B-BP	Pump No.2 Power Cable Leak Detection	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-VSH-9503-02-BP	Pump No.2 High Vibration	I-03	DI				Pump 2 VFD	LBP_BCP
LBP-ZIL-9503-03-BP	Pump No.3 Not in Remote	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-HS-9503-03-BP	Pump No.3 Start/Stop	I-03	DO				LBP_BCP	Pump 3 VFD
LBP-YIL-9503-03-BP	Pump No.3 Run	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-LIC-9503-03-BP	Pump No.3 Level Controller	I-03	AO				LBP_BCP	Pump 3 VFD
LBP-SI-9503-03-BP	Pump No.3 Speed Feedback	I-03	AI	0-100	%		Pump 3 VFD	LBP_BCP
LBP-UA-9503-03-BP	Pump No.3 Fault	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-TAH-9503-03A-BP	Pump No.3 High Winding Temperature	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-MAH-9503-03A-BP	Pump No.3 Motor Stator Leak Detection	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-YA-9503-03-BP	Pump No.3 Estop	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-ZAC-9503-03-BP	Pump No.3 Check Valve Closed	I-03	DI				Check Valve No.3 Limit Switch	LBP_BCP
LBP-TAH-9503-03B-BP	Pump No.3 High Bearing Temperature	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-MAH-9503-03B-BP	Pump No.3 Power Cable Leak Detection	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-VSH-9503-03-BP	Pump No.3 High Vibration	I-03	DI				Pump 3 VFD	LBP_BCP
LBP-FI-9504-01-BP	Bypass Pump Station Discharge Flow	I-03	AI	0-18	MGD	120VAC	FIT-9504-BP	LBP_BCP
LBP-HS-9509-01-BP	Radar/Floats Selector Switch	I-03	DI				HS-9509-01-BP	LBP_BCP
LBP-LAHH-9502-02-BP	Wet Well Hi-High Level Alarm	I-03	DO				LBP_BCP	Autodialer
LBP-LAHH-9502-03-BP	Wet Well Hi-High Level Alarm	I-03	DO				LBP_BCP	Autodialer
LONG BEACH CONSOLIDATION PUMP STATION MAIN CONTROL PANEL (LBP_MCP)								
LBP-UA-9509-02A	Surge Supressor Blown	I-04	DI					LBP_MCP
LBP-UA-9509-02B	UPS On Battery	I-04	DI					LBP_MCP
LBP-UA-9509-02C	UPS in Bypass Mode	I-04	DI					LBP_MCP
LBP-UA-9509-02D	UPS Low Battery	I-04	DI					LBP_MCP
LBP-UA-9509-02E	Tamper Switch Signal	I-04	DI					LBP_MCP
LBP-JA-9509-02A	120V Power Fail	I-04	DI					LBP_MCP
LBP-JA-9509-02B	24V Power Fail	I-04	DI					LBP_MCP
LBP-UA-9509-02A	Surge Supressor Blown	I-02/08	DI				LBP_LIP	LBP_MCP
LBP-UA-9509-02B	UPS On Battery	I-02/08	DI				LBP_LIP	LBP_MCP
LBP-UA-9509-02C	UPS in Bypass Mode	I-02/08	DI				LBP_LIP	LBP_MCP
LBP-UA-9509-02D	UPS Low Battery	I-02/08	DI				LBP_LIP	LBP_MCP
LBP-UA-9509-02E	Tamper Switch Signal	I-02/08	DI				LBP_LIP	LBP_MCP

INPUT-OUTPUT LIST

TAG	DESCRIPTION	DRAWING NO.	SIGNAL TYPE	RANGE /SETPOINT	UNITS	POWER FROM	SIGNAL FROM	SIGNAL TO
							DEVICE	DEVICE
LBP-JA-9509-02A	120V Power Fail	I-02/08	DI				LBP_LIP	LBP_MCP
LBP-JA-9509-02B	24V Power Fail	I-02/08	DI				LBP_LIP	LBP_MCP
LBP-ZIL-9509-01	Influent Channel Gate No.1 Not in Remote	I-04	DI				Gate No.1 Actuator	LBP_MCP
LBP-HS-9509-01	Influent Channel Gate No.1 Open/Close	I-04	DO				LBP_MCP	Gate No.1 Actuator
LBP-ZSO-9509-01	Influent Channel Gate No.1 Opened	I-04	DI				Gate No.1 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-01	Influent Channel Gate No.1 Closed	I-04	DI				Gate No.1 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-01	Influent Channel Gate No.1 Fault	I-04	DI				Gate No.1 Actuator	LBP_MCP
LBP-ZIL-9509-05	Influent Channel Gate No.1A Not in Remote	I-04	DI				Gate No.5 Actuator	LBP_MCP
LBP-HS-9509-05	Influent Channel Gate No.1A Open/Close	I-04	DO				LBP_MCP	Gate No.5 Actuator
LBP-ZSO-9509-05	Influent Channel Gate No.1A Opened	I-04	DI				Gate No.5 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-05	Influent Channel Gate No.1A Closed	I-04	DI				Gate No.5 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-05	Influent Channel Gate No.1A Fault	I-04	DI				Gate No.5 Actuator	LBP_MCP
LBP-ZIL-9509-02	Influent Channel Gate No.2 Not in Remote	I-04	DI				Gate No.2 Actuator	LBP_MCP
LBP-HS-9509-02	Influent Channel Gate No.2 Open/Close	I-04	DO				LBP_MCP	Gate No.2 Actuator
LBP-ZSO-9509-02	Influent Channel Gate No.2 Opened	I-04	DI				Gate No.2 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-02	Influent Channel Gate No.2 Closed	I-04	DI				Gate No.2 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-02	Influent Channel Gate No.2 Fault	I-04	DI				Gate No.2 Actuator	LBP_MCP
LBP-ZIL-9509-06	Influent Channel Gate No.2A Not in Remote	I-04	DI				Gate No.6 Actuator	LBP_MCP
LBP-HS-9509-06	Influent Channel Gate No.2A Open/Close	I-04	DO				LBP_MCP	Gate No.6 Actuator
LBP-ZSO-9509-06	Influent Channel Gate No.2A Opened	I-04	DI				Gate No.6 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-06	Influent Channel Gate No.2A Closed	I-04	DI				Gate No.6 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-06	Influent Channel Gate No.2A Fault	I-04	DI				Gate No.6 Actuator	LBP_MCP
LBP-ZIL-9509-03	Influent Channel Gate No.3 Not in Remote	I-04	DI				Gate No.3 Actuator	LBP_MCP
LBP-HS-9509-03	Influent Channel Gate No.3 Open/Close	I-04	DO				LBP_MCP	Gate No.3 Actuator
LBP-ZSO-9509-03	Influent Channel Gate No.3 Opened	I-04	DI				Gate No.3 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-03	Influent Channel Gate No.3 Closed	I-04	DI				Gate No.3 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-03	Influent Channel Gate No.3 Fault	I-04	DI				Gate No.3 Actuator	LBP_MCP
LBP-ZIL-9509-07	Influent Channel Gate No.3A Not in Remote	I-04	DI				Gate No.7 Actuator	LBP_MCP
LBP-HS-9509-07	Influent Channel Gate No.3A Open/Close	I-04	DO				LBP_MCP	Gate No.7 Actuator
LBP-ZSO-9509-07	Influent Channel Gate No.3A Opened	I-04	DI				Gate No.7 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-07	Influent Channel Gate No.3A Closed	I-04	DI				Gate No.7 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-07	Influent Channel Gate No.3A Fault	I-04	DI				Gate No.7 Actuator	LBP_MCP
LBP-ZIL-9509-04	Influent Channel Gate No.4 Not in Remote	I-04	DI				Gate No.4 Actuator	LBP_MCP
LBP-HS-9509-04	Influent Channel Gate No.4 Open/Close	I-04	DO				LBP_MCP	Gate No.4 Actuator
LBP-ZSO-9509-04	Influent Channel Gate No.4 Opened	I-04	DI				Gate No.4 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-04	Influent Channel Gate No.4 Closed	I-04	DI				Gate No.4 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-04	Influent Channel Gate No.4 Fault	I-04	DI				Gate No.4 Actuator	LBP_MCP
LBP-ZIL-9509-08	Influent Channel Gate No.4A Not in Remote	I-04	DI				Gate No.8 Actuator	LBP_MCP
LBP-HS-9509-08	Influent Channel Gate No.4A Open/Close	I-04	DO				LBP_MCP	Gate No.8 Actuator
LBP-ZSO-9509-08	Influent Channel Gate No.4A Opened	I-04	DI				Gate No.8 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-08	Influent Channel Gate No.4A Closed	I-04	DI				Gate No.8 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-08	Influent Channel Gate No.4A Fault	I-04	DI				Gate No.8 Actuator	LBP_MCP
LBP-ZIL-9509-09	Equalization Tank No.2 Influent Gate Not in Remote	I-04	DI				Gate No.9 Actuator	LBP_MCP
LBP-HS-9509-09	Equalization Tank No.2 Influent Gate Open/Close	I-04	DO				LBP_MCP	Gate No.9 Actuator
LBP-ZSO-9509-09	Equalization Tank No.2 Influent Gate Opened	I-04	DI				Gate No.9 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-09	Equalization Tank No.2 Influent Gate Closed	I-04	DI				Gate No.9 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-09	Equalization Tank No.2 Influent Gate Fault	I-04	DI				Gate No.9 Actuator	LBP_MCP
LBP-ZIL-9509-10	Equalization Tank No.1 Influent Gate Not in Remote	I-04	DI				Gate No.10 Actuator	LBP_MCP
LBP-HS-9509-10	Equalization Tank No.1 Influent Gate Open/Close	I-04	DO				LBP_MCP	Gate No.10 Actuator
LBP-ZSO-9509-10	Equalization Tank No.1 Influent Gate Opened	I-04	DI				Gate No.10 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-10	Equalization Tank No.1 Influent Gate Closed	I-04	DI				Gate No.10 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-10	Equalization Tank No.1 Influent Gate Fault	I-04	DI				Gate No.10 Actuator	LBP_MCP
LBP-LAHH-9502-01	Grinder Forebay High High Level	I-04	DI			LBP_MCP	LSH-9502-01 (ISR)	LBP_MCP
LBP-LI-9502-01	Grinder Forebay Level 1	I-04	AI	0-30 (Aprox)	ft	LBP_LIP	LY-9502-01 (LBP_LIP)	LBP_MCP
LBP-LI-9502-02	Grinder Forebay Level 2	I-04	AI	0-30 (Aprox)	ft	LBP_LIP	LY-9502-02 (LBP_LIP)	LBP_MCP
LBP-LI-9502-03	Equalization Forebay Level	I-04	AI	0-30 (Aprox)	ft	LBP_LIP	LY-9502-03 (LBP_LIP)	LBP_MCP
LBP-ZIL-9501-01	Channel Grinding Unit No.1 Not in Remote	I-04	DI				Channel Grinding Unit 1 CP	LBP_MCP
LBP-UA-9501-01A	Channel Grinding Unit No.1 Fault	I-04	DI				Channel Grinding Unit 1 CP	LBP_MCP
LBP-YIL-9501-01	Channel Grinding Unit No.1 Run Feedback	I-04	DI				Channel Grinding Unit 1 CP	LBP_MCP
LBP-YA-9501-01	Channel Grinding Unit No.1 Estop	I-04	DI				Channel Grinding Unit 1 CP	LBP_MCP
LBP-HS-9501-01	Channel Grinding Unit No.1 Start/Stop	I-04	DO				LBP_MCP	Channel Grinding Unit 1 CP
LBP-ZIL-9501-02	Channel Grinding Unit No.2 Not in Remote	I-04	DI				Channel Grinding Unit 2 CP	LBP_MCP
LBP-UA-9501-02A	Channel Grinding Unit No.2 Fault	I-04	DI				Channel Grinding Unit 2 CP	LBP_MCP
LBP-YIL-9501-02	Channel Grinding Unit No.2 Run Feedback	I-04	DI				Channel Grinding Unit 2 CP	LBP_MCP
LBP-YA-9501-02	Channel Grinding Unit No.2 Estop	I-04	DI				Channel Grinding Unit 2 CP	LBP_MCP
LBP-HS-9501-02	Channel Grinding Unit No.2 Start/Stop	I-04	DO				LBP_MCP	Channel Grinding Unit 2 CP
LBP-ZIL-9501-03	Channel Grinding Unit No.3 Not in Remote	I-04	DI				Channel Grinding Unit 3 CP	LBP_MCP
LBP-UA-9501-03A	Channel Grinding Unit No.3 Fault	I-04	DI				Channel Grinding Unit 3 CP	LBP_MCP
LBP-YIL-9501-03	Channel Grinding Unit No.3 Run Feedback	I-04	DI				Channel Grinding Unit 3 CP	LBP_MCP
LBP-YA-9501-03	Channel Grinding Unit No.3 Estop	I-04	DI				Channel Grinding Unit 3 CP	LBP_MCP
LBP-HS-9501-03	Channel Grinding Unit No.3 Start/Stop	I-04	DO				LBP_MCP	Channel Grinding Unit 3 CP

INPUT-OUTPUT LIST

TAG	DESCRIPTION	DRAWING NO.	SIGNAL TYPE	RANGE /SETPOINT	UNITS	POWER FROM	SIGNAL FROM	SIGNAL TO
							DEVICE	DEVICE
LBP-ZIL-9509-11	Equalization Tank No.1 Discharge Gate Not in Remote	I-05	DI				Gate No.11 Actuator	LBP_MCP
LBP-HS-9509-11	Equalization Tank No.1 Discharge Gate Open/Close	I-05	DO				LBP_MCP	Gate No.11 Actuator
LBP-ZSO-9509-11	Equalization Tank No.1 Discharge Gate Opened	I-05	DI				Gate No.11 Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-11	Equalization Tank No.1 Discharge Gate Closed	I-05	DI				Gate No.11 Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-11	Equalization Tank No.1 Discharge Gate Fault	I-05	DI				Gate No.11 Actuator	LBP_MCP
LBP-LI-9502-04	Wet Well No.1 Level	I-05	AI	0-30 (Aprox)	ft	LBP_LIP	LY-9502-04 (LBP_LIP)	LBP_MCP
LBP-LALL-9502-02	Wet Well No.1 Low Low Level	I-05	DI			LBP_MCP	LSLL-9502-02 (ISR)	LBP_MCP
LBP-LAL-9502-02	Wet Well No.1 Low Level	I-05	DI			LBP_MCP	LSL-9502-02 (ISR)	LBP_MCP
LBP-LAH-9502-02	Wet Well No.1 High Level	I-05	DI			LBP_MCP	LSH-9502-02 (ISR)	LBP_MCP
LBP-LAHH-9502-02	Wet Well No.1 High High Level	I-05	DI			LBP_MCP	LSHH-9502-02 (ISR)	LBP_MCP
LBP-ZIL-9503-01	Pump No.1 Not in Remote	I-05	DI				Pump 1 VFD	LBP_MCP
LBP-HS-9503-01B	Pump No.1 Start/Stop	I-05	DO				LBP_MCP	Pump 1 VFD
LBP-YIL-9503-01	Pump No.1 Run	I-05	DI				Pump 1 VFD	LBP_MCP
LBP-LIC-9503-01	Pump No.1 Level Controller	I-05	AO				LBP_MCP	Pump 1 VFD
LBP-SI-9503-01	Pump No.1 Speed Feedback	I-05	AI	0-100	%		Pump 1 VFD	LBP_MCP
LBP-UA-9503-01	Pump No.1 Fault	I-05	DI				Pump 1 VFD	LBP_MCP
LBP-TAH-9503-01A	Pump No.1 High Winding Temperature	I-05	DI				Pump 1 VFD	LBP_MCP
LBP-MAH-9503-01A	Pump No.1 Motor Stator Leak Detection	I-05	DI				Pump 1 VFD	LBP_MCP
LBP-YA-9503-01	Pump No.1 Estop	I-05	DI				Pump 1 LCS/VFD	LBP_MCP
LBP-ZAC-9503-01	Pump No.1 Check Valve Closed	I-05	DI				Check Valve No.1 Limit Switch	LBP_MCP
LBP-TAH-9503-01B	Pump No.1 High Bearing Temperature	I-05	DI				Pump 1 VFD	LBP_MCP
LBP-MAH-9503-01B	Pump No.1 Power Cable Leak Detection	I-05	DI				Pump 1 VFD	LBP_MCP
LBP-VSH-9503-01	Pump No.1 High Vibration	I-05	DI				Pump 1 VFD	LBP_MCP
LBP-ZIL-9503-02	Pump No.2 Not in Remote	I-05	DI				Pump 2 VFD	LBP_MCP
LBP-HS-9503-02	Pump No.2 Start/Stop	I-05	DO				LBP_MCP	Pump 2 VFD
LBP-YIL-9503-02	Pump No.2 Run	I-05	DI				Pump 2 VFD	LBP_MCP
LBP-LIC-9503-02	Pump No.2 Level Controller	I-05	AO				LBP_MCP	Pump 2 VFD
LBP-SI-9503-02	Pump No.2 Speed Feedback	I-05	AI	0-100	%		Pump 2 VFD	LBP_MCP
LBP-UA-9503-02	Pump No.2 Fault	I-05	DI				Pump 2 VFD	LBP_MCP
LBP-TAH-9503-02A	Pump No.2 High Winding Temperature	I-05	DI				Pump 2 VFD	LBP_MCP
LBP-MAH-9503-02A	Pump No.2 Motor Stator Leak Detection	I-05	DI				Pump 2 VFD	LBP_MCP
LBP-YA-9503-02	Pump No.2 Estop	I-05	DI				Pump 2 LCS/VFD	LBP_MCP
LBP-ZAC-9503-02	Pump No.2 Check Valve Closed	I-05	DI				Check Valve No.2 Limit Switch	LBP_MCP
LBP-TAH-9503-02B	Pump No.2 High Bearing Temperature	I-05	DI				Pump 2 VFD	LBP_MCP
LBP-MAH-9503-02B	Pump No.2 Power Cable Leak Detection	I-05	DI				Pump 2 VFD	LBP_MCP
LBP-VSH-9503-02	Pump No.2 High Vibration	I-05	DI				Pump 2 VFD	LBP_MCP
LBP-ZIL-9503-03	Pump No.3 Not in Remote	I-05	DI				Pump 3 VFD	LBP_MCP
LBP-HS-9503-03	Pump No.3 Start/Stop	I-05	DO				LBP_MCP	Pump 3 VFD
LBP-YIL-9503-03	Pump No.3 Run	I-05	DI				Pump 3 VFD	LBP_MCP
LBP-LIC-9503-03	Pump No.3 Level Controller	I-05	AO				LBP_MCP	Pump 3 VFD
LBP-SI-9503-03	Pump No.3 Speed Feedback	I-05	AI	0-100	%		Pump 3 VFD	LBP_MCP
LBP-UA-9503-03	Pump No.3 Fault	I-05	DI				Pump 3 VFD	LBP_MCP
LBP-TAH-9503-03A	Pump No.3 High Winding Temperature	I-05	DI				Pump 3 VFD	LBP_MCP
LBP-MAH-9503-03A	Pump No.3 Motor Stator Leak Detection	I-05	DI				Pump 3 VFD	LBP_MCP
LBP-YA-9503-03	Pump No.3 Estop	I-05	DI				Pump 3 LCS/VFD	LBP_MCP
LBP-ZAC-9503-03	Pump No.3 Check Valve Closed	I-05	DI				Check Valve No.3 Limit Switch	LBP_MCP
LBP-TAH-9503-03B	Pump No.3 High Bearing Temperature	I-05	DI				Pump 3 VFD	LBP_MCP
LBP-MAH-9503-03B	Pump No.3 Power Cable Leak Detection	I-05	DI				Pump 3 VFD	LBP_MCP
LBP-VSH-9503-03	Pump No.3 High Vibration	I-05	DI				Pump 3 VFD	LBP_MCP
LBP-PI-9505	Long Beach Pump Station Discharge Header Pressure	I-05	AI	0-100	PSI	LBP_MCP	PIT-9504	LBP_MCP
LBP-FI-9504-01	Long Beach Pump Station Discharge Header Flow	I-05	AI	0-18	MGD	120VAC	FIT-9504	LBP_MCP
LBP-HS-9509-00	Radar/Floats Selector Switch	I-05	DI				HS-9509-00	LBP_MCP
LBP-HS-9509-00A	WW1 Selector Switch	I-05	DI				HS-9509-00A	LBP_MCP
LBP-HS-9509-00B	Auto Selector Switch	I-05	DI				HS-9509-00A	LBP_MCP
LBP-HS-9509-00C	WW2 Selector Switch	I-05	DI				HS-9509-00A	LBP_MCP
LBP-ZIL-9509-12	Equalization Tank No.1 Discharge Gate Not in Remote	I-06	DI				Gate No.12 Actuator	LBP_MCP
LBP-HS-9509-12	Equalization Tank No.1 Discharge Gate Open/Close	I-06	DO				LBP_MCP	Gate No.12 Actuator
LBP-ZSO-9509-12	Equalization Tank No.1 Discharge Gate Opened	I-06	DI				Gate No.12Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-12	Equalization Tank No.1 Discharge Gate Closed	I-06	DI				Gate No.12Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-12	Equalization Tank No.1 Discharge Gate Fault	I-06	DI				Gate No.12Actuator	LBP_MCP
LBP-ZIL-9509-13	Wet Well Separation Gate Not in Remote	I-06	DI				Gate No.13Actuator	LBP_MCP
LBP-HS-9509-13	Wet Well Separation Gate Open/Close	I-06	DO				LBP_MCP	Gate No.13 Actuator
LBP-ZSO-9509-13	Wet Well Separation Gate Opened	I-06	DI				Gate No.13Actuator/Limit Switch	LBP_MCP
LBP-ZSC-9509-13	Wet Well Separation Gate Closed	I-06	DI				Gate No.13Actuator/Limit Switch	LBP_MCP
LBP-UA-9509-13	Wet Well Separation Gate Fault	I-06	DI				Gate No.13Actuator	LBP_MCP
LBP-LI-9502-05	Wet Well No.2 Level	I-06	AI	0-30 (Aprox)	ft	LBP_LIP	LY-9502-05 (LBP_LIP)	LBP_MCP
LBP-LALL-9502-03	Wet Well No.2 Low Low Level	I-06	DI			LBP_MCP	LSLL-9502-03 (ISR)	LBP_MCP
LBP-LAL-9502-03	Wet Well No.2 Low Level	I-06	DI			LBP_MCP	LSL-9502-03 (ISR)	LBP_MCP
LBP-LAH-9502-03	Wet Well No.2 High Level	I-06	DI			LBP_MCP	LSH-9502-03 (ISR)	LBP_MCP
LBP-LAHH-9502-03	Wet Well No.2 High High Level	I-06	DI			LBP_MCP	LSHH-9502-03 (ISR)	LBP_MCP

INPUT-OUTPUT LIST

TAG	DESCRIPTION	DRAWING NO.	SIGNAL TYPE	RANGE /SETPOINT	UNITS	POWER FROM	SIGNAL FROM	SIGNAL TO
							DEVICE	DEVICE
LBP-ZIL-9503-04	Pump No.4 Not in Remote	I-06	DI				Pump 4 VFD	LBP_MCP
LBP-HS-9503-04B	Pump No.4 Start/Stop	I-06	DO				LBP_MCP	Pump 4 VFD
LBP-YIL-9503-04	Pump No.4 Run	I-06	DI				Pump 4 VFD	LBP_MCP
LBP-LIC-9503-04	Pump No.4 Level Controller	I-06	AO				LBP_MCP	Pump 4 VFD
LBP-SI-9503-04	Pump No.4 Speed Feedback	I-06	AI	0-100	%		Pump 4 VFD	LBP_MCP
LBP-UA-9503-04	Pump No.4 Fault	I-06	DI				Pump 4 VFD	LBP_MCP
LBP-TAH-9503-04A	Pump No.4 High Winding Temperature	I-06	DI				Pump 4 VFD	LBP_MCP
LBP-MAH-9503-04A	Pump No.4 Motor Stator Leak Detection	I-06	DI				Pump 4 VFD	LBP_MCP
LBP-YA-9503-04	Pump No.4 Estop	I-06	DI				Pump 4 LCS/VFD	LBP_MCP
LBP-ZAC-9503-04	Pump No.4 Check Valve Closed	I-06	DI				Check Valve No.4 Limit Switch	LBP_MCP
LBP-TAH-9503-04B	Pump No.4 High Bearing Temperature	I-06	DI				Pump 4 VFD	LBP_MCP
LBP-MAH-9503-04B	Pump No.4 Power Cable Leak Detection	I-06	DI				Pump 4 VFD	LBP_MCP
LBP-VSH-9503-04	Pump No.4 High Vibration	I-06	DI				Pump 4 VFD	LBP_MCP
LBP-ZIL-9503-05	Pump No.5 Not in Remote	I-06	DI				Pump 5 VFD	LBP_MCP
LBP-HS-9503-05	Pump No.5 Start/Stop	I-06	DO				LBP_MCP	Pump 5 VFD
LBP-YIL-9503-05	Pump No.5 Run	I-06	DI				Pump 5 VFD	LBP_MCP
LBP-LIC-9503-05	Pump No.5 Level Controller	I-06	AO				LBP_MCP	Pump 5 VFD
LBP-SI-9503-05	Pump No.5 Speed Feedback	I-06	AI	0-100	%		Pump 5 VFD	LBP_MCP
LBP-UA-9503-05	Pump No.5 Fault	I-06	DI				Pump 5 VFD	LBP_MCP
LBP-TAH-9503-05A	Pump No.5 High Winding Temperature	I-06	DI				Pump 5 VFD	LBP_MCP
LBP-MAH-9503-05A	Pump No.5 Motor Stator Leak Detection	I-06	DI				Pump 5 VFD	LBP_MCP
LBP-YA-9503-05	Pump No.5 Estop	I-06	DI				Pump 5 LCS/VFD	LBP_MCP
LBP-ZAC-9503-05	Pump No.5 Check Valve Closed	I-06	DI				Check Valve No.5 Limit Switch	LBP_MCP
LBP-TAH-9503-05B	Pump No.5 High Bearing Temperature	I-06	DI				Pump 5 VFD	LBP_MCP
LBP-MAH-9503-05B	Pump No.5 Power Cable Leak Detection	I-06	DI				Pump 5 VFD	LBP_MCP
LBP-VSH-9503-05	Pump No.5 High Vibration	I-06	DI				Pump 5 VFD	LBP_MCP
LBP-ZIL-9503-06	Pump No.6 Not in Remote	I-06	DI				Pump 6 VFD	LBP_MCP
LBP-HS-9503-06	Pump No.6 Start/Stop	I-06	DO				LBP_MCP	Pump 6 VFD
LBP-YIL-9503-06	Pump No.6 Run	I-06	DI				Pump 6 VFD	LBP_MCP
LBP-LIC-9503-06	Pump No.6 Level Controller	I-06	AO				LBP_MCP	Pump 6 VFD
LBP-SI-9503-06	Pump No.6 Speed Feedback	I-06	AI	0-100	%		Pump 6 VFD	LBP_MCP
LBP-UA-9503-06	Pump No.6 Fault	I-06	DI				Pump 6 VFD	LBP_MCP
LBP-TAH-9503-06A	Pump No.6 High Winding Temperature	I-06	DI				Pump 6 VFD	LBP_MCP
LBP-MAH-9503-06A	Pump No.6 Motor Stator Leak Detection	I-06	DI				Pump 6 VFD	LBP_MCP
LBP-YA-9503-06	Pump No.6 Estop	I-06	DI				Pump 6 LCS/VFD	LBP_MCP
LBP-ZAC-9503-06	Pump No.6 Check Valve Closed	I-06	DI				Check Valve No.6 Limit Switch	LBP_MCP
LBP-TAH-9503-06B	Pump No.6 High Bearing Temperature	I-06	DI				Pump 6 VFD	LBP_MCP
LBP-MAH-9503-06B	Pump No.6 Power Cable Leak Detection	I-06	DI				Pump 6 VFD	LBP_MCP
LBP-VSH-9503-06	Pump No.6 High Vibration	I-06	DI				Pump 6 VFD	LBP_MCP
BP-LAH-0001	Bay Park Scavange Well High Level Alarm	I-06	ETH				RSP_MCP (Via Cellular Modem)	LBP_MCP
BP-LI-0001	Bay Park Scavange Level Indication	I-06	ETH				RSP_MCP (Via Cellular Modem)	LBP_MCP
LBP-ZSC-9509-05A	Electrical Building Door 1 Open	I-07	DI				ZSC-9509-05A	LBP_MCP
LBP-ZSC-9509-05B	Electrical Building Door 2 Open	I-07	DI				ZSC-9509-05B	LBP_MCP
LBP-TI-9509-05	Electrical Building Room Temperature	I-07	AI				TIT-9509-05	LBP_MCP
LBP-UA-9509-05A	Electrical Building Common Alarm	I-07	DI				HMCS VENDOR PANEL	LBP_MCP
LBP-YA-9509-06	Generator Run	I-07	DI				Generator Control Panel	LBP_MCP
LBP-UA-9509-06A	Generator System Warning	I-07	DI				Generator Control Panel	LBP_MCP
LBP-UA-9509-06B	Generator System Shut-Down	I-07	DI				Generator Control Panel	LBP_MCP
LBP-ZA-9509-06	Generator System Not In Auto	I-07	DI				Generator Control Panel	LBP_MCP
LBP-LA-9509-06A	Generator Low Fuel Warning	I-07	DI				Generator Control Panel	LBP_MCP
LBP-LA-9509-06B	Generator Fuel Leak	I-07	DI				Generator Control Panel	LBP_MCP
LBP-UA-9509-04A	Fire Alarm Panel Fire Alarm	I-07	DI				Fire Alarm Panel	LBP_MCP
LBP-UA-9509-04B	Fire Alarm Panel Trouble Alarm	I-07	DI				Fire Alarm Panel	LBP_MCP
LBP-YI-9509-03A	Switchgear Normal Source Avail	I-07	DI				Switchboard	LBP_MCP
LBP-YI-9509-03B	Switchgear Generator Source Avail	I-07	DI				Switchboard	LBP_MCP
LBP-ZA-9509-03	Switchgear Master Switch Not In Auto	I-07	DI				Switchboard	LBP_MCP
LBP-YI-9509-03C	Switchgear Normal Source Breaker 52-N Closed	I-07	DI				Switchboard	LBP_MCP
LBP-YI-9509-03D	Switchgear Generator Source Breaker 52-G Closed	I-07	DI				Switchboard	LBP_MCP
LBP-YI-9509-03E	Switchgear Portable Generator Source Breaker 52-PG Closed	I-07	DI				Switchboard	LBP_MCP
LBP-UA-9509-03A	Switchgear General Alarm	I-07	DI				Switchboard	LBP_MCP
LBP-YA-9509-03A	Switchgear Maintenance Mode	I-07	DI				Switchboard	LBP_MCP
LBP-YA-9509-03B	Switchgear Multiple Signals:	I-07	ETH					LBP_MCP
LBP-EI-9509-03A	Breaker 52-N (Normal Supply) Volts	I-07	ETH		V		Breaker 52-N	LBP_MCP
LBP-II-9509-03A	Breaker 52-N (Normal Supply) Amperes	I-07	ETH		A		Breaker 52-N	LBP_MCP
LBP-JI-9509-03A	Breaker 52-N (Normal Supply) Watts	I-07	ETH		W		Breaker 52-N	LBP_MCP
LBP-EI-9509-03B	Breaker 52-N (Normal Supply) Vars	I-07	ETH		VAR		Breaker 52-N	LBP_MCP
LBP-II-9509-03B	Breaker 52-N (Normal Supply) Va	I-07	ETH		VA		Breaker 52-N	LBP_MCP
LBP-UI-9509-03A	Breaker 52-N (Normal Supply) Power Factor	I-07	ETH				Breaker 52-N	LBP_MCP
LBP-SI-9509-03A	Breaker 52-N (Normal Supply) Frequency	I-07	ETH		Hz		Breaker 52-N	LBP_MCP
LBP-JI-9509-03B	Breaker 52-N (Normal Supply) Watt Hours	I-07	ETH		Wh		Breaker 52-N	LBP_MCP
LBP-EI-9509-03C	Breaker 52-N (Normal Supply) Va Hours	I-07	ETH		VAh		Breaker 52-N	LBP_MCP
LBP-EI-9509-03D	Breaker 52-N (Normal Supply) Var Hours	I-07	ETH		VARh		Breaker 52-N	LBP_MCP
LBP-JI-9509-03C	Breaker 52-N (Normal Supply) Watt Demand	I-07	ETH		W		Breaker 52-N	LBP_MCP
LBP-EI-9509-03E	Breaker 52-N (Normal Supply) Va Demand	I-07	ETH		V		Breaker 52-N	LBP_MCP

INPUT-OUTPUT LIST

TAG	DESCRIPTION	DRAWING NO.	SIGNAL TYPE	RANGE /SETPPOINT	UNITS	POWER FROM	SIGNAL FROM	SIGNAL TO
							DEVICE	DEVICE
LBP-EI-9509-03F	Breaker 52-N (Normal Supply) Var Demand	I-07	ETH		VA		Breaker 52-N	LBP_MCP
LBP-EI-9509-03G	Breaker 52-N (Normal Supply) Thd-Voltage	I-07	ETH		V		Breaker 52-N	LBP_MCP
LBP-II-9509-03C	Breaker 52-N (Normal Supply) Thd-Current	I-07	ETH		A		Breaker 52-N	LBP_MCP
LBP-II-9509-03D	Breaker 52-N (Normal Supply) Ind. Ampere Harmonics	I-07	ETH		A		Breaker 52-N	LBP_MCP
LBP-EI-9509-03H	Breaker 52-N (Normal Supply) Ind.Voltage Harmonics	I-07	ETH		V		Breaker 52-N	LBP_MCP
LBP-EI-9509-03J	Breaker 52-G (Generator Supply) Volts	I-07	ETH		V		Breaker 52-G	LBP_MCP
LBP-II-9509-03E	Breaker 52-G (Generator Supply) Amperes	I-07	ETH		A		Breaker 52-G	LBP_MCP
LBP-JI-9509-03D	Breaker 52-G (Generator Supply) Watts	I-07	ETH		W		Breaker 52-G	LBP_MCP
LBP-EI-9509-03K	Breaker 52-G (Generator Supply) Vars	I-07	ETH		VAR		Breaker 52-G	LBP_MCP
LBP-II-9509-03F	Breaker 52-G (Generator Supply) Va	I-07	ETH		VA		Breaker 52-G	LBP_MCP
LBP-UI-9509-03B	Breaker 52-G (Generator Supply) Power Factor	I-07	ETH				Breaker 52-G	LBP_MCP
LBP-SI-9509-03B	Breaker 52-G (Generator Supply) Frequency	I-07	ETH		Hz		Breaker 52-G	LBP_MCP
LBP-JI-9509-03E	Breaker 52-G (Generator Supply) Watt Hours	I-07	ETH		Wh		Breaker 52-G	LBP_MCP
LBP-EI-9509-03L	Breaker 52-G (Generator Supply) Va Hours	I-07	ETH		VAh		Breaker 52-G	LBP_MCP
LBP-EI-9509-03M	Breaker 52-G (Generator Supply) Var Hours	I-07	ETH		VARh		Breaker 52-G	LBP_MCP
LBP-JI-9509-03F	Breaker 52-G (Generator Supply) Watt Demand	I-07	ETH		W		Breaker 52-G	LBP_MCP
LBP-EI-9509-03N	Breaker 52-G (Generator Supply) Va Demand	I-07	ETH		V		Breaker 52-G	LBP_MCP
LBP-EI-9509-03P	Breaker 52-G (Generator Supply) Var Demand	I-07	ETH		VA		Breaker 52-G	LBP_MCP
LBP-EI-9509-03Q	Breaker 52-G (Generator Supply) Thd-Voltage	I-07	ETH		V		Breaker 52-G	LBP_MCP
LBP-II-9509-03G	Breaker 52-G (Generator Supply) Thd-Current	I-07	ETH		A		Breaker 52-G	LBP_MCP
LBP-II-9509-03H	Breaker 52-G (Generator Supply) Ind. Ampere Harmonics	I-07	ETH		A		Breaker 52-G	LBP_MCP
LBP-EI-9509-03R	Breaker 52-G (Generator Supply) Ind.Voltage Harmonics	I-07	ETH		V		Breaker 52-G	LBP_MCP

++ END OF SECTION ++

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SECTION 13491

PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Programming of the PLCs, configuration of Operator Interface Terminals (OIT) software and SCADA screen displays at the South Shore Water Reclamation Facility (South Shore WRF), is to be performed by Owner's Application Engineer (OAE). Control strategies provided in this Section are for general information.
2. The PLC programs and configured OIT software will be uploaded to the appropriate PLCs and computers at panel shop before the Factory Test, specified in Section 13402, Process Control System Factory Testing.
3. Programming the required control strategies in processors located within the Bar Screen Control Panel is part of this Contract. Programming the processors, testing, and start-up of the Bar Screen System is the responsibility of the package system suppliers and the Contractor.

B. Related Sections:

1. Section 13401, Process Control System General Provisions.
2. Section 13402, Process Control System Factory Testing.
3. Section 13403, Process Control System Start up and Field Testing.
4. Section 13404, Process Control System Training.
5. Section 13480, Input/Output Point List.

C. This Section describes all of the anticipated control programming under this Contract. The control strategies are generally divided by the responsible supplier and further subdivided by panel.

D. Process Control Functions:

1. Process control function shall be structured to permit the realization of all control strategy requirements. In addition, each control function shall be designed so that bumpless, balance free transfers are obtained during operating mode changeover and initialization. Where applicable, user-changeable parameters shall be automatically defaulted to a preset value if a specific value is not given during system generation.
2. The P&IDs represent the required process monitoring and control. The required control for the system is a combination of the representation on the P&IDs and the requirements specified herein. The P&IDs do not show all the required internal diagnostic indications. In addition, to the indications shown on the P&IDs the following, at a minimum shall be provided:
 - a. Indication of bad quality on any hard wired input/output point (such as less

- than 3.5 milliamps on a 4 to 20 mADC circuit).
- b. Individual PLC fault indications.
 - c. Indication of a communications failure.
 - d. Indication of Input/Output module failure.
 - e. Indication of a Input/Output channel failure.
 - f. For all motor start and stop commands check for run feedback after adjustable time delay (0 to 30 seconds). Provide a "FAIL TO START" and "FAIL TO STOP" alarm if unit fails to run or stop. Use the bad start or stop bit to remove the run command from the control logic.
 - e. For analog control loops, when control of field equipment is not in "COMPUTER," the associated PID controller output shall track the position feedback.
 - f. Runtimes shall be provided for all pieces of equipment. Runtimes shall be seven digits long and reset back to zero when it reaches the maximum number. Runtimes shall maintain the latest values during power outage.
 - g. For all analog signals, provide the following alarm indications:
 - 1) "HIGH-HIGH."
 - 2) "HIGH."
 - 3) "LOW."
 - 4) "LOW-LOW."
 - 5) "HIGH AND LOW RATE OF CHANGE."
3. In addition to the indications shown on the P&IDs, the following shall be provided at a minimum:
- a. Analog Data Scaling: This control function shall scale all analog inputs to a common span and shall normalize the digital representation of each analog input to a percent of the operating span. The processed value shall be expressed as a binary number that specifies the analog input's position on a straight line lying between zero and full scale as defined for a given input by the zero span values in the data base.
 - b. Amplitude Limit Check: This control function shall perform dual level, high/low amplitude limit checking and shall identify a limit violation every time a measured or virtual variable goes out-of-limits and returns back into limits. The control function shall determine the time at which each limit excursion occurred. A deadband shall be provided on each limit and shall be expressed as a percentage of span or in engineering units. Low and high limiting default values will be set-up for each measured or calculated variables used in the process control loops.
 - c. Engineering Unit Conversion: This control function shall convert scaled analog data to engineering units by means of the following equation:

$$Y = (H - L) (D/DH) + L$$

where:

Y = Value in engineering units.

H = High value of span, expressed in engineering units.

L = Low value of span, expressed in engineering units.
D = Digitized scaled input value in counts.
DH = Full scale digitized value in counts.

- d. Manual Control: It shall be possible for Operator or Plant Engineer to interrupt any sequence, loop or automatic operation and operate the same manually through the LBP_MCP OIT.
 - e. Verification of Digital Outputs: This control function shall verify that the equipment has responded to the digital commands before proceeding to next step during automatic operation. If any discrepancy is detected, an alarm will be annunciated.
- E. Hardware: Contractor shall provide all the hardware, as shown in the contract drawings, specified or required to implement the control strategies as described.
- F. Configuration: All set points, tuning parameters and engineering scales etc. shall be documented for each control point and each control strategy on configuration sheets or similar documents. These documents shall be updated during Factory Testing and finally during start-up.
- G. Control Strategy Displays: Control strategy displays shall be submitted for review. Displays shall clearly show initial conditions, start, and progression of the control strategies. Each control strategy shall be displayed in a minimum number of displays for ease of monitoring by the Operator.
- H. Plant Power Failure: Plant equipment controlled by the control system shall be programmed to automatically reset upon failure.
- I. Restart: All equipment and motors shall be automatically restarted after power failure by the control system in an orderly fashion approved by the Engineer.
- J. All relays, training parameters, scales, configuration values, mathematical constants, equations and set points given in the control strategies are adjustable over a wide range. The values given are initial and may change during Shop Drawing review and may have to be readjusted during start-up.
- K. All references to SCADA relate to the Plant-wide SCADA network in the South Shore Water Reclamation Facility (South Shore WRF), aka Bay Park Wastewater Treatment Plant (BPWWTP), and accessible through cellular radio communications specified in this contract.

1.2 SUBMITTALS

- A. The control strategies are written descriptions of the basic configuration and/or programming required to implement regulatory and sequential control of the unit

processes as shown on the P&IDs. They do not in all cases describe the process characteristics fully. Finalizing and tuning of strategies, as required, by process characteristics shall be accomplished during start-up. Control strategies shall fully reside in the memory of the designated PLC. The process inputs/outputs referred to in the Control Strategies are shown on the P&IDs. Any additional I/O (Maximum 20 percent) required shall be added during Shop Drawing review. It shall be provided at no additional cost to the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 LONG BEACH CONSOLIDATION PUMP STATION (LBPS) SYSTEM

A. General:

1. There is a Bubbler Level Transmitter (LIT-0001) and a Radar Level Transmitter (LIT-0002) monitoring the level in the Bay Park Influent Junction Chamber Scavenger Waste – Building 21, and wired into the Raw Sewage Pumps Main Control Panel (RSP-MCP) in the same building. Depending on the selected transducer in use (via RSP-MCP's selector switch HS-0001), the Junction Chamber Selected Level Control signal (LIC-0001) shall be monitored by LBP_MCP. In addition to the LIC-0001 analog value, LBP_MCP shall also monitor the status of the Junction Chamber High Level Alarm LAH-0001 at all times.
 - a. Provisions shall be made and configured on the LBP_MCP PLC, to allow Operators to select which of the two signals (LAH-0001 or LIC-0001 or) to use as in interlock to stop the LBP's submersible pumps.
 1. If Operators choose the discrete signal LAH-0001 as the interlock, pumps shall stop when the signal becomes active.
 1. If Operators choose the analog signal from LIC-0001 as the interlock, pumps shall stop when Level is above a configurable setpoint is reached (final elevation setpoint to be defined in the field) and a corresponding alarm shall be displayed to the LBP_MCP OIT and SCADA.
 - b. To prevent sudden/momentary spikes in the selected signal from stopping the pumps at LBP, provide a configurable time delay initially set to 60 seconds. This delay timer shall reset if the signal falls below setpoint or becomes inactive.
 - c. After stopping, the submersible pumps at LBPS, shall only restart operation after the monitored level (LIC-0001) is below a user configurable elevation level (to be defined in the field), unless manually overridden by operators.
 - d. Contractor is required to confirm that level instruments, level selector switch and level controller indicated above are consistent with record drawings from Contract No. S35121-03G (Bay Park Raw Sewage Pumping System

Improvements). Contractor shall inform Engineer of any deviation preventing the remote monitoring of these signals from LBP_MCP.

2. Wastewater from the existing 48" sewer line will enter the Long Beach Consolidation Pump Station and flow into the Grinder Forebay.
3. Flow from LBPS to BPWWTP as measured by magnetic flow meter FIT-9504 shall be maintained above 4.5 MGD at all times. Provisions shall be incorporated to meet this capacity during dry weather conditions. E.g., Storing sufficient sewage in the EQ Tanks during the day to meet this flow requirement at night.
4. Raw sewage from the 48" sewer line will enter the LBPS and flow into the Dropbox Manhole and Grinders Forebay, where it is distributed into the influent channels. The level in the Grinder Forebay is monitored by a radar level transducer (LE-9502-01) and a float (LSH-9502-01 mounted at EL-7.30, initially).
5. There are four influent channels in the pump station. Three of these channels are furnished with a channel grinding unit, while the fourth channel serves as a bypass of the channel grinder units. Under normal operating conditions, raw sewage shall pass through the channel grinding units before entering the EQ Forebay. Each channel grinding unit can be isolated by closing its associated motorized slide gates, directly upstream and downstream of the unit.
 - a. Motorized Slide Gates: Each motorized slide gate actuator incorporates a Local/Off/Remote (L/O/R) selector switch, Open and Close controls, indicating display and indicating lights for Open and Close status.
 - b. Channel Grinder Units:
 2. There is a Channel Grinding Unit Control Panel (CGUCP) for each grinder in the Electrical Room. Each CGUCP has the following components: Hand/Off/Remote (H/O/R), Hand/Off/Auto (H/O/A) selector switches, indicating lights for Running, Stopped, Power and Fault as well as its own internal controller (PLC).
 3. The H/O/A selector switch controls operation of the grinder's Screen Motor. In the HAND position, the screen motor runs continuously. Whenever the selector switch is in the Auto position, the screen motor operation is controlled by the CGUCP internal controller.
 4. There is a Local Control Station (LCS) near each Grinding Unit on the field. Each LCS shall have a Start Pushbutton and a Lockable E-Stop pushbutton. The (lockable) E-Stop at the LCS shall always be functional regardless of the position of the H/O/R and H/O/A switches in the CGUCP. Whenever the E-stop is activated, the respective Grinder Unit shall be completely de-energized and a corresponding alarm shall be displayed to the LBP_MCP OIT and SCADA.
 - c. After the Grinding Channels, sewage is discharged into the EQ Forebay. The level in the EQ Forebay is monitored by a radar level transducer (LE-9201-02).
6. Once sewage arrives into the EQ Forebay, it is distributed between two Equalization Tanks (EQ Tanks) where wastewater is discharged from the respective grinding channels. These EQ Tanks store grinded sewage and feed the respective Wet Wells.
7. There are two Wet Wells where grinded sewage is discharged from the EQ Tanks

as shown in the contract drawings. These Wet Wells are separated by a 36"x36" motorized gate (SG-9509-13). This gate allows the diversion of wastewater between the Wet Wells and to each train of submersible pumps. Under normal operating conditions, SG-9509-13 shall remain open. The operation and the status of the limit switches shall be monitored from LBP_MCP PLC at all times.

- a. Each Wet Well is monitored by a radar level transducer (LE-9502-04 and LE-9502-05). When the 36"x36" slide gate between the Wet Wells is open and as confirmed by its open limit switch (ZCO-9509-13), the levels in the wet well will be hydraulically similar. Hydraulically similar conditions in the Wet Well are defined as instances where the level difference between the two Wet Wells does not exceed more than 2" for a time period initially set to 1 minute. An alarm shall be shown on the LBP_MCP OIT and SCADA informing about the difference in levels between the Wet Wells and that hydraulically similar conditions are not being met. Whenever hydraulic similar conditions are not met, automatic operation of the pump station cannot be initiated.
 - b. In addition to the radar level transmitters, each Wet Well is furnished with four float level switches. Installed at the following elevations:
 1. Low-Low Level Switch: EL -17.13
 2. Low Level Switch: EL -16.13
 3. High Level Switch: EL -9.80
 4. High-High Level Switch: EL -8.80
8. The pump station has six variable speed submersible pumps arranged in two trains of three submersible pumps in each Wet Well as shown in the contract drawings. Each train serving its associated Wet Well. Wet Well No.1 pump train, is composed of two low capacity pumps and one high capacity pump. Wet Well No.2 pump train, is composed by two high capacity pumps and one low capacity pump. The low capacity pumps can handle up to 6.5 MGD (42ft TDH) each, and can reach up to 8.0 MGD (59ft TDH) with two low capacity pumps in operation. The low capacity pumps are to be used during dry weather or low flow operations. The high capacity pumps are sized for 17.0 MGD (158ft TDH) with two pumps operating simultaneously, and shall typically be used during wet weather conditions.
- a. All pump motor protection devices shall be hardwired to the electric motor so that they are always active. Trip of these devices for high motor temperature, high bearing temperature, stator moisture detection, power cable leak detection or high vibration shall shutdown the pump and prevent it from starting until the fault is cleared. These signals shall provide respective fault and alarm indications at the LBP_MCP OIT and SCADA.
 - b. Each pump is furnished with a VFD panel in the Electrical Room. Each VFD panel shall have a Local/Off/Remote (L/O/R) selector switch, Start/Stop pushbuttons, Speed Control potentiometer as well as indicating lights for Running and Fault.
 - c. There is a lockable E-Stop pushbutton near each pump. The E-Stop shall always be functional regardless of the position of the L/O/R switch in the respective VFD panel. Whenever the E-stop is activated, the respective

submersible pump shall be completely de-energized and a corresponding alarm shall be sent to the LBP_MCP OIT and SCADA.

9. There will be a new magnetic flow meter and a new pressure transmitter that shall be installed on the effluent header as shown in the contract drawings.
10. Motorized Slide Gates: Each motorized slide gate actuator incorporates a Local/Off/Remote (L/O/R) selector switch, Open and Close controls, indicating display and indicating lights for Open and Close status. All motorized gates are provided with Opened and Closed limit switches.
11. The Long Beach Consolidation Pump Station Main Control Panel (LBP_MCP) shall control operation of the system as a whole.

B. Local Control:

1. Slide Gates:
 - a. When the L/O/R selector switch of the respective motorized actuator is in the Local position, the Open and Close controls are used to manually operate the slide gate. Local and Off position shall send an alarm to the LBP_MCP OIT and SCADA.
2. Channel Grinding Unit:
 - a. When the H/O/R selector switch in the respective CGUCP is in the Hand position, the grinder shall run as commanded from the Start pushbutton in the Local Control Station (LCS). Whenever the H/O/R selector switch is in Off position, the LCS Start Pushbutton and the LBP_MCP shall not be permitted to Start the grinder unit. Hand and Off position shall send an alarm to the LBP_MCP OIT and SCADA.
3. Submersible Pumps:
 - a. When the (L/O/R) selector switch in the respective pump VFD is in the Local position, the VFD's Start, Stop and speed controls are used to manually operate the respective pump. Local and Off position shall send an alarm to the LBP_MCP OIT and SCADA.
4. Maintenance Mode, Wet Well float switches, Radars and backup operation:
 - a. The selection of which radar or set of floats to be considered, and therefore which pumps to run shall be done via a Wet-Well 1/Auto/Wet-Well 2 (WW1/A/WW2) selector switch on the face of LBP_MCP. Selecting WW1, LBP_MCP PLC logic shall use the instruments in Wet Well No.1 (LSLL/LSL/LSH/LSHH-9502-02 and LIT-9502-04) and its associated pumps for operation. Selecting WW2, LBP_MCP PLC logic shall use the instruments in Wet Well No.2 (LSLL/LSL/LSH/LSHH-9502-03 and LIT-9502-05) and its associated pumps for operation. Selecting Auto, LBP_MCP PLC logic shall use all instruments installed in the Wet Wells.
 - b. The two position selector switch to select between Radar and Float control shall provide functionality such that normal operation (Radar) shall prompt the LBP_MCP PLC for radar level transducer operation; Position 2 (Floats) shall be for backup float operation and shall prompt the LBP_MCP PLC to use the floats as described below. When Floats is selected, provide positive indication

that the selection is made, as this is not normal operation and shall be indicated as an alarm. In addition, provide indication on the LBP_MCP OIT and SCADA of the selection made.

1. LBP_MCP PLC Logic, when selected to operate the with Floats, shall be incorporated so that when the active high level float switch (LSH-9502-02 or LSH-9502-03) is reached (and remains active for a field adjustable time period, initially set to 5 minutes), the corresponding train Low Capacity pump shall be called to start, and run until the low level float is reached (LSL-9502-02 or LSH-9502-03). If on the other hand, the level continues rising, and reaches the High-High level float (LSHH-9502-02 or LSHH-9502-03), a second low capacity pump shall start. In case a second Low Capacity pump is not available, the running low capacity pump(s) shall be called to stop and a high capacity pump shall be started. The High Capacity Pump shall run until the Low Level float is reached (LSL-9502-02 or LSL-9502-03). VFD speeds shall be entered manually by the operator using the manual mode of the proportional only controller such that the operator directly enters the speed that he wants the drive to operate at.
- c. The floats installed in the Wet Wells are intended for backup operation of the pumps in situations where both radar level transmitters are unavailable (out of service) for maintenance or fail.

C. Remote Manual Control:

1. Slide Gates:
 - a. When the L/O/R selector switch of the respective motorized actuator is in the Remote position, control of the respective gate shall be made through soft pushbuttons configured in the LBP_LCP OIT.
 - b. Remote/Manual operation of slide gates is intended for maintenance and troubleshooting purposes only.
2. Channel Grinding Unit:
 - a. Each Grinder Unit shall have the ability to be controlled to Start and Stop from LBP_MCP and its OIT. When the H/O/R selector switch is in the Remote position, an Auto/Manual (A/M) soft selector switch shall be displayed near the respective grinder. When in Manual, soft push buttons shall be made available on the LBP_MCP OIT to Start and Stop the respective grinder.
3. Submersible Pumps:
 - a. When a submersible pump VFD L/O/R selector switch is in the Remote position, a respective pump Auto/Manual (A/M) soft selector switch shall be made available on the LBP_MCP OIT display. Whenever the A/M soft selector switch is in the Manual position, Start/Stop soft-pushbuttons and Speed Control entry setpoint field, shall be made available to allow manual control of the respective pump.
 - b. When the remote 36"x36" slide gate between the Wet Wells is closed as confirmed by its Closed Limit switch (ZSC-9509-05), and one Wet Well and its associated Train of Pumps is taken out of service, the Operator shall use the WW1/A/WW2 selector switch in front of LBP_MCP, to manually assign the

Wet Well (and its associated level transmitter and backup float) that remains in service (selecting either WW1 or WW2). Operators shall be able to drain the out of service Wet-Well by manually starting and stopping its pumps.

D. Remote Automatic Control:

1. Channel Grinding Units and Grinding Channel Motorized Slide Gates:
 - a. Channel Grinding Unit:
 1. The H/O/R selector switch allows the Grinder Unit to be commanded to Start and Stop from LBP_MCP. When this switch is in the Remote position, an Auto/Manual (A/M) soft selector switch shall be configured in the LBP_MCP OIT. When in Automatic, Start and Stop operation of the grinder is controlled from the LBP_MCP PLC and depending on the criteria specified herein.
 - b. Under normal operating conditions, Operators shall have the ability to select Duty/Standby/Spare grinding units via soft selector switches on OIT and SCADA and configured in PLC. If a Grinding unit is out of service or fails, an alarm shall be prominently displayed prompting operators to take corrective action.
 - c. There shall be at least one grinder in service at all times, and as confirmed by its run feedback signal and respective slide gates opened and closed limit switches.
 - d. The next available Grinders (Stand-by and Spare), shall be started according to the following conditions, as measured by the magnetic flowmeter (FE/FIT-9504-01) and LE/LIT-9502-01, 9502-02 9502-03:
 1. Pumping between 4.5 MGD and 8 MGD: When pumping is in this range, and level in the Grinder Forebay increases above EL-9.80, the second grinder shall be started. If level continues to increase, and reaches EL -9.30, the third grinder shall be started. Subsequently, when all grinders are running and level continues to raise, reaching EL -8.80, the bypass channel gates shall be commanded to open.
 2. Pumping above 8 MGD: When flow measured by the electromagnetic flow meter (FE/FIT-9505-01) is above 8MGD, a timer initially set to 1 minute shall be started. If flow conditions remain above 8MGD upon expiration of the timer, the second grinder shall be called to start. If the level in Grinder Forebay continues to rise and reaches EL -9.80, the third grinder shall be called to start. If the level reaches EL -9.30 or higher, the bypass gates shall be commanded to open.
 - e. Once an additional Grinder has been called to start, its associated motorized gates shall be immediately called to open.
 - f. The Motorized Slide Gates shall be commanded to close when the associated channel grinding unit is called to stop.
 - g. Conversely, the Grinding Unit shall be called to stop when both of its associated motorized Gates are called to close. In this case the Grinding Unit shall remain running until the expiration of an adjustable time delay initially set to 60 seconds after the respective limit switches are made.

- h. Whenever three Grinding units malfunction simultaneously, their associated Influent Gates shall fully open and the influent and effluent channel gates of the Bypass Channel shall be commanded to open. An alarm shall be generated, indicating on the LBP_MCP OIT and SCADA that raw sewage is reaching the Equalization Tanks and Wet Wells.
- 2. Submersible Pumps:
 - a. Two modes of operation shall be provided: Normal and Wet Weather mode.
 - 1. In Normal mode and whenever the two position selector switch, located on front of the LBP_MCP is set to RADAR (letting the LBP_MCP PLC know that the pump system shall run based on radar level transducer operation), and the WW1/A/WW2 selector switch is in Auto, the submersible pumps operation shall be controlled by the LBP_MCP PLC as described below.
 - a. When the L/O/R selector switch is placed in the Remote position at the respective Pump VFD Panel, the submersible pumps shall be controlled by LBP_MCP.
 - b. Once a pump's L/O/R switch is placed in Remote, a respective Auto/Manual (A/M) soft selector switch shall be displayed on the LBP_MCP OIT.
 - c. Provisions shall be made to allow Operators to select Lead, Lag and Spare for both the Low Capacity and the High Capacity pumps.
 - d. When all the submersible pumps A/M soft selector switches on the LBP_MCP OIT are placed in Auto position and the 36"x36" Wet Well separation gate conditions are met (levels in the wet wells are hydraulically similar), the submersible pumps shall run as follows:
 - 1. During Normal conditions and during initial operation, the Lead Low Capacity pump shall run at a constant speed setpoint initially set to 50%. Constant speed setpoint shall be field determined during startup to match a minimum flow of 4.5 MGD, and as measured by electro-magnetic flowmeter FE/FIT-9504.
 - 2. Increasing Level Conditions:
 - a. If level in the Wet Wells rises, and reaches the bottom of the level set band as set by the proportional only level controller, a timer initially set to 60 seconds shall be started. Once the timer completes its countdown, the Lag Low Capacity pump shall start. Both Low Capacity Pumps (Lead and Lag), shall modulate their speed in sync using the output of the proportional only level controller to maintain the desired target level band (Level Band 1) as shown on the table in paragraph 3.1.D.3.c.4. If the condition is no longer valid before expiration of the countdown, the timer shall reset.
 - b. Whenever the Low Capacity Pumps reach full speed as reported by their VFD speed signal feedback and the level band is at maximum (top of band), OR whenever the BPS flow to BPWWTP (as measured by FIT-9504) exceeds a flow setpoint initially set to 8MGD, a timer initially set to 60 seconds shall be

- started. Once the timer completes its countdown, both Low Capacity Pumps shall be called to stop and the two Lead High Capacity Pumps shall be called to Start. If either condition is no longer valid (Speed=100% and max level band, OR Flow >8.0MGD), before expiration of the countdown, the timer shall reset.
- c. Once the two Lead High Capacity Pumps have started, the pumps shall modulate their speed in sync, using the output of the proportional only level controller to maintain the desired target level band (Level Band 1), as shown on a table in paragraph 3.1.D.3.c.4.
3. Receding Level Conditions:
- a. If two High Capacity Pumps running in parallel reach the bottom of the level band for a time setpoint initially set to 60 seconds, stop the High Capacity pumps and start the Lead and Lag Low Capacity Pumps. The Low Capacity pumps shall run in sync with their VFDs following the wet well proportional only level controller output to maintain the desired target level band (level Band 1), as shown on a table in paragraph 3.1.D.3.c.4.
 - b. If the running Low Capacity Pump(s) reaches the bottom of the level band for a time period setpoint initially set to 60 seconds, continue running the Lead pump at constant speed defined on paragraph 3.1.D.3.b.4.a.
4. In the event that a running pump fails, operation shall start the respective capacity Spare Pump.
- e. Whenever the two position selector switch, located on front of the LBP_MCP is set to Floats, (letting the LBP_MCP PLC know that the pump system shall run based on float level switches operation), Operators shall be prompted to select a set of floats to control the operation of the pumps. This selection shall be made through the WW1/A/WW2 selector switch in front of the LBP_MCP. Operators shall be prompted to make a selection if the WW1/A/WW2 switch remains in Automatic position. This automatic mode of operation is intended for temporary situations where maintenance or troubleshooting procedures are occurring in the facility. In this situation, the submersible pumps operation shall be controlled by the LBP_MCP PLC as described below.
 - 1. When the L/O/R selector switch is placed in the Remote position at the respective Pump VFD Panel, the submersible pumps in the selected wet well (Via WW1/A/WW2 switch), shall be controlled by LBP_MCP. The Pumps in the wet well that is not selected shall be commanded to stop at all times.
 - 2. Once a pump's L/O/R switch is placed in Remote, a respective Auto/Manual (A/M) soft selector switch shall be displayed on the LBP_MCP OIT.

3. Provisions shall be made to allow Operators to select Lead, Lag and Spare for the pumps in the active wet well.
4. When all the submersible pumps A/M soft selector switches on the LBP_MCP OIT are placed in Auto, the active wet well submersible pumps shall run as follows:
 - a. Increasing Level Conditions:
 1. If level in the active Wet Well rises and reaches the high level float (LSH-9502-02 or LSH-9502-03), the pumps shall start as follows:
 - a. If WW1 is active, the Lead Low Capacity pump shall run at a constant speed manually set by operators via respective VFD control keypad. If WW2 is active, Pump No.6 (P-9503-06) shall run at a constant speed manually set by operators via its VFD control keypad.
 2. If level in the Wet Wells continues to rise and reaches the active well's high-high level float (LSHH-9502-02 or LSHH-9502-03):
 - a. If WW1 is active, start the High Capacity Pump (P-9503-01). Speed of the pump is determined by operators through the respective VFD control keypad.
 - b. If WW2 is active, start the two High Capacity Pumps (P-9503-04 and P-9503-05). Speed of the pumps is determined by operators through the respective VFD control keypads. If the pair of pumps does not run at the same speed, as confirmed by the respective Speed Feedback signals, provide Operators with a screen indication, reminding them that under this mode of operation, both pumps shall be manually controlled to run at the same speed. If operator doesn't manually adjust the speed of the pumps within a time period initially set to 60 seconds, stop the High Capacity Pump with the highest accumulated runtime and continue running the second pump. Alarm the condition to the operator and prompt to take corrective action on OIT Screen Display.
 - b. Receding Level Conditions:
 5. If level in the Wet Wells decreases and reaches the active well's low level float (LSL-9502-02 or LSL-9502-03), the running pump(s) shall be commanded to stop.
2. In Wet Weather mode and whenever the two position selector switch, located on front of the LBP_MCP is set to RADAR (letting the LBP_MCP PLC know that the pump system shall run based on radar level transducer operation), and the WW1/A/WW2 selector switch is in Auto, the submersible pumps operation shall be controlled by the LBP_MCP PLC as described below.

- a. When the L/O/R selector switch is placed in the Remote position at the respective Pump VFD Panel, the submersible pumps shall be controlled by LBP_MCP.
- b. Once a pump's L/O/R switch is placed in Remote, a respective Auto/Manual (A/M) soft selector switch shall be displayed on the LBP_MCP OIT.
- c. Provisions shall be made to allow Operators to select Lead, Lag and Spare for both the Low Capacity and the High Capacity pumps.
- d. When all the submersible pumps A/M soft selector switches on the LBP_MCP OIT are placed in Auto position and the 36"x36" Wet Well separation gate conditions are met (levels in the wet wells are hydraulically similar), the submersible pumps shall run as follows:
 1. Operator shall be required to confirm change of mode of operation from Normal mode into Wet Weather mode. As soon as confirmation is made, the high capacity pumps shall be called to start and modulate their speed in sync using the output of the proportional only level controller to maintain the desired target level band (Level Band 2) as shown on the table in paragraph 3.1.D.3.b.4.
 2. Receding Level Conditions:
 - a. If two High Capacity Pumps running in parallel reach the bottom of the level band for a time setpoint initially set to 60 seconds, stop the High Capacity pumps and start the Lead and Lag Low Capacity Pumps. The Low Capacity pumps shall run in sync with their VFDs following the wet well proportional only level controller output to maintain the desired target level band (Level Band 2), as shown on a table in paragraph 3.1.D.3.b.4.
 - b. If the running Low Capacity Pumps reach the bottom of the level band for a time period setpoint initially set to 60 seconds, continue running the Lead pump at constant speed defined on paragraph 3.1.D.3.b.4.a. and stop the lag low capacity pump.
 3. Increasing Level Conditions:
 - a. If level in the Wet Wells rises, and reaches the top of the Level Band 2, as set by the proportional only level controller, a timer initially set to 60 seconds shall be started. Once the timer completes its countdown, start the Lag Low capacity Pump (if it has not been running).
 - b. If both Lead and Lag Capacity pumps are running and the top of the Level Band 2 is reached, a timer initially set to 60 seconds shall be started. Once the timer completes its countdown, both Low capacity pumps shall be called to stop and two high capacity pumps shall be started.
 4. In all cases, the pumps shall modulate their speed in sync using the output of the proportional only level controller to maintain the desired target level band (Level Band 2) as shown on the table in paragraph 3.1.D.3.b.4. If the condition is no longer valid before

expiration of the countdown, the timer shall reset.

5. In the event that a running pump fails, operation shall start the respective capacity Spare Pump.

- b. The speed of the running pumps shall be determined by the Wet Well level as follows:

1. The pumps shall primarily operate based on Wet Well level as monitored by the radar level transducers (LIT-9203 and LIT-9204), as selected by HS-9202-03. In this mode, the speed of the operating pump shall be controlled to maintain the appropriate Wet Well level band, by using a level control loop configured in the LBP_MCP PLC with displays configured on the LBP_MCP OIT and SCADA. The level controller for each type of pump shall be configured as a proportional only controller (with the integral set to infinity and derivative set to zero initially). These level controllers shall be used to modulate the respective running pump(s) VFD(s) from min to max flow and to maintain the level band selected for the wet well. Feedback to the pump proportional only level controller shall be from the selected level transmitter.
2. The pump(s) speed shall be controlled by the pump proportional only level controller to maintain the desired "Target Level Band" in the Wet Well. As the level increases, the output of the level controller proportionally increases to a max output when the level rises to the top of the band.
3. If the wet well level should drop to the low-low level float elevation (LSLL-9502-03, 9502-04), the running pump(s) shall stop.
4. The following is the list of the initial adjustable level bands and level setpoints. These figures are provided in elevation, which needs to be converted by CONTRACTOR to level in the Wet Well, and based on the final mounting location of the radar level transducers and floats. This information may be subject to change during commissioning based on actual operational data.

Wet Well high-high level (Floats LSHH-9502-02, LSHH-9502-03 and radar level transducer) (Alarm when any of the sensors reach this elevation. Provide 1 minute buffer timer before triggering.)	-8.50 EL*
Wet well full notification. (Based on radar level transducers. Provide 1 minute buffer timer before notification)	-8.80 EL
Wet Well high level (Floats LSH-9502-02, LSH-9502-03 and radar level transducer).	-9.30 EL
Target Level Band 1 (Selected radar level transducers only) (For Normal Mode Operation)	-9.80 to -10.80 EL
Target Level Band 2 (Selected radar level transducers only) (For Wet Weather Mode operation)	-15.88 to -16.88 EL

Wet Well low level (Floats LSL-9502-02, LSL-9502-03 and radar level transducer) --	-15.88 EL
Wet Well low-low level (Floats LSLL-9502-02, LSLL-9502-03 and radar level transducer) (stops all pumps when any of the sensors reach this elevation)	-17.13 EL*
* Confirm floats final mounting elevation with final field and equipment conditions.	

5. If at any given time a pump is called to run and its check valve remains closed for a field adjustable time (initially set at 15s) as determined by the Check Valve Closed limit switch contact (ZSC-9503-01, 9503-02, 9503-03, 9503-04, 9503-05 and 9503-06), a check valve failed to open alarm shall be generated and displayed on the LBP_MCP OIT and SCADA. Similarly, if a pump is called to stop and its check valve remains opened for a field adjustable time (initially set at 15s), a check valve failed to close alarm shall be generated and displayed on the LBP_MCP OIT and SCADA.
- c. The LBP_MCP PLC shall monitor the main force header Flow (FIT-9504) and Pressure (PIT-9504) and provide indications as shown in the contract drawings.
- d. Pump alternation shall occur after a LBP_MCP PLC adjustable timer initially set to 24hr. Last input from either LBP_MCP OIT or SCADA shall be valid. Alternation shall occur as follows:
 1. During flow conditions requiring only low capacity pumps: During low flow conditions and when the permissible level is reached, one low capacity pump shall run at constant speed, initially set to 40% (user configurable). Once an alternation timer expires (initially set to 24hr, user configurable), the second low capacity pump shall start, and the initial Low Capacity pump shall stop (only after the second Low Capacity pump is confirmed running). The operating Low Capacity pump shall then continue.
 2. During flow conditions requiring two Low Capacity pumps operation shall be based on the control strategy described in paragraph 3.b below. No alternation is required when the Low Capacity Pumps are modulating their speed in sync and as described in paragraph b.4.a. and the alternation timer shall be paused. Once flow conditions into the Wet Well determine that synchronous modulation of Pump speed is no longer required (see paragraph c below for description), stop the longest total runtime low capacity pump and resume the timer to continue alternation for flow conditions requiring only one low capacity pump.
 3. During flow conditions requiring the high capacity pumps (see paragraph 3.c below for description), no alternation is required while the pumps are running. However, once flow conditions do not require the high capacity pumps and the pumps stops, the next time flow conditions requiring high capacity pumping, pumps shall alternate. The operating high capacity pumps speed shall follow the wet well PID level controller output. Restart a new alternation timer and resume operation.

E. Main Header Flush-out:

1. Control logic shall be provided in the LBP_MCP PLC to manually initiate a flush-out of the main discharge header connected to the BPWWTP. A single Main Header Flush-out procedure is defined as one high flow cycle of water pumped into the main discharge header. Relevant OIT and SCADA screen displays shall be developed to provide an interface where operators configure the parameters for this procedure.
 - a. Operators shall be able to adjust the level of water in the Wet Well to be used in each flushing cycle.
 - b. Automatic pump operation (and sequencing) specified herein, shall be paused. All running pumps shall be called to stop. Once the wet well level reaches a user configurable elevation (initially set to -8.80), the Duty High Capacity Pump shall be called to start and quickly ramp its speed to a setpoint initially set to 50%. As soon as the Duty Pump reaches the speed setpoint, the Standby High Capacity Pump shall be called to start and match the speed of the Duty Pump. Once both pumps are running at the same speed, the Pumps shall synchronously ramp their speed to 100%. Once the Wet Well Low Level setpoint is reached, the High Capacity Pumps shall be called to Stop, and the low capacity pumps shall resume normal operation as described herein.
 1. If the operator requires additional Flushing exercises, the procedure shall be repeated only after the Wet Well reaches the preset flush-out level.
 2. Control logic shall be put in place for dry weather situations where the level of the Wet Well rises slowly and the flush-out sequence cannot be completed in a reasonable amount of time. In this scenario, a timer shall be configured to resume normal operation of the system if the level in the Wet Well does not reach the flush-out preset elevation within a user adjustable time limit (initially set to 20min). An Alarm shall be displayed on the LBP_MCP OIT and SCADA, informing operators that the flush-out procedure could not be completed due to low flow conditions into the Wet Well.
 - c. Once a flush-out procedure is complete, or the above mentioned timer expires, operation of the pumps shall resume as specified herein.

F. Preparation for Wet Weather events:

1. In preparation for wet weather events, provisions shall be taken to ensure maximum capacity of the facility is available.
2. Operators shall be given the option via OIT and SCADA to initiate preparation for a wet weather event. Once this option is selected, the System shall prompt which Grinding units to put in service. Once the selection is made, the selected grinders channels shall be called to run as specified herein.
3. Level in the Wet Wells shall be drawn to a minimum. To this effect, a single flush out procedure shall run as specified herein.

G. Alarms:

1. Alarms: This section provides required annunciation of field generated alarms, logic generated alarms, and logic generated warnings. Logic generated alarms and warnings are identified in the control strategy. These alarms include:
 - a. OOR Analog Input: For all analog inputs, issue an Out of Range (OOR) alarm if an analog input is outside of the 4 to 20 mA range for 30 seconds.
 - b. FAIL-to-CLOSE: If a Gate or valve is commanded to Close and there is no CLOSED feedback to indicate that the device has closed within a specific period of time (verify actual travel time under real conditions).
 - c. FAIL-to-OPEN. If a Gate or valve is commanded to Open and there is no OPENED feedback to indicate that the device has opened within a specific period of time (verify actual travel time under real conditions).
 - d. FAIL-to-RUN: If a START command is issued and there is no ON status feedback to indicate device has started within 15 seconds or the ON status is not present while device is running, then issue a FAIL-to-RUN alarm.
 - e. FAIL-to-STOP: If a STOP command is issued and there is still an ON status feedback after 15 seconds from issuing a STOP command, then issue a FAIL-to-STOP alarm.
 - f. FEEDBACK FAILURE: A PID controller modulates equipment operation to maintain a process set point under AUTO mode and the controller's feedback used to determine offset from set point is $\pm 5\%$ from the set point for 45 seconds then issue a FEEDBACK FAILURE alarm.
 - f. FORCE OVERRIDE: A failure condition occurs that requires the control logic to override a calculated value used for controlling a device such as valve position or pump speed, etc.
 - g. NO STANDBY AVAILABLE: The control strategy has a 'duty' and "standby" service operation under AUTO mode and there is only one train of pumps available for AUTO control then issue a NO STANDBY PUMP TRAIN AVAILABLE warning.

3.2 LONG BEACH TEMPORARY BYPASS PUMP STATION SYSTEM

A. General:

1. During construction, sewage from the City of Long Beach shall continue treatment

in the existing Long Beach Waste Water Treatment Plant. To accomplish this purpose, a temporary bypass Pump Station will divert influent sewage away from the Existing Long Beach Pump Station (to be demolished) and directly into the Grit Chambers of the facility.

2. The Temporary Bypass Pump Station will be furnished with a motorized bar screen with a Control Panel of the same manufacturer. Two ultrasonic level transducers installed upstream and downstream of the screen will be used to determine when the rack bar mechanism is activated. Additionally, a timer will also exercise the mechanism to prevent buildup or ice formation.
3. Once influent sewage is screened it will be discharged into a Wet Well with three submersible pumps of identical capacity. Each submersible pump shall be provided with a VFD.
4. To monitor level in the Wet Well, it will be furnished with a Radar level transducer (for normal operation), and a set of floats (Hi-high, High, Low and Lo-low, for backup control).
5. A Control Panel (Long Beach Temporary Bypass Pump Station Control Panel – LBP_BCP) shall be provided to control the Submersible pumps operation, as well as to monitor the level of the Wet Well in the Temporary Bypass Pump Station.

B. Local Control:

1. Rack Bar Screen Unit:
 - a. The vendor provided Rack Bar Screen Unit shall control the operation of the mechanized rack via its own PLC and OIT.
2. Submersible Pumps:
 - a. When the (L/O/R) selector switch in the respective pump VFD is in the Local position, the VFD's Start, Stop and speed controls are used to manually operate the respective pump. Local and Off position shall send an alarm to the LBP_BCP OIT.

C. Remote Manual Control:

1. Submersible Pumps:
 - a. When a submersible pump VFD L/O/R selector switch is in the Remote position, a respective pump Auto/Manual (A/M) soft selector switch shall be made available on the LBP_BCP OIT display. Whenever the A/M soft selector switch is in the Manual position, Start/Stop soft-pushbuttons and Speed Control entry setpoint field, shall be made available to allow manual control of the respective pump.

D. Remote Automatic Control:

1. Submersible Pumps shall normally run automatically as follows:
 - a. Start single pump on rising Wet Well Level when it reaches the bottom of the level set band. Pumps shall alternate on start.
 - b. Whenever first pump reaches full speed as reported by the VFD speed signal feedback, a second pump shall be started. To this effect, the running pump shall temporarily reduce its speed to match the speed of the second pump. Once both pumps are confirmed running at the same speed (as determined by their respective speed feedback signals), both pumps shall modulate their speed in

sync using the PID level controller to maintain the desired target level band. When the Pumps reach the bottom of the level band stop the pump that has the longest runtime. The remaining pump shall continue running following the wet well PID level controller output.

- c. The speed of the running pump(s) shall be determined by Wet Well Level. The speed of the operating pump(s) shall be controlled to maintain the selected Wet Well level band, by using a level control loop configured in the PLC. A level controller shall be configured as a proportional only controller. These level controllers shall be used to modulate the running pump VFD from its min to max flow and to maintain the level band selected for the wet well.
- d. The pump(s) speed shall be controlled by the PID level controller to maintain the desired "Target Level Band" in the Wet Well. As the level increases, the output of the level controller proportionally increases to a max output when the level rises to the top of the band.
- e. Should the wet well level drop to the low-low level float elevation the running pump(s) shall stop.
- f. The following is the list of the initial adjustable levels expressed as elevations. This information may change during commissioning based on actual operational data.

Wet Well high-high level (LSHH)	-7.20
Wet Well high level (LSH)	-7.70
Target Level Band	-7.70 to -8.90
Wet Well low Level (LSL)	-8.90
Wet Well low-low level (LSLL)	-9.40

2. At a minimum high-high level in the wet well of the Temporary Bypass Pump Station and high level upstream of the screen initially set at El -6.8 shall trigger an alarm.

E. Telemetry:

1. The Temporary Bypass Pump Station shall include an automatic dialer with a battery backup to alarm conditions of high-water level in the wet well (float or transducer level). The alarm system must be capable of full operation in the absence of electrical power and must provide redundancy in case of alarm system component failure.

3.3 TELEMETRY AND REMOTE CONTROL

A. General:

1. Remote monitoring and control from the BPWWTP Plant-wide SCADA system shall be configured considering the following criteria:
 - a. The Cellular modem installed inside the LBP_MCP cabinet shall communicate via Ethernet to the redundant LBP_MCP PLC. Redundant communication between the two PLC processors and the cellular radio shall be implemented.

- b. The Cellular modem shall be configured for the exiting Verizon Private Network unless otherwise determined by Owner at time of implementation.
 - 1. Contractor shall coordinate with the Client, the procurement of a new SIM card from the cellular service provider.
- c. Communications through the cellular service provider Mobile Private Network to BPWWTP shall be configured using DNP3 communication protocol.
 - 1. Utilize DNP3 protocol buffering for LBPS communications to the BPWWTP plantwide SCADA Network.
- d. Contractor shall make all necessary configuration changes to the BPWWTP MPN Router to allow secure communications with the plant SCADA network.
- e. Contractor shall create new screen displays in the BPWWTP plant-wide SCADA system to present all signals as shown in the contract drawings and specified herein.
- f. Contractor shall configure new trend screens for all analog and alarm signals relayed from the LBP_MCP.
- g. Contractor shall configure existing BPWWTP servers for historical data collection of the new signals sent from the LBPS.
- h. Contractor shall configure software interlock in LBP_MCP PLC as specified herein.

3.4 AUXILIARY EQUIPMENT

A. General:

- 1. A generator providing backup power to the Pump Station upon line power failure is furnished according to Section 16. A vendor provided control panel shall control the generator system and automatic transfer switch.
- 2. The new electrical room in the Pump Station shall be provided with a temperature indicating transmitter to monitor the room temperature and shall be connected to the LBP_MCP.

B. Generator:

- 1. The LBP_MCP PLC shall receive generator status and alarms from the vendor control panel for display at the LBP_MCP OIT and SCADA.

C. Switchgear:

- 1. The LBP_MCP PLC shall receive Switchgear status and alarms from the vendor control panel for display at the LBP_MCP OIT and SCADA.

D. Electrical Room:

- 1. The LBP_MCP PLC shall receive the temperature signal from a Temperature Transmitter (TIT-9509-05) mounted on the wall inside of the Electrical Room.

+ + END OF SECTION + +

SECTION 14604

JIB CRANES AND TROLLEY HOIST

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all professional services, labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install jib crane and trolley hoist equipment complete and operational.
2. Included are one (1) 2.5-ton jib cranes at the Grinder Chamber.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before hoisting equipment Work.

C. Related Sections:

1. Section 03300, Cast-in-Place Concrete.
2. Section 03600, Grouting
3. Section 05051, Anchor Systems.
4. Section 05120, Structural Steel Framing
5. Section 05501, Miscellaneous Metal Fabrications.
6. Section 09900, Painting.
7. Section 11000, Electric Motors.
8. Section 13491, Process Control Descriptions

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AGMA.
2. AISC, Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings.
3. ASME B30.2, Overhead and Gantry Cranes.
4. ASME B30.11, Monorails and Underhung Cranes.
5. ASME B30.16, Overhead Hoists (Underhung).
6. CMAA No. 74, Top and Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist.
7. HMI 100, Hoist Manufacturers Institute (Electric Wire Rope Hoists).
8. MMA, Underhung Cranes and Monorail Systems.
9. NEC Article 610, Standards of National Electric Code.
10. NEMA.

11. OSHA.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

- a. Manufacturer shall have a minimum of five years of experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of component manufacturer, from single jib crane manufacturer.
2. Jib crane equipment manufacturer shall review and approve or prepare all Shop Drawings and other submittals for components furnished under this Section.
3. All components shall be specifically constructed for specified service conditions and shall be integrated into overall equipment assembly by jib crane equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following

1. Manufacturer's Qualifications.
2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, and engineering data including:
 - 1) Complete description in sufficient detail to permit item by item comparison with the Specifications.
 - 2) Dimensions and required clearances.
 - 3) Weights.
 - 4) Maximum support reactions.
 - 5) Performance characteristics.
 - 6) Manufacturer's installation and testing instructions.
 - 7) Affidavits of compliance with referenced standards and codes.
 - 8) Manufacturer's standard guarantee.
 - b. Motor test data in accordance with Section 11000, Electric Motors.
 - c. List of any deviations from the Contract Drawings.
2. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details and wiring diagrams.
 - b. Dimensions and required clearances.
 - c. Drawings and information for controls logic and wiring.
 - d. Motor Shop Drawings in accordance with Section 11000, Electric Motors.

3. Testing Plans: Prior to performing tests, submit and obtain ENGINEER's approval of test procedures for field operating tests.
 4. Quality Control:
 - a. Test procedures for shop and field performance tests.
 - b. Written report of the results of the shop and field tests.
- B. Informational Submittals: Submit the following:
1. Manufacturer's Report: Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.
 2. Source Quality Control Submittals:
 - a. Motor Shop Test results in accordance with Section 11000, Electric Motors.
 3. Field Quality Control Submittals:
 - a. Results of motor tests at the Site in accordance with Section 11000, Electric Motors.
 4. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended and the unit price of each part.
- C. Closeout Submittals: Submit the following:
1. Operational and Maintenance Data:
 - a. Submit complete operation and maintenance manuals, including copies of test reports, maintenance data, and schedules, descriptions of operation, and spare parts information.
 - b. Required Operation Data: Explanation of all safety considerations relating to operation.
 - c. Furnish operation and maintenance manuals per Section 01730, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Assemble components in the factory to the greatest extent possible prior to shipping.
 2. Packing:
 - a. Inspect prior to packing to assure that assemblies and components are complete and undamaged.
 - b. Protect machined surfaces and mating connections.
 - c. Protect bearings and gearing with a shop applied corrosion prevention coating.
 - d. Cover all openings into gear boxes with vapor inhibiting and water repellent material.
 - e. Crate in a manner which will prevent damage during shipment, delivery and storage.

- f. Identify crate contents by a packing slip fastened to the outside of the crate.
 - 2. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to and run concurrent with other warranties made by CONTRACTOR under the Contract Documents. Obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by provisions of specified special warranty
- B. Special Warranty on Materials and Equipment:
 - 1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct or, at option of OWNER, remove and replace, materials and equipment specified in this Section found to be defective during period of 1 year after date of Substantial Completion.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. System Description:
 - 1. Jib crane and hoisting equipment shall be of the free-standing type. Jib crane and hoisting equipment shall conform to minimum and maximum hook radii, maximum length of boom assembly, boom height, hook elevation and side clearance requirements shown and indicated in the Contract Documents, and shall provide required available lift height and capacity.
- B. Area Classification:

1. Jib crane and hoisting equipment and appurtenances shall be suitable for installation in the specified NEC Hazardous Classification as indicated on the Drawings.
- C. Performance Criteria:
1. Grinder Chamber:
 - a. Equipment description: Electric jib crane and electric wire rope trolley hoist.
 - b. Quantity: one.
 - c. Hoist Type: Underhung, low headroom, wire rope, double reeved true vertical lift, motorized, one speed hoist.
 - d. Service Classification: Infrequent use.
 - e. Rated Hoisting Capacity: 2.5 tons.
 - f. Operating Floor Elevation: 9.89.
 - g. Minimum Clearance from Bottom of Beam to Operating Floor Elevation: 20ft
 - h. Minimum Rated Hook Lift: 32.00 feet.
 - i. Hoist and Trolley Operating Temperature Range: -20 to 110 degrees F. Hoist and trolley components shall be suitable for outdoor use under the temperature range specified herein.
 - j. Nominal Operating Speeds:
 - 1) Trolley: 45/15 feet per minute.
 - 2) Hoist: 26/8.7 feet per minute.
 - k. Trolley Motors:
 - 1) Rated Horsepower: 0.75hp
 - 2) Rated Voltage: 460 VAC, 3 phase.
 - l. Hoist Motor:
 - 1) Rated Horsepower: 10 hp
 - 2) Rated Voltage: 460 VAC, 3 phase.
 - m. Electrification System: Festooned cable.
 - n. Controls: Pendant control with cable length and retracting cable reel providing pendant control 3 feet above the adjacent pavement elevation.
 - o. Jib Crane:
 - 1) Span: 18.5 feet.
 - 2) Minimum Mast Diameter: 18 inches.
 - 3) Maximum Mounting Bolt Circle: 54 inches.
 - 4) Rotation Speed: 0.5 rpm.
 - 5) Motor: Minimum 1 Hp.
 - 6) Weatherized Bottom Entry Collector.
 - 7) Minimum Beam Depth: 24 inches.
 - 8) Design Wind Speed: 15 mph
 - 9) Temperature Range: -20 to 110 degrees F.
 - 10) Designed for outdoor use.

2.2 MANUFACTURERS

A. Manufacturers:

1. Provide jib crane of one of the following:
 - a. Progressive Crane.
 - b. Spanco, Inc.
 - c. Or equal.
2. Provide motorized trolley and hoist of one of the following:
 - a. Yale Hoist, a division of Columbus McKinnon.
 - b. Acco Material Handling Solutions.
 - c. Or Equal.

2.3 DETAILS OF CONSTRUCTION

A. General:

1. Provide all equipment of structural steel construction in accordance with the specifications contained in the AISC Specifications for Design, Fabrication and Erection of Structural Steel for Buildings.
2. Castings, Forgings and Stampings: Design with an allowable stress not to exceed 20% of the minimum ultimate strength of the material.
3. Design load for stress calculations shall be based upon the capacity plus 15% for the weight of the hoist and trolley plus 25% for impact. Deflection of the boom at design load shall be limited to a maximum of 0.925".
4. Welding: Conform to AWS D14.1 Specification for Welding Industrial and Mill Cranes.
5. Safety Requirements: Comply with the requirements of ANSI B30.11 Safety Standards for Monorails and Underhung Cranes for all equipment furnished under these specifications.
6. Rated Load:
 - a. Maximum load for which the jib crane or trolley hoist is designed and built by the manufacturer.
 - b. Plainly mark the rated load on each side of the jib crane.
 - c. Markings to be clearly legible from the loading position.
7. Provide NEMA 4X Type 316 stainless steel main disconnect switch mounted on jib crane mast for each jib crane. Disconnect switch shall be provided in accordance with Section 16071, Supporting Devices.
8. Accessories: Provide the following accessories in accordance with Section 11000, Electric Motors:
 - a. Motor space heaters.

B. Electric Jib Crane:

1. Type: Motorized 360 deg rotation type.
2. Head Assembly: Designed as an independent assembly which rotates about a pin on top of the mast.
3. Top Pivot Bearing: Tapered roller bearing. Provide a retaining ring above the bearing channel to help inhibit separation of head assembly from the top of the mast.
4. Trunnion Roller Assembly:
 - a. Heavy duty roller bearings.
 - b. Furnish with grease fittings for field lubrication.
 - c. Mounting bracket assembly shall permit field level adjustment.
5. Mast: Construct with structural steel pipe.
6. Boom: Construct with standard AISC beams reinforced as necessary and with channel capping.
7. Baseplate: Weld to mast and reinforce with gusset plates equally spaced about the circumference of the mast.
8. Maximum deflection at rated load shall not exceed 1/300 of the span.

9. Weatherized bottom entry 3-ring collector for 360 degree rotation. Festoon flat cable in rigid track to trolley hoist.
10. Furnish multi-position parking lock device.
11. Anchor Bolts:
 - a. Furnish required number of anchor bolts, nuts and washers sized per the manufacturers recommendations.
 - b. Materials: 304 stainless steel.
 - c. Furnish anchor bolt base template.
12. Gear Case Heater.
13. Panel Strip Heater
 - a. Provide a panel strip heater in all control enclosures.

C. Electric Trolley Hoist:

1. Frame: Steel.
2. Two part double reeving.
3. Trolley Suspension:
 - a. Motorized.
 - b. Wheels to be heat treated gray iron with pre-lubricated, sealed ball bearings and external grease fittings.
4. Hoist Motor:
 - a. Comply with Section 11000, Electric Motors, including requirements for source quality control and field quality control.
 - b. Motors shall be of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation.
 - c. Suspension lug mounted to geared trolley.
 - d. Motor Enclosure Type: TEFC or TENV enclosure.
 - e. Motor horsepower sized as required to provide the required hoisting capacity as described in Paragraph 2.1.
 - f. Provide Class F insulation.
 - g. Motor shall be suitable for frequent start-stops at the required hoisting capacity without injurious temperature rise in an ambient temperature of 40o C.
 - h. Locked rotor currents shall be as specified in NEMA standards.
 - i. Provide lubrication of non-hygroscopic grease or oil type.
 - j. Provide automatic breather and drain for TEFC and TENV motor enclosures.
5. Hoist Gearing:
 - a. Spur gearing shall operate in sealed oil tight housing. All gearing to be machine cut, heat-treated alloy steel with shock-resistant ductile cores. Gearing to be designed to AGMA standards.
 - b. Aluminum alloy housing.
 - c. All gear and pinions mounted on anti-friction permanently lubricated bearings and bushings.
 - d. Precision, heavy duty ball bearings to be lifetime pre-lubricated and sealed.
 - e. Gear case heater.

D. Accessories:

1. Trolley Cover: Provide trolley cover to be attached to jib crane

6. Trolley Gearing:

- a. Worm gearing in an oil bath.
- b. Hardened steel.

7. Wire Rope:

- a. Extra improved plow steel with steel center.
- b. Internally lubricated.

8. Hook:

- a. Drop-forged, heat-treated, alloy steel.
- b. Equip with spring latch.
- c. Hook swivels 360° on a permanently lubricated shielded roller thrust bearing under capacity load.

9. Hoist Motor Brake:

- a. A.C. magnet-actuated multiple coil disc brake with aluminum cover.
- b. Rating: Minimum 125% of full load motor torque.
- c. Provide brake-sensing microswitch to prevent motor from operating against the brake and from operating when brake requires adjustment.

10. Trolley Wheels:

- a. Compound tread.
- b. Steel with a Brinell Hardness of 255 – 285.

9. Mechanical Load Brake:

- a. Automatic Weston-type multiple disc brake with ratcheting pawl should hold a full capacity load independent of motor brake.
- b. No wear compensation adjustment should be required.

10. Drum:

- a. Drum to have deep machined grooves and large flanges. At least two full turns of rope must remain on the drum at the lowest hook position of rated lift.

11. Overload Cutoff:

- a. Protect load, hoist and operator by interrupting raising circuit when hoist is overloaded. When overload is lowered and removed, the unit must automatically reset.

12. Control:

- a. Two speed, magnetic reversing type, mechanically and electrically interlocked with control circuit. All wiring to conform to applicable Division 16, NEC and CSA requirements.
- b. Include time delay fuses for branch circuit and motor running overcurrent protection.
- c. Include control power transformer for low-voltage pendant controls.
- d. NEMA Type 4X stainless steel enclosures.

13. Limit Switches:

- a. NEMA 4 Upper/Lower Geared Limit Switch.
- b. NEMA 4 Upper Block Limit Switch.

c The unit shall have an automatic momentary lowering circuit.

14. Panel Strip Heater:

a. Provide a panel strip heater in all control enclosures.

15. Rubber Trolley Bumpers.

2.4 CONTROLS FOR ELECTRIC JIB CRANE WITH MANUAL TROLLEY AND HOIST

A. Control Station:

1. Control station shall be rated in accordance with Paragraph 2.1.B of this Section. Motion control pushbuttons shall spring return to "Off" position when released. Function of each pushbutton shall be clearly marked and indicate direction of resultant motion.

a. Control station shall contain the following functions:

- 1) "POWER ON"
- 2) "POWER OFF"
- 3) "BOOM-FORWARD"
- 4) "BOOM-REVERSE"

2. Pendant Control:

- a. When specified in Paragraph 2.1 of this Section, control of hoist and trolley shall be by pendant pushbutton control station.
- b. Pendant mounting shall include steel cable to provide strain relief for pendant's electric control cable. Provide isolating transformer to reduce voltage to 120 volts (or less) in control circuits.
- c. Pendant shall be intrinsically safe.

2.5 CONTROLS FOR ELECTRIC JIB CRANE AND TROLLEY HOIST

A. Control Station:

1. Control station shall be rated in accordance with Paragraph 2.1.B of this Section. Motion control pushbuttons shall spring return to "Off" position when released. Function of each pushbutton shall be clearly marked and indicate direction of resultant motion.

a. Control station shall contain the following functions:

- 1) "POWER ON"
- 2) "POWER OFF"
- 3) "HOIST UP"
- 4) "HOIST DOWN"
- 5) "TROLLEY-FORWARD"
- 6) "TROLLEY-REVERSE"
- 7) "BOOM-FORWARD"
- 8) "BOOM-REVERSE"

2. Pendant Control:

- a. When specified in Paragraph 2.1 of this Section, control of hoist and trolley shall be by pendant pushbutton control station.
- b. Pendant mounting shall include steel cable to provide strain relief for

pendant's electric control cable. Provide isolating transformer to reduce voltage to 120 volts (or less) in control circuits.

- c. Provide a retracting cable reel for pendant cable storage and slack take up.

2.6 ELECTRIFICATION

- A. Contractor shall provide an electrification system for the electrically operated jib crane and hoisting system.
 - 1. Festooned Cable System:
 - a. Contractor shall provide and install festooned cable type electrification for the crane, trolley and hoist. The festooned cable system shall be mounted parallel to the crane runway.
 - b. Conductors shall be sized suitable for power, control and grounding, carrying the required current to all connected motors when operated at rated conditions. Provide 30 ampere minimum rated power conductors..
 - c. Special consideration to clearance, headroom and hook approach requirements shall be given in designing the layout of the festooned cable system. System layout shall permit full travel of crane and hoist equipment along the entire length of the crane runway.
 - d. A minimum of 8 feet clearance shall be maintained between the bottom of the cable loop and operating level below, which shall include all platforms, stairs, walkways and floors unless otherwise shown on the Drawings.
 - e. Loop depth shall not exceed 3.0 feet.
 - f. Provide a cable length equal to 110 percent of the required length in order to avoid overstressing.
 - g. Provide all wire, cable, connectors, supports, special tooling and incidentals as required for power and control hookups on the load side of the manual safety switch.

2.7 FINISHING

- A. Surface Preparation and Painting:
 - 1. Surface preparation and shop painting is required for ferrous metals, equipment, and accessories. Do not paint stainless steel and machined surfaces.
 - 2. Clean and apply in the shop prime coat in accordance with Section 09900, Painting.
 - 3. Apply in the shop finish coat in accordance with Section 09900, Painting.
- B. Gears, bearing surfaces, and other machined surfaces shall receive a heavy application of rust-inhibiting coating that shall be maintained during storage and until equipment is placed into operation.

2.8 IDENTIFICATION

- A. Identify component subassemblies with stainless steel nameplates and each labeled with the following:
 - 1. Manufacturer and model number.

2. Date of manufacture with pertinent ratings, operation, and maintenance information.
3. Certification, stamp, or approval to applicable codes.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which products are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Inspect and verify that no part of the building, structure, piping, mechanical systems including ductwork, electrical systems including lighting and conduit, or other elements that will interfere with proper operation of jib crane and hoisting equipment along the entire length of both jib crane runway beams.

3.2 INSTALLATION

- A. Manufacturer's representative shall check and approve the installation prior to operation. Manufacturer's representative shall field test and calibrate the equipment to assure that the system operates to the OWNER's satisfaction.
- B. Lubricate, adjust, test and leave crane in proper operating condition.
- C. Install all power and control, conductors, wire, cables and connectors on the load side of the manual safety switch. Receive approval from ENGINEER, in writing, before wiring.

3.3 FIELD TESTS

- A. Site Tests:
 1. After installing equipment and associated controls, perform at the Site running tests for jib crane and hoisting equipment and appurtenances. Should testing indicate malfunction, make repairs and adjustments as required. Repeat testing and adjusting until, in ENGINEER's opinion, installation is complete and equipment is functioning properly and accurately, and is Substantially Complete.
 2. Load Test:
 - a. Perform load tests under supervision of manufacturer's factory-trained service technician, in presence of ENGINEER.
 - b. Weights used in load testing shall be certified by a state or local bureau of weights and measures. Submit weight certification as part of the load test report.

- c. Load testing shall conform to ASME B30.11, ASME B30.16, and the following:
 - 1) For electric hoists, power failure test with rated load: Load shall be held suspended when power is removed.
 - 2) Hoist travel full length of runway beams and trolley travel full length of jib crane girders with rated load, while verifying that all functions operate properly.
 - 3) Hoist brake drift test with rated load: Lift weight, measure distance to floor, allow five minutes to elapse, and re-measure. Record the results measured. Criteria for Acceptance: No difference in measurements.
 - 4) Upper/lower limit switch test with no load.
 - 5) Emergency stop test with no load.
 - 6) Deflection Test: With hoist positioned at center of longest monorail span, and at tip of longest cantilever (if any), while hoisting rated load, measure distance from hook to floor. Remove load and measure distance from hook to floor. Criteria for Acceptance: Difference in measurements shall conform to manufacturer's specifications.
- d. Load Test Report: Submit results of load testing as report that lists tests performed, data collected, results of each test, and corrective actions taken (if any). Test report shall be signed by manufacturer's service technician present during testing.

3.4 MANUFACTURER'S SERVICES

- A. A qualified, factory trained representative shall be provided for installation supervision, start-up and test services, and operation and maintenance personnel training services. The manufacturer's representative shall make a minimum of two visits to the Site as described below. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.
 - 1. Second visit shall be for checking completed installation, start-up of system, and performing field quality control testing. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Minimum number of hours on-Site: 16 hours, no more than 8 hours per day.
 - 2. Third visit shall be for instructing operations and maintenance personnel in recommended operation and maintenance of equipment.
- B. Reports: Submit report by manufacturer of each visit to the site that provides complete information on time, schedule, tasks performed, persons contacted, problems corrected, test results, training, instruction and all other pertinent information.
- C All costs, including travel, lodging, meals and incidentals, for additional visits shall be at no additional cost to the OWNER.

++ END OF SECTION ++

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SECTION 14630

BRIDGE CRANES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. The design, fabrication, installation, and testing of the overhead bridge crane system will be performed by the Crane Supplier and the CONTRACTOR. CONTRACTOR shall provide all labor, materials, tools, equipment, and incidentals as shown, specified and required to install bridge cranes complete and operational.
2. The Work includes:
 - a. Double-girder, electric, top-running bridge cranes with top-running electric wire-rope hoist and trolley.
 - b. Pendant operated controls.
 - c. Bridge and trolley electrification systems.
 - d. Rails, splice bars, rail clips, stops, fasteners, and all other appurtenances required for complete and operational bridge crane systems.
 - e. Crane support columns and baseplates with anchor bolts
 - f. Runway beams and Crane support side rails.
 - g. Electric power to the Crane

B. Design and Coordination:

1. Crane Supplier
 - a. Design the Crane support system, except foundation. Column Spacing and quantity shall be as shown on the drawings.
 - b. Document the Operational Crane that meets the requirements of this contract.
 - c. Prepare shop drawings and submittals for the Crane support system and Operational Crane, and coordinate with OWNER, CONTRACTOR and ENGINEER.
 - d. Confirm fabrication and delivery schedule.
2. CONTRACTOR
 - a. Review installation procedures under other Sections and coordinate the installation of items to be installed with or before bridge cranes Work. Verify column layout and spacing with Crane Provider.
 - b. Verify with ENGINEER, Crane Support System and Operational Crane as designed by the Crane Supplier are compatible with the structure over which the Crane will be installed.

b. Notify other contractors in advance of installing bridge cranes Work to provide other contractors with sufficient time to install items included in their contracts that must be installed with or before bridge cranes Work.

C. Related Sections:

1. Section 05120, Structural Steel Framing.
2. Section 09900, Painting.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI/AGMA 6013-A, Standard for Industrial Enclosed Gear Drives.
2. ASME B30.2, Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist).
3. ASME B30.16, Overhead Hoists (Underhung).
4. ASME B30.17, Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist).
5. ASME HST-1, Performance Standard for Electric Chain Hoists.
6. ASME HST-2, Performance Standard For Hand Chain Manually Operated Chain Hoists.
7. ASME HST-4, Performance Standard for Overhead Electric Wire Rope Hoists.
8. ASTM A36/A36M, Specification for Carbon Structural Steel.
9. ASTM A325, Specification for Structural Bolts, Steel, Heat-Treated, 120/105 KSI Minimum Tensile Strength.
10. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
11. ASTM A992/A992M, Specification for Structural Steel Shapes.
12. AWS D1.1, Structural Welding Code – Steel.
13. AWS D14.1, Specification for Welding of Industrial and Mill Cranes and other Material Handling Equipment.
14. CMAA 70, Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes.
15. CMAA 74, Top Running & Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist.
16. NEC, Article 610, Cranes and Hoists.
17. NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
18. SAE J429, Mechanical and Material Requirements for Externally Threaded Fasteners.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar

equipment and shall be able to furnish documentation of at least five installations in satisfactory operation for at least five years in the United States.

b. Equipment shall be manufactured in the United States.

2. Installer:

a. Engage to perform the Work under this Section an installer experienced in installing bridge crane equipment similar to that required for the Project and is acceptable to bridge crane manufacturer.

b. Submit name and qualifications, and the following information for at least three successful, completed projects:

1) Names and telephone numbers of each owner and architect or engineer responsible for project.

2) Approximate contract cost of bridge crane work.

3) Number of installations.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of component manufacturer from a single bridge crane manufacturer.

2. Bridge crane manufacturer shall review and approve or prepare all submittals for components furnished under this Section.

3. Components shall be specifically constructed for the specified service conditions and shall be integrated into overall equipment assembly by bridge crane manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Complete description of materials and equipment in sufficient detail to allow comparison with requirements of this Section.

b. Manufacturer's certified clearance diagram showing arrangement of system and clearances, including plan and sections.

c. Maximum wheel loads.

d. Weight of hoist and trolley.

e. Specialized wiring diagrams, if applicable.

2. Product Data:

a. Manufacturer's literature, illustrations, specifications identifying the materials of construction, rated capacities, dimensions of individual components, and finishes.

b. Make, model, weight and horsepower of each component.

c. External power requirements for each component.

3. Testing Plans: Plan for load testing at the Site.

4. Signed and sealed Calculations of the Crane support system by a registered Structural Engineer licensed to practice in State of New York

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Affidavits of compliance with referenced standards and codes.
 - b. Manufacturer's installation certification.
 2. Manufacturer's Instructions:
 - a. Special shipping, storage and protection, and handling instructions.
 - b. Routine maintenance requirements prior to start-up.
 3. Field Quality Control Submittals:
 - a. Load test report, including copy of certifications of test weights.
 4. Manufacturer's Reports: Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained.
 5. Qualifications Statements:
 - a. Manufacturer, when qualifications are requested by ENGINEER.
 - b. Installer, when qualifications are requested by ENGINEER.
- C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
 - a. Submit operation and maintenance manuals in accordance with Section 01730, Operation and Maintenance Data.
 - b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
 2. Conform to Section 01610 , Transportation and Handling of Materials and Equipment
- B. Storage and Protection:
1. Comply with Section 01610 , Transportation and Handling of Materials and Equipment.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to and run concurrent with other warranties made by CONTRACTOR under the Contract Documents. Obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by provisions of specified special warranty

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:

1. Bridge crane shall conform to headroom, hook elevation, and side clearance requirements shown and indicated in the Contract Documents, and shall provide required available lift height and capacity.
2. Electrical equipment and controls shall conform to applicable NEMA requirements for the equipment environment specified in the Contract Documents.

B. Special Service Conditions:

1. Equipment is located outside in an unclassified area.
2. Electric motors and components shall be rated explosion-proof. Exposed mechanical equipment shall be non-sparking.

C. Performance Criteria:

1. Bridge Cranes with Electrically-operated Hoists:

Designation	Bridge Crane 1
General Location:	outdoors
Hoist Type:	wire rope
Bridge Type:	Top running, double girder
CMAA Service Classification:	Class C
Ambient Conditions (deg F, Indoor/Outdoor):	outdoor -10 to 110F
Number Required:	1
Capacity (tons):	10
Runway Beam Length (ft)	72
Bridge Span (ft)	16.2
Required Lift (feet):	50
Max Required Hook Elevation:	EL 27.00
Operating Floor Elevation	EL 9.89
Lift Speed (fpm):	12.5/2.1ft/min
Hoist Horsepower:	15hp
Trolley Type:	motor driven
Trolley Speed (fpm):	min. 65ft/min
Trolley Horsepower:	20.5hp
Bridge Type	motor driven
Bridge Horsepower	20.5hp
Volts:	480
Phase:	3
Frequency (Hertz):	60

Control:	pendant
Bridge Electrification:	C Track Festoon
Runway Electrification:	480v

2.2 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
1. Reliable, by Stanspec, division of American Crane & Hoist Corporation.
 2. R&M Materials Handling, Inc.
 3. Whiting.
 4. Or equal.

2.3 DETAILS OF CONSTRUCTION

- A. General
1. Comply with applicable provisions of CMAA 70 or CMAA 74, and ASME B30.2, ASME B30.16, and ASME B30.17, as applicable to the equipment provided.
 2. Design Stresses: Load suspension components shall be constructed so that stresses at rated load do not exceed 20 percent of material's average ultimate strength.
 3. Shop welding shall be in accordance with AWS D14.1.
 4. Give special consideration to available headroom and vertical clearances.
 5. Provide bridge crane with configuration and weight that does not result in load exceeding design capacity of bridge crane runway beams. Runways are designed for maximum wheel load of 12,000 pounds, including impact allowances, based on two wheels per end-truck spaced 7.5 feet apart.
 6. Include impact allowance in design calculations for trolley, bridge, and end-trucks. Impact allowance shall be 1/2 percent of rated load for each foot per minute of hoisting speed with minimum allowance of 15 percent and maximum allowance of 50 percent.
 7. Incorporate into equipment provided safety requirements in accordance with ASME B30.2, ASME B30.16, and ASME B30.17, as applicable to the equipment provided.
- B. Electric-powered Chain Hoists:
1. Comply with ASME B30.16 and ASME HST-1. Welding shall comply with AWS D14.1.
 2. Hooks: Provide latch-type hooks that are free to rotate through 360 degrees under all loading conditions. Hooks shall be heat-treated drop forged steel.
 3. Hoisting Chain: Hardened alloy steel.
 4. Lift Wheel: Machined and heat-treated alloy steel with hardened steel chain guides.
 5. Gearing: Machined and heat-treated. Hoist gearbox shall be in accordance

with AGMA 6013-A. Provide means for adequate lubrication of gearing.

6. Hoist Brakes: Breaking system shall consist of break and control breaking means, and shall perform the following functions under normal operating conditions both with rated load and under test conditions with 125 percent of rated load:
 - a. Stop and hold the load when controls are released.
 - b. Control the load during lowering to maximum speed of 120 percent of rated lowering speed for load being handled.
 - c. Stop and hold the load in the event of a complete power failure.
 - d. Breaking system shall have heat dissipation capability for frequency of operation required by hoist duty cycle classification.
 - e. Breaking system shall have provision for adjustments to compensate for wear.
7. Provide overload protection device that prevents lifting of loads beyond rated capacity.
8. Motor: Specifically constructed for reversing and hoisting service and capable of operating at specified loads. Motor shall be heavy-duty, thermally protected, 30-minute rated, H3 duty classification. At rated frequency, capable of operating at plus or minus ten percent of rated motor voltage.
9. Hoist shall contain upper and lower limit switches to limit hook travel.
10. Housing and Covers: Cast aluminum.
11. Provide supports, fasteners, brackets, chain container, and all accessories required.

C. Electric-powered Wire Rope Hoists:

1. Comply with ASME B30.16 and ASME HST-4. Welding shall comply with AWS D14.1.
2. Load Blocks: Load blocks shall be enclosed type, constructed to prevent rope jamming.
3. Hooks: Provide latch-type hooks, free to rotate through 360 degrees under all loading conditions. Hooks shall be heat treated drop forged steel.
4. Hoisting Rope: Rated load shall be based on factor of safety factor of five on rope's nominal breaking strength. Attach rope ends to hoist drum to prevent rope from coming off drum on full extension. Rope shall be stainless steel.
5. Rope Sheaves: Sheave grooves shall be smoothly finished to close, form-fitting saddle for rope with sides of groove tapered outward. Provide running sheaves with means for lubrication. Pitch diameter of sheaves shall not be less than 16 times rope diameter for running sheaves, and for non-running sheaves not less than 12 times rope diameter.
6. Drum: Rope drum diameter shall not be less than 18 times rope diameter. At least one complete wrap of rope shall remain on drum after rope's full rated extension.
7. Hoist shall be true vertical lift.
8. Gearing: Machined and heat-treated. Hoist gear box shall be in accordance

- with AGMA 6013-A. Provide means for adequate lubrication of gearing.
9. Hoist Brakes: Breaking system shall consist of break and control breaking means, and shall perform the following functions under normal operating conditions both with rated load and under test conditions with 125 percent of rated load:
 - a. Stop and hold the load when controls are released.
 - b. Control the load during lowering to maximum speed of 120 percent of rated lowering speed for load being handled.
 - c. Stop and hold the load during a complete power failure.
 - d. Breaking system shall have heat dissipation capability for frequency of operation required by hoist duty cycle classification.
 - e. Breaking system shall have provision for adjustments to compensate for wear.
 10. Provide overload protection device that prevents lifting of loads beyond rated capacity.
 11. Motor: Specifically constructed for reversing and hoisting service and capable of operating at specified loads. Motor shall be heavy-duty, thermally protected, 30-minute rated, H3 duty classification. Motor at rated frequency shall be capable of operation at plus or minus ten percent of rated motor voltage.
 12. Hoist shall contain upper and lower limit switches to limit hook travel.
 13. Housing and Covers: Cast aluminum.
 14. Provide supports, fasteners, brackets, and all accessories required.
- E. Electric-powered Trolleys:
1. Wheels: Fabricated of hardened steel. Wheels shall have uniform surface hardness and capable of carrying maximum applied load.
 2. Trolley motor shall be thermally protected.
 3. Gearing: Machined and heat-treated. Hoist gear box shall be in accordance with AGMA 6013-A. Provide means for adequate lubrication of gearing.
- G. Crane Bridge:
1. Bridge Girders: ASTM A992, A572 Grade 50, or ASTM A36 structural steel.
 2. Maximum Deflection: 1/1000 of bridge span.
 3. Provide rubber stops on ends of bridge girders and ends of runways.
- H. Bridge End-trucks:
1. Fabricate of structural steel shapes.
 2. Wheelbase of end-truck shall be 1/8 of span or greater.
 3. Lugs shall be provided on end-trucks to limit drop of end-truck to one-inch or less in the event of wheel or axle failures. Provide rail sweeps in front of each outside wheel, projecting below runway rail.
 4. Wheels: Double flanged, and of drop forged or rolled steel.
 - a. Minimum Tread Hardness: 200 Brinell.
 - b. Bearings: Pre-lubricated and sealed, or provided with fittings and seals

for pressure lubrication

2.4 CONTROLS FOR ELECTRIC HOIST AND TROLLEY

A. Hoist Speed Control:

1. Hoist motor shall be single-speed or dual-speed, as specified in Article 2.1 of this Section, with magnetic control.
2. Each magnetic control shall have contactors sized for specified service class. Reversing contactors shall be mechanically and electrically interlocked to prevent line-to-line faults and shall be provided with automatic reset thermal overloads for hoist motor.

B. Control Station:

1. Control station shall be rated in accordance with Paragraph 2.1.A.2 of this Section. Motion control pushbuttons shall spring return to “Off” position when released. Clearly mark function of each pushbutton, and indicate direction of resultant motion.
 - a. Control station shall contain the following functions for two-speed hoists:
 - 1) “Power On”
 - 2) “Power Off”
 - 3) “Raise – Hi/Lo”
 - 4) “Lower – Hi/Lo”
 - 5) “Trolley – Right”
 - 6) “Trolley – Left”
 - 7) “Bridge – Forward”
 - 8) “Bridge – Reverse”
2. Pendant Control: Control of hoist, trolley, and bridge shall be by pendant pushbutton control station.
 - a. Pendant mounting shall include steel cable to provide strain relief for pendant’s electric control cable. Provide isolating transformer to reduce voltage to 120 volts (or less) in control circuits.
 - b. Mount control pendant and cable on 12-gage stainless steel C-track festoon system that allows hoist and trolley to move independently of control station.

2.5 ELECTRIFICATION

A Eight-bar Conductor:

1. When specified in Article 2.1 of this Section, provide enclosed rigid type contact conductor system mounted parallel to crane runway. Conductors shall comply with NEC Article 610. Contact conductors shall be sized to carry required current to all motors when operating at rated conditions.

Collectors shall be shoe-type and be constructed to reduce to a minimum sparking between shoe and contact conductor.

2. System Components: Electrification system shall include the following:

- a. Conductor bars.
- b. Hanger clamps for conductor bars.
- c. Power feeds to conductor bars.
- d. End caps for conductor bars.
- e. Torsion spring collectors.
- f. Special tooling to install electrification system.
- g. Cable and connectors for power and control connections.

B. C-Track Festoon:

1. Provide power cable on 12-gage stainless steel C-track festoon system.
2. System Components: Electrification system shall include, but is not limited to, the following:
 - a. C-track
 - b. Track hangers.
 - c. Cable carriers.
 - d. Lead carrier.
 - e. End stop.
 - f. Splices.
 - g. Clamps.
 - h. Cable and connectors required for power and control connections.

C. Manual Safety Switch: Provide manual safety switch to disconnect power to bridge crane.

2.6 FINISHING

A. Surface Preparation and Painting:

1. Surface preparation and shop painting is required for ferrous metals, equipment, and accessories. Do not paint stainless steel and machined surfaces.
2. Clean and apply in the shop prime coat in accordance with Section 09900, Painting.
3. Apply manufacturer's standard factory finish.
4. Paint the bridge "Safety Yellow". Stencil system's hoisting capacity in black-painted characters, clearly visible from loading floor.

B. Gears, bearing surfaces, and other machined surfaces shall receive heavy application of rust-inhibiting coating that shall be maintained during storage and until equipment is Substantially Complete.

2.7 IDENTIFICATION

- A. Identify component subassemblies with stainless steel nameplates and each labeled with the following:
 - 1. Manufacturer and model number.
 - 2. Date of manufacture with pertinent ratings, operation, and maintenance information.
 - 3. Certification, stamp, or approval, in accordance with Laws and Regulations.

2.8 CRANE RUNWAY RAILS

- A. Crane Rails: Provide rails for crane service that are standard ASCE design, or complying with ASTM A759, size as recommended by bridge crane manufacturer for service conditions specified.
 - 1. Provide rails with tight end joints suitable for crane service with joint bars matching the rail sections, joint bar bolts and nuts complying with ASTM A325 with alloy steel spring washers.
- B. Weldable Rail Clips:
 - 1. Provide weldable rail clips recommended by bridge crane manufacturer, of appropriate size and spacing to suit specified bridge cranes and service classification.
 - 2. Provide rail clips consisting of forged steel or ductile iron upper component with resilient, synthetic rubber pressure block vulcanize-bonded to upper component that holds the rail, and forged steel lower component welded to the runway girder. Fasten upper component to the lower component via two SAE J429 Grade 5 bolts and nuts.
 - 3. Clips shall allow lateral adjustability of the rail, and shall be self-locking and self-tightening through system of double wedging action.
 - 4. Product and Manufacturer:
 - a. Provide Weldlok Series Weldable Rail Clips by Gantrex.
 - b. Or equal.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
- B. Before installing bridge cranes, verify the following: that design strength of cast-in-place concrete supporting elements has been attained, structural steel or other support framing is properly erected, plumb and level, in accordance with the

Contract Documents, adequately bolted, braced and welded, and ready for installation of bridge crane system. Do not begin installing bridge crane equipment until building or structure is enclosed and weathertight.

- C. Inspect and verify that no part of building, structure, piping, mechanical systems including ductwork, electrical systems including lighting and conduit, or other elements will interfere with proper operation of bridge crane system along entire length of runway and entire span of bridge. Verify that there is at least three inches clear between topmost part of bridge crane and lowest overhead obstruction.

3.2 INSTALLATION

- A. Crane Rails:
 - 1. Bridge crane installer shall install runway rails. Set and adjust gage, alignment, and elevation of bridge crane rails to tolerances of CMAA 70 or CMAA 74, as applicable for the equipment provided. Stagger joint locations on opposite sides of runway. Rail joints shall be at least two feet from crane girder joints. Provide flush joints at top of bridge crane rails.
 - 2. Weld rail clips to runway girders in the shop. Field welding is not allowed unless approved by ENGINEER in writing.
- B. Install materials and equipment in conformance with Laws and Regulations, applicable standards, manufacturer's instructions and recommendations, and the Contract Documents. Field welding of equipment shall be in accordance with manufacturer's written instructions. Field welding to building or structure shall be in accordance with AWS D1.1.
- C. Refer to Section 05120, Structural Steel Framing, for requirements for bridge crane supporting steel.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. After installing equipment and associated controls, perform at the Site running tests for bridge crane and appurtenances. Should testing indicate malfunction, make repairs and adjustments as required. Repeat testing and adjusting until, in ENGINEER's opinion, installation is complete and equipment is functioning properly and accurately, and is Substantially Complete. Equipment will not be Substantially Completion until field tests are successfully completed.
 - 2. Load Test:
 - a. Perform load tests under supervision of manufacturer's factory-trained service technician, in presence of ENGINEER.
 - b. Weights used in load testing shall be certified by a state or local

bureau of weights and measures. Submit weight certification as part of load test report.

- c. Load testing shall conform to ASME B30.2 or ASME B30.17, as applicable, and the following:
 - 1) Power failure test with rated load: Load shall be held suspended when power is removed.
 - 2) Bridge travel full length of runway with rated load, while verifying that all functions operate properly.
 - 3) Trolley travel full length of bridge with rated load, while verifying that all functions operate properly.
 - 4) Hoist brake drift test with rated load: Lift weight, measure distance to floor, allow five minutes to elapse, and re-measure. Record the results measured. Criteria for Acceptance: No difference in measurements.
 - 5) Upper/lower limit switch test with no load.
 - 6) Emergency stop test with no load.
- d. Load Test Report: Submit results of load testing in a report that lists tests performed, data collected, results of each test, and corrective actions taken (if any). Test report shall be signed by manufacturer's service technician present during testing.

B. Manufacturer's Services: Provide services of qualified, factory-trained service technician to perform the following:

- 1. Instruct CONTRACTOR in installing equipment and assist with installing equipment.
- 2. Inspect and adjust equipment after installation, ensure proper operation, and supervise initial operations and load tests.
- 3. Instruct OWNER's personnel in operating and maintaining the equipment.
- 4. Manufacturer's technician shall make a minimum of 3 visits to the Site, with minimum number of hours on-Site for each visit as specified.
 - a. First visit shall be for instructing CONTRACTOR in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 4 hours.
 - b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control testing. Minimum number of hours on-Site: 4 hours.
 - c. Third visit shall be to instruct operations and maintenance personnel. Number of hours on-Site shall be in accordance with 01730, Operation and Maintenance Data.
 - d. Technician shall revisit the Site as often as necessary until installation is acceptable.
- 5. Manufacturer's Installation Certification: Submit certification that manufacturer's technician has checked completed installation and equipment, as specified in the Contract Documents, has been provided in accordance with manufacturer's recommendations, and that operation of equipment is satisfactory. Certification shall be signed by manufacturer's

technician present at the Site and CONTRACTOR.

6. Training: Furnish services of Supplier's qualified factory trained specialists to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment. Training requirements, duration of instruction and qualifications shall be in accordance with Section 01730, Operation and Maintenance Data.
7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

+ + END OF SECTION + +

SECTION 15050

VIBRATION, SEISMIC, AND WIND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all professional services, labor, materials, tools, equipment, and incidentals as shown, specified, and required to design, furnish, and install Vibration Control, Seismic Control, and Wind Control for Process Mechanical, HVAC, plumbing, fire protection, electrical, instrumentation and control, and architectural Components.
2. Extent of Components requiring Controls are described in this Section and as required by Laws and Regulations. The Work includes:
 - a. Vibration Controls for Components.
 - b. Wind Controls for Components.
3. The Work excludes:
 - a. Seismic Controls are not required for this project. Information contained in this specification pertaining to Seismic Controls shall not apply for this project.
 - b. Designing Controls for piping larger than 24-inch diameter.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the vibration, seismic, and wind controls Work.

C. Related Sections:

1. Section 05051, Anchor Systems.
2. Section 05501, Miscellaneous Metal Fabrications.
3. Section 09900, Painting.
4. Section 10400, Identification Devices.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AWS D1.1, Structural Welding Code – Steel.
2. AWS D1.2, Structural Welding Code – Aluminum.
3. AWS D1.3, Structural Welding Code – Sheet Steel.
4. AWS D1.6, Structural Welding Code – Stainless Steel.
5. CISC 0-2, Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings, Seismic Zones 0-2.
6. CISC 3-4, Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings, Seismic Zones 3-4.

7. National Roofing Contractors Association (NRCA) Standards.

1.3 DEFINITIONS

- A. The following definitions are used in this Section:
1. Certificate of Compliance: Certificate provided by Component manufacturer indicating that Component has been tested or analyzed in accordance with Laws and Regulations, including applicable building code, and is capable of resisting design forces defined in Laws and Regulations.
 2. Components: Process Mechanical, HVAC, plumbing, fire protection, electrical, instrumentation and control, architectural, and other non-structural equipment, systems, and elements permanently attached to structures, including supporting structures and attachments.
 3. Component Assembly: Component assembled by Contractor from individual components of different Suppliers.
 4. Controls: Vibration Control, Seismic Control, and Wind Control.
 5. Controls Design Engineer: Professional Engineer responsible for Vibration Control, Seismic Control, and Wind Control.
 6. Essential Facility: Buildings and other structures intended to remain operational in event of extreme environmental loading from flood, wind, snow, or earthquakes.
 7. Failure: Separation of an attachment between Components, or Components and structure, vertical permanent deformation greater than 1/8-inch, horizontal permanent deformation greater than 1/4-inch, or failure of the equipment to perform its function.
 8. Hazardous Contents: Material that is highly toxic or potentially explosive in sufficient quantity to pose significant life-safety threat to personnel working in building or the general public if an uncontrolled release were to occur.
 9. Importance Factor (Ip): Factor that accounts for degree of hazard to human life and damage to property.
 10. Isolated Component: Component indirectly connected to structure through Control designed to prevent transmission of Component vibration to structure.
 11. Lateral Forces: Horizontally applied forces resulting from wind or seismic event, combined with operational horizontal forces. Wind and seismic forces are considered separately.
 12. Life Safety Systems: All systems involved with fire protection including sprinkler piping, water service piping, jockey pumps, fire pumps, fire dampers, smoke dampers, smoke exhaust systems, control panels and fire alarm panels associated with fire protection Components, and Components in Essential Facilities necessary for keeping the Essential Facility Operational.
 13. Non-Isolated Component: Component that is connected to structure in such a way that allows transmission of Component vibration to structure.
 14. Operational: Capable of providing intended function.
 15. Process Mechanical: All mechanical Components that are not part of HVAC, plumbing and fire protection Components.
 16. Seismic Control: Seismic restraining systems.

17. Seismic Use Group: Classification assigned to building based on use defined in applicable building code.
18. Vibration Control: Vibration isolating systems.
19. Wind Control: Wind restraining systems.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Supplier:
 - a. Minimum of five years of experience producing Controls substantially similar to those specified in the Contract Documents and able to provide evidence of at least five installations in satisfactory operation for at least five years in the United States.
 - b. Design and analysis delegated through Supplier shall be performed by a registered Professional Engineer licensed in same state as the Site.
2. Controls Design Engineer:
 - a. Engage registered Professional Engineer licensed in same state as the Site, who has a minimum of five years of experience in providing engineering services for Vibration, Seismic, and Wind Controls.
 - b. Submit qualifications data and include professional liability insurance certificate in amount of at least \$1,000,000 per claim/aggregate with maximum deductible of \$100,000.
 - c. Responsibilities include:
 - 1) Reviewing performance and design criteria for Controls specified in the Contract Documents.
 - 2) Determining sizes and locations of Controls.
 - 3) Preparing or supervising preparation of design calculations and related drawings, Shop Drawings and submittals, testing plan development, test result interpretation, and comprehensive engineering analysis verifying compliance of Controls with the Contract Documents.
 - 4) Signing and sealing all calculations, design drawings, and Shop Drawings.
 - 5) Certifying that:
 - a) Design of Controls was performed in accordance with performance and design criteria stated in the Contract Documents.
 - b) Design conforms to Laws and Regulations, and to prevailing standards of practice.
 - 6) Provide installation instructions and drawings.
 - 7) Provide field quality control in accordance with Paragraph 3.3 of this Section.
3. Installer:
 - a. Engage an experienced installer to perform the Work of this Section who specializes in installing Controls similar to that required for this Project.

- b. Submit name and qualifications to Engineer with the following information on a minimum of three completed, successful projects:
 - 1) Names and telephone numbers of Owners, and architects or Engineers responsible for project.
 - 2) Approximate cost of Control Work for which installer was responsible.
- 4. Welder:
 - a. Qualify welding processes and welding operators in accordance with AWS D1.1, D1.2, D1.3, and D1.6 as appropriate for material to be welded.
 - b. Provide certification that welders employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Detailed schedules of flexible and rigidly mounted Components to receive Controls. Schedules shall be numbered and include Contract Drawing number references where Component is located.
 - b. Fabrication details of Component bases including dimensions, structural member sizes, support point locations, and weight distribution.
 - c. Specific details of Controls and anchorages, including number, size, and locations for each Component.
 - d. Details of suspension and support for ceiling-hung Components.
 - e. Details of attachment methods where walls, floors, slabs, or supplementary steel work are used for restraint attachment.
 - f. Location of all attachment and support points and forces transferred to supporting structure at each location, as a result of each load combination of static forces and Lateral Forces.
 - g. Detailed piping, ductwork, and conduit restraining system layout drawings showing their attachment to building or structure. Include dimensions, size, and location of restraints and attachment connections. Coordinate with system layout Shop Drawings provided under other Sections, as applicable.
 - h. Where Seismic Controls exclusions are allowed in applicable building code, identify in writing proposed exclusions to be taken and include a reference to the building code section and paragraph.
- 2. Product Data:
 - a. Supplier and model of Controls.
 - b. Supplier's literature, performance data, weight, illustrations, specifications, identification of materials of construction, dimensions of individual parts, and finishes.
 - c. Setting drawings, templates, and directions for installation of anchor bolts and other anchorages.

3. Certifications:
 - a. Component Certificates of Compliance: Where Component Suppliers are required by Laws and Regulations to provide a Certificate of Compliance for Components, submit the following:
 - 1) Component Certificate of Compliance from an agency that is accepted by authority having jurisdiction for compliance with building code. Analytical or shaker test certification shall be based on Project-specific seismic forces applied at Component's center of gravity, verifying capacity to transfer forces in continuous load path to supporting structure. Certification shall include design of anchorage or attachment to the supporting structure and post-seismic Operational capability. Submittals will not be reviewed without a Certificate of Compliance.
 - b. Provide completed Professional Design Services Performance Certification on Attachment A to this Section.
 - c. Controls Design Engineer's professional liability insurance certificate per Paragraph 1.4.A.2.b of this Section.
4. Delegated Design Submittals:
 - a. Information required to clearly demonstrate basis of design for Controls, including calculations, design dimensions, approach and assumptions, and Laws and Regulations on which design of Controls and anchorage is based. Design documents prepared by Controls Design Engineer shall bear the seal and original signature and date of the Controls Design Engineer. State of Engineer's registration, name, and license number shall be clearly legible on the seal.
5. Test Reports:
 - a. Component test reports to confirm statements made on Certificate of Compliance, for Components where a Certificate of Compliance is required.
 - b. Test reports substantiating seismic restraint designs when calculations are not used.
6. Supplier's Instructions:
 - a. Instructions for shipping, storage protection, handling, and installation.
 - b. Routine maintenance requirements prior to start-up.
7. Field Quality Control Submittals:
 - a. Supplier's Field Reports: Submit reports confirming that Controls have been installed in accordance with Supplier's recommendations and approved Shop Drawings and submittals.
 - b. Controls Design Engineer Report: Submit report confirming that Controls have been installed in accordance with the Controls design. Report shall bear the professional engineering seal, date, and original signature of the Controls Design Engineer.
8. Qualifications Statements: Submit qualifications for.
 - a. Supplier.
 - b. Controls Design Engineer.

- c. Installer.
 - d. Welder.
- B. Closeout Submittals:
 - 1. Operation and Maintenance Data:
 - a. Submit complete operation, and maintenance manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Conform to Section 01730, Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. System Description:
 - 1. Schedules in Part 3 of this Section describe Components that are to receive Vibration Control and systems to receive Seismic Control.
 - 2. Tables in Part 3 and performance criteria specified in Paragraph 2.1.C of this Section describes Controls to be provided on Components and systems described in the schedules. Tables are general in nature and may include certain Components that may not be specified in the schedules to receive Controls, while the schedules are Project-specific.
 - 3. Where Components are subject to wind, design Component and related anchorage to supporting structure to resist wind loads per applicable building code using wind load factors indicated on structural Drawings. Using guy wires is allowed for assisting in support of Components.
 - 4. Design of Components, including Vibration Controls provided by Component Supplier if required, and associated anchorage to supporting structure, are delegated through Supplier. Design shall resist seismic forces according to requirements of Laws and Regulations using seismic load factors indicated on structural Drawings. Design shall demonstrate that Component is capable of transferring Project-specific seismic forces (at minimum) applied at Component's center of gravity, and center of gravity of Component's major elements, to supporting structure without losing structural integrity.
 - 5. Interconnection design of Component Assemblies, including Vibration Controls if required, and anchorage to supporting structure, shall be by Controls Design Engineer. Design of individual Components within assembly to resist seismic forces is responsibility of individual Component Supplier. Component Assembly design shall resist seismic forces according to requirements of Laws and Regulations using seismic load factors indicated on structural Drawings. Design shall demonstrate that Component Assembly is capable of transferring Project-specific seismic forces (at minimum) applied at Component's center of gravity, and center of gravity of Component's major elements, to supporting structure without losing structural integrity. Coordinate design with each Supplier of Components used in the assembly

and obtain approval of each Supplier prior to providing Shop Drawings for Component Assembly.

6. Equivalency: Products or methods specified for Controls are not intended to limit use of other products or methods of equivalent or superior quality and effectiveness.

B. Design Criteria:

1. Determine seismic design loads as stipulated in the building code. Lateral Force design information is included on the structural Drawings. Factored strength design seismic forces acting on a Component, per building code, shall be determined by calculation for each Component, considering all factors of Laws and Regulations.
2. Determine vertical seismic forces based on acceleration equal to two-thirds of building code-defined horizontal acceleration. Combine vertical seismic forces with horizontal seismic forces based on square root of sum of squares method.
3. Testing or calculations to support seismic restraint designs shall include shear, flexural, and axial loads, and at least one test or analyses at 45 degrees to weakest mode.
4. Analyses for anchorage shall include calculated dead loads, Lateral Forces, and capacity of materials utilized for connections to Components and structure. Analysis for anchorage shall include anchoring methods, bolt diameter, embedment, and weld requirements. Design Seismic Controls to accept, without failure, forces acting through Component's center of gravity and distributed relative to Component's mass distribution.
5. Design Wind Controls to accept, without failure, wind forces acting on Component's exposed wind surface area. Analyses for wind forces shall consider Lateral Forces applied on a minimum of two orthogonal axes in two directions per axis. Overturning moments may result in uplift forces that exceed gravitational forces at ground level that shall be incorporated into analysis.
6. Components are to remain in place during a seismic event. Where Hazardous Materials are contained in Components such as certain tanks and piping, Components and related systems shall be designed to prevent rupture.

C. Performance Criteria:

1. Design and provide Components to maintain structural integrity and to provide continuous load path to transfer Lateral Forces through elements of Component and through anchorage to supporting structure.
2. Fan and compressor Components shall be protected against excessive displacement that results from high air thrust in relation to Component weight. Horizontal thrust restraints shall be provided when horizontal motion exceeds 3/8-inch.
3. Internally Isolated Components, when provided in lieu of external isolation and restraint systems, shall conform to requirements of this Section.

4. Curb or roof rail-mounted Components shall be attached to the curb or rails that shall, in turn, be attached to supporting structure, creating continuous load path for vertical and Lateral Forces. Sheet metal screw attachment is unacceptable.
5. Where location and characteristics of elements of supporting structure are not appropriate for supporting Component and transferring vertical and Lateral Forces, notify Engineer in writing.
6. Where changes in specified Components or location of Components are proposed by Contractor for convenience of Contractor and accepted by Engineer, modifications to supporting structure required by such changes shall be responsibility of Contractor at no additional cost to Owner. Design of modification shall consider all vertical and Lateral Forces and be signed, dated, and sealed by Controls Design Engineer.
7. Where ceilings are not braced, lighting fixtures shall have independent four corner diagonal wire ties to structure.
8. Design lay-in ceilings, including accessory Components, in accordance with CISCA 0-2 or CISCA 3-4, as applicable.
9. Seismic Restraint of Piping:
 - a. For Isolated piping use Type V seismic cable restraints or resilient single arm braces. For piping that is not Isolated, use Type V seismic cable restraints or Type VI seismic solid braces.
 - b. Maximum seismic bracing distances are specified in Table 15050-E in this Section. Fuel oil, natural gas piping, thermoplastic piping, and glass-lined pipe are exceptions to requirements of Table 15050-E. Fuel oil and natural gas piping transverse restraints shall be at maximum intervals of 20 feet and longitudinal restraints at maximum intervals of 40 feet. Brace thermoplastic and glass-lined pipe with bottom shields at maximum intervals of 20 feet transversely and 40 feet longitudinally.
 - c. Determine by calculation required bracing distances when multiple runs of pipe are located on same support.
 - d. Use hanger rod braces when hanger rod lengths are greater than three feet.
 - e. Provide spacers inside clevis hangers at seismic brace locations.
 - f. Where thermal expansion guides and anchors are provided, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than restraint loads plus loads induced by expansion and contraction.
 - g. Transverse restraints for one pipe section may also act as longitudinal restraint for another pipe section of same size connected perpendicular to it if restraint is installed within two feet of elbow or tee, or combined stresses are within allowable limits at longer distances.
 - h. Use hold-down clamps to attach pipe to trapeze members before applying restraints. Use Type V or VII restraint, if trapeze is smaller than 48 inches wide.
 - i. Do not use smaller piping to restrain larger pipe.
 - j. Fire protection branch piping shall be end-tied and seismically restrained.

10. Seismic Restraint of Electrical Conduit, Bus Duct, and Cable Tray:
 - a. For Components not Isolated, use Type V seismic cable restraints or Type VI seismic solid braces.
 - b. Maximum seismic bracing distances are specified in Table 15050-E in this Section.
 - c. Determine by calculation bracing distances for multiple runs of conduit on same support.
 - d. Use hanger rod braces when hanger rod lengths are greater than three feet.
 - e. Use hold-down clamps to attach conduits to trapeze members before applying restraints. Use Type V or VII restraint, if trapeze is smaller than 48 inches wide.
11. Seismic Restraint of HVAC Ductwork:
 - a. Provide Type V seismic cable restraints or Type VI seismic solid braces.
 - b. Maximum bracing distances are specified in Table 15050-E of this Section.
 - c. Reinforce ductwork at restraint locations. Reinforcement shall consist of an additional angle on top of ductwork that is attached to support hanger rods. Attach ductwork to both upper angle and lower trapeze.
 - d. A group of ducts may be combined in a larger frame so that combined weights and dimensions of ducts are less than or equal to maximum weight and dimensions of duct for which bracing details are selected.
 - e. Walls, including gypsum board used for non-bearing partitions, that have duct penetrations may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between duct and frame.
 - f. Support and laterally brace independent of duct system Components with an operating weight greater than 75 pounds installed in ductwork.

D. Seismic Control Exclusions:

1. Exclusions for Seismic Control of Components per building code are allowed, except where noted otherwise in the Contract Documents.

2.2 MANUFACTURERS

- A. Provide products of one of the following:
1. Vibration Mountings and Controls, Inc.
 2. Mason Industries.
 3. Kinetics Noise Control.
 4. Amber/Booth Company, Inc.
 5. Or equal.

2.3 VIBRATION ISOLATION TYPES

- A. Type A: Spring Isolator - Free Standing
1. Spring isolators shall be free standing and laterally stable without housing, and complete with a molded neoprene cup or 1/4-inch neoprene acoustical friction pad between baseplate and support.

2. Mountings shall have leveling bolts rigidly bolted to the Component.
3. Spring diameters shall be no less than 0.8 of compressed height of spring at rated load.
4. Springs shall have minimum additional travel to solid equal to 50 percent of rated deflection.
5. Product and Manufacturer: Provide one of the following:
 - a. ASC, manufactured by Vibration Mountings and Controls.
 - b. SLF, manufactured by Mason Industries.
 - c. Or equal.

B. Type B: Seismically Restrained Spring Isolator

1. Restrained spring mountings shall have Type A spring isolator within rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. Housing shall serve as blocking during erection. Remove steel spacer after adjustment. Installed and operating heights are equal. Provide minimum clearance of 1/4-inch around restraining bolts and internal neoprene deceleration bushings to avoid interfering with spring action. Limit stops shall be out of contact during normal operation. Because housings shall be bolted or welded in position, provide an internal isolation pad. Design housing to resist seismic forces.
2. Product and Manufacturer: Provide one of the following:
 - a. AWRS, ASCM, manufactured by Vibration Mountings and Controls.
 - b. SLR, manufactured by Mason Industries.
 - c. Or equal.

C. Type C: Combination Spring/Elastomer Hanger Isolator (30-degree Type)

1. Hangers shall consist of rigid steel frames containing minimum 1.25-inch thick neoprene elements at top and steel spring with general characteristics specified for Type A. Neoprene element shall have neoprene bushings projecting through steel box.
2. Spring diameters and hanger box lower hole sizes shall be large enough to allow hanger rod to swing through a 30-degree arc from side to side before contacting rod bushing and short-circuiting the spring.
3. Submittals shall include hanger drawing showing 30-degree capabilities.
4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be pre-compressed by manufacturer.
5. Product and Manufacturer: Provide one of the following:
 - a. RSH30, manufactured by Vibration Mountings and Controls.
 - b. 30N, manufactured by Mason Industries.
 - c. Or equal.

D. Type D: Elastomer Double Deflection Hanger Isolator

1. Molded neoprene element, minimum 1.25-inch thick, with Projecting bushing lining rod clearance hole. Static deflection at rated load shall be minimum of 0.35 inches.
2. Steel retainer box encasing neoprene mounting capable of supporting Component up to four times rated capacity of element.

3. Product and Manufacturer: Provide one of the following:
 - a. RHD, manufactured by Vibration Mountings and Controls.
 - b. HD, manufactured by Mason Industries.
 - c. Or equal.
- E. Type E: Combination Spring/Elastomer Hanger Isolator
 1. Spring and neoprene elements in a steel retainer box with the features as specified in this Section for Type C and Type D isolators.
 2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be pre-compressed by manufacturer.
 3. Thirty-degree angularity feature is not required.
 4. Product and Manufacturer: Provide one of the following:
 - a. RSH, manufactured by Vibration Mountings and Controls.
 - b. DNHS, manufactured by Mason Industries.
 - c. Or equal.
- F. Type F: Seismically Restrained Elastomer Floor Isolator
 1. Neoprene mountings shall have minimum static deflection of 0.2 inches and all-directional seismic capability. Mount shall consist of two separated and opposing molded neoprene elements. Elements shall prevent central threaded sleeve and attachment bolt from contacting casting during normal operation. Shock absorbing neoprene materials shall be compounded to bridge-bearing specifications.
 2. Product and Manufacturer: Provide one of the following:
 - a. RSM, manufactured by Vibration Mountings and Controls.
 - b. BR, manufactured by Mason Industries.
 - c. Or equal.
- G. Type G: Pad Type Elastomer Isolator (Standard)
 1. One layer of 3/4-inch thick neoprene pad consisting of two-inch square modules.
 2. Use load distribution plates as required.
 3. Provide bolting for seismic compliance. Provide neoprene and duck washers and bushings to prevent short circuiting.
 4. Product and Manufacturer: Provide one of the following:
 - a. Maxiflex, manufactured by Vibration Mountings and Controls.
 - b. Super W, manufactured by Mason Industries.
 - c. Or equal.
- H. Type H: Pad Type Elastomer Isolator (High Density)
 1. Laminated canvas duck and neoprene, minimum 1/2-inch thick, with loading capacity of 1,000 psi.
 2. Use load distribution plate as required.
 3. Bolting as required for seismic compliance. Provide neoprene and duck washers and bushings to prevent short circuiting.
 4. Product and Manufacturer: Provide one of the following:
 - a. Fabriflex, manufactured by Vibration Mountings and Controls.

- b. HL, manufactured by Mason Industries.
 - c. Or equal.
- I. Type I: Thrust Restraints
 - 1. Spring element similar to that specified for Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers, and nuts to produce a pair of devices capable of limiting movement of Components to 1/4-inch.
 - 2. Restraint shall be easily converted in field from compression type to tension type.
 - 3. Unit shall be factory pre-compressed.
 - 4. Product and Manufacturer: Provide one of the following:
 - a. RSHTR, manufactured by Vibration Mountings and Controls.
 - b. WBI \ D, manufactured by Mason Industries.
 - c. Or equal.
- J. Type J: Pipe Anchors
 - 1. Provide all-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by minimum 1/2-inch thick 60-durometer neoprene.
 - 2. Allowable loads on isolation material shall not exceed 500 psi. Balance design for equal resistance in all directions.
 - 3. Product and Manufacturer: Provide one of the following:
 - a. MDPA, manufactured by Vibration Mountings and Controls.
 - b. ADA, manufactured by Mason Industries.
 - c. Or equal.
- K. Type K: Pipe Guides
 - 1. Pipe guides shall consist of telescopic arrangement of two sizes of steel tubing separated by minimum 1/2-inch thick 60-durometer neoprene.
 - 2. Height of guides shall be pre-set with shear pin to allow vertical motion induced by pipe expansion and contraction. Shear pin shall be removable and re-insertable to allow selection of pipe movement.
 - 3. Guides shall be capable of minimum 1-5/8-inch motion in both directions
 - 4. Product and Manufacturer: Provide one of the following:
 - a. PG, manufactured by Vibration Mountings and Controls.
 - b. VSG, manufactured by Mason Industries.
 - c. Or equal.
- L. Type L: Isolated Pipe Hanger System
 - 1. Provide pre-compressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
 - 2. Provide with spring element specified for Type A, with steel lower spring retainer and upper elastomer retainer cup with integral bushing to insulate support rod from isolation hanger.
 - 3. Neoprene element under lower steel spring retainer shall have integral bushing to insulate support rod from steel spring retainer.

4. Design and construct hangers to support loads over three times the rated load without Failure.
5. System shall be pre-compressed to allow for rod insertion and standard leveling.
6. Product and Manufacturer: Provide one of the following:
 - a. CIH, CIR, TIH, PIH, manufactured by Vibration Mountings and Controls.
 - b. Or equal.

2.4 SEISMIC RESTRAINT TYPES

- A. Type I: Spring Isolator, Restrained
 1. Refer to vibration isolation Type B.
 2. Product and Manufacturer: Provide one of the following:
 - a. ASCM, AWR, manufactured by Vibration Mountings and Controls.
 - b. SLR, SLRS, manufactured by Mason Industries.
 - c. Or equal.
- B. Type II: Seismically Restrained Elastomer Floor Isolator
 1. Refer to vibration isolation Type F.
 2. Product and Manufacturer: Provide one of the following:
 - a. RSM, manufactured by Vibration Mountings and Controls.
 - b. BR, manufactured by Mason Industries.
 - c. Or equal.
- C. Type III: All-Directional Seismic Snubber
 1. All-directional seismic snubbers shall consist of interlocking steel members restrained by one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and minimum of 1/4-inch thick. Rated loadings shall not exceed 1,000 psi. Minimum air gap of 1/8-inch shall be incorporated in snubber in all directions before contact is made between rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated.
 2. Product and Manufacturer: Provide one of the following:
 - a. Type SR, manufactured by Vibration Mountings and Controls.
 - b. Z1225, manufactured by Mason Industries.
 - c. Or equal.
- D. Type IV: Floor or Roof Anchorage
 1. Rigid attachment to structure utilizing wedge-type anchor bolts, anchored plates machine screw, bolting or welding. Powder shots are unacceptable.
 2. Product and Manufacturer: Provide one of the following:
 - a. FA, manufactured by Vibration Mountings and Controls.
 - b. SAB, manufactured by Mason Industries.
 - c. Or equal.

- E. Type V: Seismic Cable Restraints
1. Seismic Cable Restraints shall consist of steel aircraft cables sized to resist seismic loads with minimum safety factor of 2.0, and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables shall not bend across sharp edges. Single arm braces with resilient bushings can be substituted for seismic cable restraints. Deck fitting shall have two through-bolts for attachment.
 2. Product and Manufacturer: Provide one of the following:
 - a. SCR, manufactured by Vibration Mountings and Controls.
 - b. SCB, manufactured by Mason Industries.
 - c. Or equal.
- F. Type VI: Rigid Arm Brace
1. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with minimum safety factor of 2.0, and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to final installation angle and utilize two through-bolts to provide attachment.
 2. Product and Manufacturer: Provide one of the following:
 - a. SAB, manufactured by Vibration Mountings and Controls.
 - b. SSB, manufactured by Mason Industries.
 - c. Or equal.
- G. Type VII: Internal Clevis Cross Brace
1. Internal clevis cross braces at seismic locations shall be pre-cut pipe sized for internal clevis dimensions.
 2. Product and Manufacturer: Provide one of the following:
 - a. ICB, manufactured by Vibration Mountings and Controls.
 - b. CCB, manufactured by Mason Industries.
 - c. Or equal.

2.5 COMPONENT BASES

- A. General
1. All curbs and roof rails shall be anchored to building structural steel for resisting Lateral Forces. Fastening to metal deck is unacceptable.
- B. Type B-1: Integral Structural Steel Base
1. Rectangular bases are preferred for all Components.
 2. Centrifugal refrigeration machines and pump bases may be T- or L-shaped when there are space constraints. When the pump has pump-mounted suction and discharge fittings, base of pump shall include required supports.
 3. All perimeter members shall be steel beams with minimum depth equal to 1/12 of the longest dimension of base.
 4. Base depth need not exceed 12 inches provided that deflection and misalignment is within acceptable limits as determined by Supplier.

5. Height-saving brackets shall be employed on all mounting locations to provide minimum base clearance of two inches.
6. Product and Manufacturer: Provide one of the following:
 - a. WFB, manufactured by Vibration Mountings and Controls.
 - b. MSL, WSFL, manufactured by Mason Industries.
 - c. Or equal.

C. Type B-2: Concrete Inertia Base

1. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations.
2. When pump has pump-mounted suction and discharge fittings, base of pump shall include required supports
3. Base depth shall be a minimum of 1/12 of the longest dimension of the base but not less than six inches.
4. Base depth need not exceed 12 inches unless specifically recommended by base manufacturer for mass or rigidity.
5. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on six-inch centers running both ways in layer 1.5 inches above bottom.
6. Provide forms with steel templates to hold anchor bolts sleeves and anchors while concrete is poured.
7. Provide height-saving brackets on all mounting locations to maintain a two-inch minimum clearance below base.
8. Flush-profile wooden formed bases having correct depth and reinforcing requirements are acceptable.
9. Product and Manufacturer: Provide one of the following:
 - a. MPF, manufactured by Vibration Mountings and Controls.
 - b. BMK, manufactured by Mason Industries.
 - c. Or equal.

D. Type B-3: Seismic Isolation Curb

1. Curb-mounted rooftop Components shall be mounted on structural seismic spring isolation curbs. Upper frame shall provide continuous support for Component and be captive to resiliently resist Lateral Forces. Lower frame shall accept point support for both seismic attachment and leveling. Upper frame shall provide positive fastening provisions (welding or bolting) to anchor roof top unit to curb. Sheet metal screws are unacceptable. Contact points between roof top unit, curb, and building's structure shall allow load path through those locations only.
2. All-directional neoprene snubber bushings shall be a minimum of 1/4-inch thick. Steel springs shall be laterally stable and rest on 1/4-inch thick neoprene acoustical pads.
3. Curbs' waterproofing shall meet NRCA standards.
4. All spring locations shall have access ports with removable waterproof covers and all isolators shall be adjustable, removable, and interchangeable.

5. Curb shall be sound-attenuating type utilizing standard two-inch roof insulation supplied and installed by Contractor to act thermally outside and acoustically inside. Curbs supplied without this feature shall be acoustically lined in the factory with two-inch duct liner.
 6. Product and Manufacturer: Provide one of the following:
 - a. Models P6200 or P6300. Type RPFMA/SRPFMA where Option No. 1 or Option No. 2 is specified, manufactured by Vibration Mountings and Controls.
 - b. RCS, manufactured by Mason Industries.
 - c. Or equal.
- E. Type B-4: Seismic Non-Isolated Curbs
1. Curbs shall conform to Type B-3 curbs except spring isolation is not required.
 2. Product and Manufacturer: Provide one of the following:
 - a. Model P6000. Type RPFMA/SRPFMA where Option No. 1 or Option No. 2 is specified, manufactured by Vibration Mountings and Controls.
 - b. RRC, manufactured by Mason Industries.
 - c. Or equal.
- F. Type B-5: Isolated Component Supports
1. Continuous structural Component support rails that combine Component support and isolation mounting into one utilized roof flashed assembly with same features specified for Type B-3.
 2. System shall provide for positive anchorage or welding of Component to supports and welding of supports to building steel.
 3. Product and Manufacturer: Provide one of the following:
 - a. R7200/R7300, manufactured by Vibration Mountings and Controls.
 - b. RSR, manufactured by Mason Industries.
 - c. Or equal.
- G. Type B-6: Non-Isolated Component Supports
1. Shall be as specified for Type B-5, except without spring isolation.
 2. Product and Manufacturer: Provide one of the following:
 - a. R7000, manufactured by Vibration Mountings and Controls.
 - b. RRC, manufactured by Mason Industries.
 - c. Or equal.
- H. Type B-7: Control/Electric Room Air Conditioning Unit Base
1. Components shall be welded or bolted to welded structural steel stands having minimum 0.5 "G" certified lateral acceleration capabilities.
 2. Non-Isolated stand shall have one inch adjustment capability to accommodate floor irregularities.
 3. Bolting or welding required to meet seismic criteria.
 4. Product and Manufacturer: Provide one of the following:
 - a. CRC, manufactured by Vibration Mountings and Controls.
 - b. CRMSL, manufactured by Mason Industries.

- c. Or equal.

2.6 FLEXIBLE CONNECTORS

A. Type FC-2: Flexible Stainless Steel Hose

1. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes three-inch diameter and larger shall be flanged. Smaller sizes shall have male nipples.
2. Connector shall be braided bronze for refrigerant connections.
 - a. Minimum lengths shall be as tabulated:

Flanged: diameter x length (inches)		Male Nipples: diameter x length (inches)	
3 x 14	10 x 26	0.5 x 9	1.5 x 13
4 x 15	12 x 28	0.75 x 10	2 x 14
5 x 19	14 x 30	1 x 11	2.5 x 18
6 x 20	16 x 32	1.25 x 12	
8 x 22			

3. Provide hoses on Component side of shut-off valves horizontally and parallel to Component shafts, where possible.
4. Product and Manufacturer: Provide one of the following:
 - a. BS, manufactured by Vibration Mountings and Controls.
 - b. BSS, manufactured by Mason Industries.
 - c. Or equal.

2.7 MATERIALS OF CONSTRUCTION AND FINISHES

- A. Controls including all miscellaneous structural steel and appurtenances shall be constructed of Type 316 stainless steel when located in corrosive areas and galvanized steel when located in non-corrosive areas.
- B. Controls shall be factory-painted per Section 09900, Painting.
- C. Miscellaneous steel angles, supports, and appurtenances shall be cleaned and prime-coated in the shop and field-painted per Section 09900, Painting.
- D. Hardware in corrosive areas shall be Type 316 stainless steel. Hardware in non-corrosive areas shall be galvanized steel.
- E. Neoprene and elastomer parts shall be resistant to ultraviolet radiation and constructed from high grade materials suitable for exposure to high concentrations of hydrogen sulfides, mercaptans, chlorine, and moisture in air.

2.8 IDENTIFICATION

- A. Provide each Control device with Type 316 stainless steel tag embossed or engraved with serial number cross-referenced to Component schedule, in accordance with Section 10400, Identification Devices.

2.9 ANCHORAGE

- A. Anchorages shall be per Section 05051, Anchor Systems.

2.10 MISCELLANEOUS METAL

- A. Miscellaneous metal fabrications shall be per Section 05501, Miscellaneous Metal Fabrications.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which Control Work is to be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.
- B. Coordinate anchorage of Components to receive Controls with installation locations. Examine roughing-in of reinforcing and cast-in-place anchor bolts to verify locations before installation.

3.2 COMPONENT INSTALLATION

- A. Install Controls in accordance with Supplier's written instructions and Shop Drawings and submittals accepted by Engineer.
- B. Rigid connections between Components and building structure shall not be made in a manner that degrades performance of Control systems.
- C. Do not rigidly connect Isolated Components to building structure.
- D. Bracing may occur from flanges of structural beams, upper truss chords in bar joist construction, and concrete inserts or cast-in-place anchor bolts. Component support shall not overstress the structure.
- E. Install cable restraints with minimum slack to avoid short-circuiting associated Component.
- F. Install cable assemblies without slack on Non-Isolated systems. Solid braces may be used in place of cables on rigidly attached systems except where single arm braces incorporate resilient bushings.

- G. At locations where restraints or solid braces are located, brace support rods as required to accept compressive loads.
- H. Minimum operating clearance under all Isolated Component bases shall be two inches.

3.3 FIELD QUALITY CONTROL

- A. Controls Design Engineer Services:
 - 1. Controls Design Engineer shall check Controls installation before Controls and related equipment are placed into operation.
 - 2. Controls Design Engineer shall make at least one visit to the Site.
 - 3. After Controls installation is complete, Controls Design Engineer shall inspect completed Controls Work and certify in writing to Contractor that all systems are installed in accordance with design. Contractor shall submit Control Design Engineer's report to Engineer, certifying correctness of the Work.
- B. Supplier's Services:
 - 1. Supplier shall check Controls installation before Controls and related equipment are placed into operation.
 - 2. Supplier shall make at least one visit to the Site.
 - 3. After installation of Controls is complete, Supplier shall inspect completed Controls Work and certify in writing to Contractor that Controls are installed in accordance with Supplier's recommendations and Shop Drawings and submittals accepted by Engineer. Contractor shall submit Supplier's report to Engineer certifying correctness of the Work.

3.4 ADJUSTING

- A. After entire system is started and under full operating load, adjust Controls so that Controls operate as designed.

3.5 CLEANING

- A. Remove debris from beneath Components and in and around the vibration isolator.

3.6 SUPPLEMENTS

- A. Supplements listed below, following the "End of Section" designation, are a part of this Section:
 - 1. Controls Schedules:
 - a. Schedule of Process Mechanical Components for Vibration Control.
 - b. Schedule of Process Mechanical Components for Seismic Control.
 - c. Schedule of HVAC Components for Vibration Control.
 - d. Schedule of HVAC Components for Seismic Control.
 - e. Schedule of Plumbing Components for Vibration Control.
 - f. Schedule of Plumbing and Fire Protection Components for Seismic Control.

- g. Schedule of Electrical Components for Vibration Control.
 - h. Schedule of Electrical Components for Seismic Control.
 - i. Schedule of Instrumentation Components for Vibration Control.
 - j. Schedule of Instrumentation Components for Seismic Control.
 - k. Schedule of Architectural Components for Vibration Control.
 - l. Schedule of Architectural Components for Seismic Control.
- 2. Controls Tables:
 - a. Table 15050-A - HVAC and Process Mechanical System Components.
 - b. Table 15050-B - Plumbing Components.
 - c. Table 15050-C - Electrical Components.
 - d. Table 15050-D – Not Used.
 - e. Table 15050-E - Seismic Bracing.
 - f. Table 15050-F - Minimum Deflection Guide.
 - 3. Attachment 15050-A – Professional Design Services Performance Certification.

+ + END OF SECTION + +

CONTROLS SCHEDULES FOR SECTION 15050

Section 15050 Schedule of Process Mechanical Components for Vibration Control		
Item No.	Component	Notes
1	Odor control system fans.	
2		
3		
4		
5		
6		
7		
8		
9		
10		

NOTES:

Section 15050 Schedule of Process Mechanical Systems for Seismic Control				
Item No.	Systems	I_p	Certificate of Compliance Required	Notes
1	Seismic Controls are not required.			
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTES:

<p style="text-align: center;">Section 15050 Schedule of HVAC Components for Vibration Control</p>		
Item No.	Component	Notes
1	Rooftop AC unit fans.	1.
2		
3		
4		
5		
6		
7		
8		
9		
10		

NOTES:

1. Vibration Controls shall be factory installed by the unit manufacturer in accordance with Section 15050.

Section 15050
Schedule of HVAC Systems for Seismic Control

Item No.	Component	I_p	Certificate of Compliance Required	Notes
1	Seismic Controls are not required.			
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTES:

Section 15050 Schedule of Plumbing Components for Vibration Control		
Item No.	Component	Notes
1	Vibration Controls are not required.	
2		
3		
4		
5		
6		
7		
8		
9		
10		

NOTES:

Section 15050 Schedule of Plumbing and Fire Protection Systems for Seismic Control				
Item No.	Component	I_p	Certificate of Compliance Required	Notes
1	Seismic Controls are not required.			
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTES:

Section 15050 Schedule of Electrical Components for Vibration Control		
Item No.	Component	Notes
1	Vibration Controls are not required.	
2		
3		
4		
5		
6		
7		
8		
9		
10		

NOTES:

Section 15050 Schedule of Electrical Systems for Seismic Control				
Item No.	Component	I _p	Certificate of Compliance Required	Notes
1	Seismic Controls are not required.			
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTES:

Section 15050 Schedule of Instrumentation Components for Vibration Control		
Item No.	Component	Notes
1	Vibration Controls are not required.	
2		
3		
4		
5		
6		
7		
8		
9		
10		

NOTES:

Section 15050 Schedule of Instrumentation Systems for Seismic Control				
Item No.	Component	I_p	Certificate of Compliance Required	Notes
1	Seismic Controls are not required.			
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTES:

Section 15050 Schedule of Architectural Components for Vibration Control		
Item No.	Component	Notes
1	Vibration Controls are not required.	
2		
3		
4		
5		
6		
7		
8		
9		
10		

NOTES:

Section 15050 Schedule of Architectural Systems for Seismic Control				
Item No.	Component	I _p	Certificate of Compliance Required	Notes
1	Seismic Controls are not required.			
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTES:

SECTION 15050 TABLES

Abbreviations for Tables 15050-A, 15050-B, 15050-C, and 15050-D:

ISOL	Vibration Isolator
DEFL	Deflection
RESTR	Seismic Restraint
MTNG	Mounting
MDG	Minimum Deflection Guide – Table 15050-F

General Notes (G) for Tables 15050-A, 15050-B, 15050-C, and 15050-D:

- Note G1: For variable speed Components with an operating speed below 600 rpm, select isolation deflection from Table 15050-F, Minimum Deflection Guide.
- Note G2: Determine static deflection based on Table 15050-F, Minimum Deflection Guide.
- Note G3: Deflections indicated are minimum at actual load and shall be selected for Supplier's nominal 5-, 4-, 3-, 2- and 1-inch deflection spring series; rpm is defined as lowest operating speed of Component.
- Note G4: Single stroke compressors may require inertia bases with thickness greater than 14-inch maximum specified for Base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8-inch.
- Note G4: For floor-mounted fans, substitute base Type B-2 for Class 2 or 3 and fan having static pressure over five inches of water column.
- Note G5: Indoor utility sets with wheel diameters less than 24 inches need not have deflections greater than 0.75 inches.
- Note G6: For Components with multiple motors, horsepower classification applies to largest single motor.

Reference Notes (R) for Tables 15050-A, 15050-B, 15050-C, and 15050-D:

- Note R1: For roof applications, use base Type B-5.
- Note R2: Curb Type B-3 shall use sound barrier RPFMA when there is no concrete underneath rooftop units. Curbs can be used for return plenums. (See Option No. 1 under Type B-3 base in Paragraph 2.5 of this Section.)
- Note R3: Where curbs require supply and return sound attenuation package, use Type SRRFMA. (See Option No. 2 under Type B-3 base in Paragraph 2.5 of this Section.)
- Note R4: Units may not be capable of point support. Refer to separate Specification Section for Component. If base is not specified in that Section and external isolation is required, provide Type B-1 base under this Section for entire unit.
- Note R5: Use Type B-6 where Non-Isolated seismic support is required.
- Note R6: Use Type B-4 where Non-Isolated seismic curbs are used.

TABLE 15050-A - HVAC and PROCESS MECHANICAL SYSTEM COMPONENTS										
COMPONENT	HP, CLASS, OR SIZE	MTNG	Mounted on Soil Supported Slab				Mounted on Suspended Slab and Floor or Roof System			
			ISOL	DEFL (in.)	BASE	RESTR	ISOL	DEFL (in.)	BASE	RESTR
Absorption Machine		Flr.	---	---	---	IV	B	0.75	B-2	IV
Air Handling Units Indoor		Flr	B	0.75	---	IV	B	See MDG	---	IV
		Clg	E	0.75	---	V	E	See MDG	---	V
Air Compressor Tanks	To 10 HP	Flr	B	0.75	---	IV	B	0.75	---	IV
	>10 HP	Flr	B	0.75	B-2	IV	B	1.50	B-2	IV
Dry Coolers Condensers/Condensing Outdoor Units		Roof	---	---	---	IV	B	2.50 (minimum)	B-5	IV
Axial Fans (Inline Type)		Flr	B	0.75	---	IV	B	See MDG	---	IV
		Clg	E	0.75	---	V	E	See MDG	---	V
Base Mounted Pumps	To 15 HP	Flr	B	0.75	B-2	IV	B	0.75	B-2	IV
	>15 HP	Flr	B	0.75	B-2	IV	B	1.50	B-2	IV
Boilers		Flr	G	0.10	---	IV	B	0.75	---	IV
Cabinet Fans & Packaged AHU Indoor	To 1 HP	Flr	F	0.20	---	IV	B	0.75	---	IV
		Clg	D	0.35	---	V	E	0.75	---	V
	>1 HP	Flr	B	0.75	---	IV	B	See MDG	---	IV
		Clg	E	0.75	---	V	E	See MDG	---	V
Centrif. Chillers		Flr	B	0.75	---	IV	B	1.50	---	IV
Centrif. Fans Arr. 1 & 3	Class 1	Flr	B	0.75	B-1	IV	B	See MDG	B-1	IV
	Class 2 & 3	Flr	B	0.75	B-2	IV	B	See MDG	B-2	IV
Centrif. Fans (Vent Sets) Arr. 9 & 10	Class 1	Flr	B	0.75	---	IV	B	See MDG	See Note R1	IV
	Class 2 & 3	Clg	E	0.75	B-2	V	E	See MDG	B-2	V
Computer Room Units		Flr	F	0.20	B-7	IV	B	1.5	B-7	IV
Condensate Pumps		Flr	F	0.20	If req.	IV	F	0.20	If req.	IV
Cooling Towers		Flr	B	0.75	---	IV	B	2.50	B-5 opt.	IV
Curb Mtd. Equip. (Non-Isol.)		Roof	---	---	---	IV	---	---	B-6	IV
Fan Coil Units		Flr	F	0.20	---	IV	B	0.75	---	IV
		Clg	D	0.35	---	V	E	0.75	---	V
Outdoor Reciprocating, Rotary or Screw Chillers		Flr	F	0.20	---	IV	B	1.50	---	IV
		Roof	---	---	---	IV	B	2.50	B-5 See note R5	IV

TABLE 15050-A - HVAC and PROCESS MECHANICAL SYSTEM COMPONENTS (Continued)										
COMPONENT	HP, CLASS, OR SIZE	MTNG	Mounted on Soil Supported Slab				Mounted on Suspended Slab and Floor or Roof System			
			ISOL	DEFL (in.)	BASE	REST R	ISOL	DEFL (in.)	BASE	REST R
Rooftop AHU/AC	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-3 see notes R2, R3, R6	IV
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-3 see notes R2, R3,R6	IV
Unit/Cab Heaters		Clg	D	0.30	---	V	D	0.30	---	V

TABLE 15050-B - PLUMBING COMPONENTS

COMPONENT	HP	MTNG	Mounted on Soil Supported Slab				Mounted on Suspended Slab and Floor or Roof System			
			ISOL	DEFL (in.)	BASE	RESTR	ISOL	DEFL (in.)	BASE	RESTR
Air Compressors & Vacuum Pumps	to 10	Flr	B	0.75	---	IV	B	0.75	---	IV
	>10	Flr	B	0.75	B-2	V	B	1.50	B-2	IV
Base Mounted Pumps	to 15	Flr	B	0.75	B-2	IV	B	0.75	B-2	IV
	>15	Flr	B	0.75	B-2	IV	B	1.50	B-2	IV

TABLE 15050-C - ELECTRICAL COMPONENTS										
			ON GRADE				ABOVE GRADE			
COMPONENT	SIZE	MTNG	ISOL	DEFL	BASE	RESTR	ISOL	DEFL	BASE	RESTR
Transformer Dry type	All	Flr	--	--	--	IV	D	0.30	See note R4	IV
		Ceiling	--	--	--	V	E	0.20	See note R4	V
Generators	All	Flr	B	1.0	--	IV	B	1.50	See note R4	IV
Generators	All	Over Occupied Space					B	2.50	See note R4	IV
UPS Systems	M		II	0.40		IV	B	1.50	See note R4	IV

TABLE 15050-E – SEISMIC BRACING (Max. Brace Spacing Shown – Actual Spacing to be Determined by Calculation)*			
COMPONENT	ON CENTER TRANSVERSE (Spacing in Feet)	ON CENTER LONGITUDINAL (Spacing in Feet)	CHANGE OF DIRECTION (Distance in Feet)
HVAC Duct	30	60	4
PIPE – NO HUB OR BELL AND SPIGOT			
2.5-inch dia. and larger	10	20	4
PIPE – ALL OTHER JOINT TYPES			
16-inch dia. and smaller	40	80	4
18 to 28-inch dia.	30	60	4
30 to 40-inch dia.	20	60	4
42-inch dia. and larger	10	30	4
MISCELLANEOUS			
Breeching	30	60	4
Chimneys and Stacks	30	60	4
Electrical Conduit	40	80	4
Electrical Bus Duct	20	40	4
Cable Tray	40	80	4

* Note: See Paragraph 2.1.C.11.b of this Section regarding fuel oil, natural gas piping, thermoplastic piping, and glass-lined pipe.

**Table 15050-F – MINIMUM
DEFLECTION GUIDE**

rpm	MINIMUM REQUIRED DEFLECTION (inches)
Less than 400	3.5
401 to 600	2.5
601 to 900	1.5
Over 900	0.75

ATTACHMENT 15050-A
Professional Design Services Performance Certification
(Page 1 of 2)

1. My name is _____.
2. My New York professional engineering/architecture license number is _____.
3. My license expires _____, 20____.
4. The Project for which I have performed professional design services is described as _____.
5. The Specification Section(s) under which I have performed my services is/are _____.
6. The name and address of the individual or entity for whom I have performed professional design services is:

ATTACHMENT 15050-A
Professional Design Services Performance Certification
(Page 2 of 2)

7. I hereby certify that, to the best of my knowledge, information, and belief, I have performed or supervised performance of the professional design services hereunder, and that said services have been performed in accordance with Laws and Regulations and in accordance with the standard of care currently expected of professional engineers/architects performing similar services for Projects of similar size and complexity in New York.

Date

Signature

Type or Print Name

Name of Firm

Street Address
[PROFESSIONAL SEAL]

City/State/Zip Code

Telephone: _____ Fax: _____

++ NO TEXT ON THIS PAGE ++

SECTION 15051

BURIED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:
 - a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections.
 - b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.
 - c. Work on or affecting existing buried piping.
 - d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, cathodic protection, and other Work required for a complete, buried piping installation.
 - e. Supports, restraints, and thrust blocks.
 - f. Pipe encasements, with the exception of the following, which are specified under Section 15052, Exposed Piping Installation:
 - 1) Piping embedded in concrete within a structure, or
 - 2) Piping embedded in a foundation.
 - g. Field quality control, including testing.
 - h. Cleaning and disinfecting.
 - i. Incorporation of valves, meters, and special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.
2. Coordinate with appropriate piping Sections of Division 15, Mechanical.
3. Refer to Section 01700, Maintenance of Plant Operations, for constraints before developing laying schedules.

C. Related Sections:

1. Section 02200, Earthwork.
2. Section 03300, Cast-In-Place Concrete.
3. Section 09900, Painting.
4. Section 15061, Ductile Iron Pipe.

5. Section 15065, Concrete Pipe.
7. Section 15120, Couplings, Adapters, and Specials for Piping.
8. Section 15121, Wall Pipes, Floor Pipes, and Pipe Sleeves.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. ASTM B32, Specification for Solder Metal.
 2. ANSI/AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems.
 3. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 4. ANSI/AWWA C606, Standard for Grooved and Shouldered End Joints.
 5. ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 8. AWWA M9, Concrete Pressure Pipe.
 6. AWWA M41, Ductile-Iron Pipe and Fittings.
 7. ASCE 37, Design and Construction of Sanitary and Storm Sewers.
 8. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Comply with requirements and recommendations of authorities having jurisdiction over the Work.
 2. Obtain required permits for Work in roads, rights-of-way, railroads, and other areas of the Work.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Laying schedules for concrete pipe and piping with restrained joints.
 - b. Details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances.
 2. Product Data:
 - a. Manufacturer's literature and specifications, as applicable, for products specified in this Section.
 3. Testing Procedures:
 - a. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain Engineer's approval prior to commencing testing.
- B. Informational Submittals: Submit the following:
1. Certificates:

- a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
- 2. Field Quality Control Submittals:
 - a. Results of each specified field quality control test.
- C. Closeout Submittals: Submit the following:
 - 1. Record Documentation:
 - a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
 - b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.
 - c. Include profile drawings with buried piping record documents when the Contract Documents include piping profile drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.
- B. Storage:
 - 1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
 - 2. Pipe and fittings specified herein may be stored outdoors without cover.
- C. Handling:
 - 1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.
 - 2. Avoid unnecessary handling of pipe.
 - 3. Keep pipe interiors free from dirt and foreign matter.
 - 4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Piping materials are specified in Table 15051-A, Buried Piping, following the "End of Section" designation. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable Sections of Division 15, Mechanical.
- B. General:
 - 1. Pipe Markings:
 - a. Factory-mark each length of pipe and each fitting with designation conforming to those on approved laying schedules.
 - b. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.
- C. Polyethylene Encasement:
 - 1. Polyethylene may be supplied in tubes or sheets.
 - 2. Polyethylene encasement materials shall be in accordance with ANSI/AWWA C105.

2.2 BURIED PIPING IDENTIFICATION

- A. Polyethylene Underground Warning Tape for Metallic Pipelines:
 - 1. Tracer tape shall be of inert, acid- and alkali-resistant, polyethylene, four mils thick, six inches wide, suitable for direct burial. Tape shall be capable of stretching to twice its original length.
 - 2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other service as appropriate, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW", with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as pipeline colors specified for associated pipe service in Section 09900, Painting.
 - 3. Manufacturer: Provide products of one of the following:
 - a. Brady Corporation
 - b. Seton Identification Products
 - c. Marking Services, Inc.
 - d. Or equal.
- B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
 - 1. Tape shall be of inert, acid- and alkali-resistant, polyethylene, five mils thick, six inches wide, with aluminum backing, and have 15,000 psi tensile strength and 140 percent elongation capability. Tape shall be suitable for direct burial.
 - 2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS",

or other appropriate service, as indicated in the Buried Pipe Schedule at the end of this Section] **PIPE BURIED BELOW**” with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored the same as the pipeline colors as specified for the associated pipe service in Section 09900, Painting.

3. Manufacturer: Provide products of one of the following:
 - a. Brady Corporation
 - b. Seton Identification Products
 - c. Marking Services, Inc.
 - d. Or equal.

2.3 FIRE HYDRANTS

- A. Products and Manufacturers: Provide one of the following:
 1. Mueller, Model: Super Centurion.
 2. Kennedy, Model: Guardian K81D.
 3. Or equal.
- B. General:
 1. Provide fire hydrants conforming to AWWA C502, Underwriters’ Laboratories-listed and Factory Mutual approved, and as specified herein.
 2. Rated Working Pressure: 175 psig, minimum.
 3. Rated Hydrostatic Test Pressure: 400 psig, minimum.
 4. Length of Bury: 50 feet.
- C. Construction:
 1. Type: Three-way fire hydrants with two hose nozzles and one pumper nozzle.
 2. Nozzles:
 - a. Provide one 4.5-inch diameter pumper nozzle and two 2.5-inch diameter hose nozzles with NFPA threads.
 - b. Nozzles shall be O-ring sealed, threaded, and retained with stainless steel locks. Nozzles shall be field replaceable.
 3. Main Valve and Drainage Assembly:
 - a. Opening: 5.25-inch diameter.
 - b. Main valve shall be compression type provided with upper and lower metal plates and lower valve plate nut.
 - c. Barrel drainage shall be through dual drain valves. Opening and closing of main valve shall cause force-flush of dual drain ports.
 - d. Main valve seat ring shall be easily replaceable from above-ground.
 4. Provide an oil filled reservoir for lubrication of stem threads and bearing surfaces. Oil shall be U.S. Food and Drug Administration approved and ANSI/NSF 61-listed, and shall flow freely in temperature range of -60 to 158 degrees F.
 5. Provide traffic flange in barrel and safety coupling in stem.

6. Inlet Connection: Six-inch diameter mechanical joint, restrained.
- D. Materials of Construction: Materials of construction shall conform to the requirements of AWWA C502 and shall be as follows:
1. Upper and Lower Barrels, Shoe, and Bonnet: Cast-iron.
 2. Stem and Accessories:
 - a. Upper and Lower Stems: Steel.
 - b. Operating Nut: Bronze.
 - c. Safety Coupling: Stainless steel.
 3. Nozzles:
 - a. Pumper and Hose Nozzles: Bronze.
 - b. Nozzle Caps: Cast-iron.
 - c. Cap Chains: Steel.
 4. Main Valve Assembly:
 - a. Main Valve: Rubber.
 - b. Upper Valve Plate: Bronze.
 - c. Lower Valve Plate and Nut: Cast-iron.
 5. Drain Valves:
 - a. Drain Ring Housing: Cast-iron.
 - b. Drain Ring: Bronze.
 6. O-ring Gaskets: Rubber.
 7. External Assembly Bolts: Steel.
 8. Internal Pins and Other Hardware: Stainless steel, ASTM A276.
- E. Testing:
1. Test each fire hydrant in manufacturer's shop in conformance with AWWA C502.
- F. Interior Coating:
1. Hydrants shall be coated on the interior. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

2.4 – YARD HYDRANTS

- A. Exposed head, non-freeze type, model Z-1385 by Zurn or equal.
- B. Shall be complete with bronze casting and cast aluminum casing guard, all bronze interior parts, bronze seat, and replaceable seat washer. Unit shall be provided with ¼" drain port in valve housing.
- C. Unit shall be for a ¾-inch hose connection. Provide operating key for each hydrant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
2. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from Engineer before proceeding.
3. Engineer will observe excavations and bedding prior to laying pipe by Contractor. Notify Engineer in advance of excavating, bedding, pipe laying, and backfilling operations.
4. Minimum cover over buried piping shall be four feet, unless otherwise shown or approved by Engineer.
5. Earthwork is specified in Section 02200, Earthwork.
6. Excavation in excess of that required or shown, and that is not authorized by Engineer shall be filled at Contractor's expense with granular material furnished, placed, and compacted in accordance with Section 02200, Earthwork.
7. Comply with NFPA 24 for "Outside Protection", where applicable to water piping systems used for fire protection.

B. Manufacturer's Installation Specialist:

1. Provide services of competent installation specialist of pipe manufacturer when pipe installation commences for:
 - a. Concrete pipe.
2. Retain installation specialist at the Site for minimum of two days (eight hours per day at the Site) or until competency of pipe installation crew has been satisfactorily demonstrated.

C. Separation of Sewers and Potable Water Piping:

1. Horizontal Separation:
 - a. Where possible, existing and proposed potable water mains and service lines, and sanitary, combined, and storm sewers shall be separated horizontally by clear distance of at least ten feet.
 - b. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undistributed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above top of sewer.
 - c. Exception:
 - 1) Where it is not possible to provide minimum horizontal separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test water main and sewer as specified in this Section prior to backfilling. Hydrostatic test pressure at crossing shall be at least

150 psi.

2. Vertical Separation:

- a. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of sewer when sewer crosses over potable water main.
- b. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.
- c. Provide adequate structural support where potable water main crosses under sewer. At minimum, provide compacted select backfill for ten feet on each side of crossing.
- d. Exceptions:
 - 1) Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe. Hydrostatically test water main and sewer as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
 - 2) Encase either potable water main or sewer in watertight carrier pipe extending ten feet on each side of crossing, measured perpendicular to potable water main.

D. Plugs:

1. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
4. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to Engineer.

E. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.

1. Trench excavation and backfill, and bedding materials shall conform to Section 02200, Earthwork, as applicable.
2. Where pipe is installed in rock excavation, provide minimum of three inches of granular bedding material underneath pipe smaller than four-inch nominal diameter, and minimum of six inches of granular bedding material underneath pipes four-inch nominal diameter and larger.
3. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.

4. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.
5. Do not lay pipe until Engineer approves bedding condition.
6. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

F. Laying Pipe:

1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:
 - a. Ductile Iron Pipe: ANSI/AWWA C600, ANSI/AWWA C105, AWWA M41.
2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by Engineer. Remove and reinstall pipes that are not installed correctly.
3. Slope piping uniformly between elevations shown.
4. Keep groundwater level in trench at least 24 inches below bottom of pipe before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.
5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by Engineer.
6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by Engineer.
7. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.
8. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by Engineer.
9. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
10. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before pipe is laid.
11. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.
12. Do not place blocking under pipe, unless specifically approved by Engineer for special conditions.
13. Touch up protective coatings in manner satisfactory to Engineer prior to backfilling.
14. Notify Engineer in advance of backfilling operations.

15. On steep slopes, take measures acceptable to Engineer to prevent movement of pipe during installation.
16. Thrust Restraint: Where required, provide thrust restraint conforming to Article 3.3 of this Section.
17. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.

G. Polyethylene Encasement:

1. Provide polyethylene encasement for ductile iron piping to prevent contact between pipe and surrounding bedding material and backfill.
2. Polyethylene encasement installation shall be in accordance with ANSI/AWWA C105.

H. Jointing Pipe:

1. Ductile Iron Mechanical Joint Pipe:
 - a. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.
 - b. Lubricate plain ends and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.
 - c. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.
 - d. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
 - e. Push gland toward socket and center gland around pipe with gland lip against gasket.
 - f. Insert bolts and hand-tighten nuts.
 - g. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

Pipe Diameter (inches)	Bolt Diameter (inches)	Range of Torque (ft-lbs)
3	5/8	45 to 60
4 to 24	3/4	75 to 90
30 to 36	1	100 to 120

- h. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Tnemec, or equal.
- i. Restrained mechanical joints shall be in accordance with Section 15061, Ductile Iron Pipe.
2. Ductile Iron Push-On Joint Pipe:

- a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
 - b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
 - c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
 - d. Immediately prior to joint assembly, apply thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
 - e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
 - f. Maintain an adequate supply of gaskets and joint lubricant at the Site when pipe jointing operations are in progress.
3. Ductile Iron Proprietary Joints:
- a. Install pipe that utilizes proprietary joints for restraints specified in Section 15061, Ductile Iron Pipe, or other such joints, in accordance with manufacturer's instructions.
4. Copper Tubing Joints:
- a. Soldered Joints:
 - 1) Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
 - 2) Ream or file pipe to remove burrs.
 - 3) Clean and polish contact surfaces of joints.
 - 4) Apply flux to both male and female ends.
 - 5) Insert end of tube into full depth of fitting socket.
 - 6) Heat joint evenly.
 - 7) Form continuous solder bead around entire circumference of joint starting at the bottom.
5. Mechanical Coupling Joints:
- a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings specified in Section 15120, Couplers, Adapters, and Specials for Piping.
 - b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with wire brush to remove foreign matter.

- c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.
- I. Backfilling:
 - 1. Conform to applicable requirements of Section 02200, Earthwork.
 - 2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.
- J. Connections to Valves and Hydrants:
 - 1. Install valves and hydrants as shown and indicated in the Contract Documents.
 - 2. Provide suitable adapters when valves or hydrants and piping have different joint types.
 - 3. Provide thrust restraint at all hydrants and at valves located at pipeline terminations.
- K. Transitions from One Type of Pipe to Another:
 - 1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.
- L. Closures:
 - 1. Provide closure pieces shown or required to complete the Work.

3.2 TRACER TAPE INSTALLATION

- A. Polyethylene Underground Warning Tape for Metallic Pipelines:
 - 1. Provide polyethylene tracer tape for buried metallic piping, which includes pipe that is steel, ductile iron, cast iron, concrete, copper, and corrugated metal.
 - 2. Provide tracer tape 12 to 18 inches below finished grade, above and parallel to buried pipe.
 - 3. For pipelines buried eight feet or greater below finished grade, provide second line of magnetic tracer tape 2.5 feet above crown of buried pipe, aligned along pipe centerline.
 - 4. Tape shall be spread flat with message side up before backfilling.

3.3 THRUST RESTRAINT

- A. Provide thrust restraint on pressure piping systems where shown or indicated in the Contract Documents.
- B. Thrust restraint may be accomplished by using restrained pipe joints, concrete thrust blocks, or harnessing buried pipe. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Buried Piping Schedule at the end of this Section.
- C. Place concrete thrust blocks against undisturbed soil. Where undisturbed soil does not exist, or for projects where the Site consists of backfill material, thrust restraint shall be provided by restrained pipe joints.
- D. Restrained Pipe Joints:
 - 1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
 - a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with proprietary restrained joint system as specified in Section 15061, Ductile Iron Pipe; lugs and tie rods; or other joint restraint systems approved by Engineer.
 - b. Prestressed Concrete Cylinder Pipe Joints: Restrain utilizing clamp type restrained joint, snap ring-type restrained joint, or by welding. Restrain, at a minimum, pipe segments to all wall fittings, and both joints of all bends and other transition pieces. Concrete pipe requiring restraint shall have sufficient longitudinal steel reinforcement provided to handle thrust forces at maximum design stress of 12,500 psi. Thrust forces in longitudinales must be transmitted directly to steel joint bands using welded connections sufficient to carry stresses involved. No allowance for the concrete to handle tensile forces is allowed. Thrust restraint shall be in accordance with ANSI/AWWA Manual M9.
 - c. Joints for Concrete Pipe Other than Prestressed Concrete Cylinder Pipe: Restrain joints utilizing clamp type restrained joint or snap ring-type restrained joint.
- E. Concrete Thrust Blocks:
 - 1. Provide concrete thrust blocks on pressure piping at changes in alignment of 15 degrees or more, at tees, plugs and caps, and where shown or indicated in the Contract Documents. Construct thrust blocks of Class B concrete, conforming to Section 03300, Cast-In-Place Concrete.
 - 2. Install thrust blocks against undisturbed soil. Place concrete so that pipe and fitting joints are accessible for repair.
 - 3. Concrete thrust block size shall be as shown on the Drawings or as approved by Engineer.
- F. Harnessed lengths of buried pipe shall be determined by the pipe manufacturer in accordance with the formula for determination of buried pipe harnessed lengths

located at the end of this Section.

3.4 WORK AFFECTING EXISTING PIPING

- A. Location of Existing Underground Facilities:
 - 1. Locations of existing Underground Facilities shown on the Drawings should be considered approximate.
 - 2. Determine the true location of existing Underground Facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of Underground Facilities that could be disturbed during excavation and backfilling operations, or that may be affected by the Work.
- B. Work on Existing Pipelines or Underground Facilities:
 - 1. Cut or tap piping or Underground Facilities as shown or required with machines specifically designed for cutting or tapping pipelines or Underground Facilities, as applicable.
 - 2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
 - 3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.

3.5 FIELD QUALITY CONTROL

- A. General:
 - 1. Test all piping, except as exempted in the Buried Piping Schedule in this Section.
 - 2. When authorities having jurisdiction are to witness tests, notify Engineer and authorities having jurisdiction in writing at least 48 hours in advance of testing.
 - 3. Conduct all tests in presence of Engineer.
 - 4. Remove or protect pipeline-mounted devices that could be damaged by testing.
 - 5. Provide all apparatus and services required for testing, including:
 - a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain Owner's operations.
 - b. Temporary bulkheads, bracing, blocking, and thrust restraints.
 - 6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
 - 7. Unless otherwise specified, Owner will provide fluid required for hydrostatic testing. Contractor shall provide means to convey fluid for hydrostatic testing into piping being tested. Contractor shall provide fluid for other types of testing required.
 - 8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.

9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by Contractor and that fails the test shall be repaired upon authorization of Owner. Unless otherwise included in the Work, repair of existing piping or Underground Facilities will be paid as extra Work.
- B. Test Schedule:
1. Refer to the Buried Piping Schedule in this Section for type of test required and required test pressure.
 2. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.
 3. For piping not listed in Buried Piping Schedule in this Section:
 - a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires separate test.
 - b. Use exfiltration testing, low-pressure air testing, or vacuum testing for other piping.
 - c. Disinfect for bacteriological testing piping that conveys potable water.
 4. Test Pressure:
 - a. Use test pressures listed in Buried Piping Schedule in this Section.
 - b. If test pressure is not listed in Buried Piping Schedule, or if test is required for piping not listed in the Buried Piping Schedule, test pressure will be determined by Engineer based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.
- C. Hydrostatic Testing:
1. Preparation for Testing:
 - a. Follow procedures described in ANSI/AWWA Manual M9. Wetting period is not required for pipe that is not cement mortar-lined.
 - b. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.
 2. Test Procedure:
 - a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
 - b. Expel air from pipe as required. Obtain approval of Engineer prior to tapping pipe for expelling air.
 - c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
 - d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.

- e. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
 - f. Timed Test Period: After stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure.
 - g. Pump from test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.
3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of test pressure during timed test period. Allowable leakage rates for piping are:
- a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
 - b. Rates based on formula or table in ANSI/AWWA Manual M41:
 - 1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:
 - a) Bell and spigot and push-on joints.
 - b) Mechanical joints.
 - c) Bolted sleeve type couplings.
 - d) Grooved and shouldered couplings.
 - c. Rates based on make-up allowance in ANSI/AWWA Manual M9:
 - 1) Prestressed concrete cylinder pipe and other types of concrete pipe joined with O-ring rubber gasket sealing members.

D. Sanitary Sewer Testing:

- 1. Contractor may test sanitary sewer and storm drain piping using the method specified in one of the following: Paragraph 2 or 3. Notify Engineer in writing in advance of the first test of method to be used for testing, and use the same test method for testing all sanitary sewer and storm drain piping in the Contract, unless otherwise accepted by Engineer.
- 2. Exfiltration Testing:
 - a. Plug and bulkhead ends and lateral connections of pipe segment to be tested and admit fluid until the pipe is full. Admit fluid slowly to minimize air entrapment. Groundwater level shall be below the pipe during exfiltration test.
 - b. Before measuring leakage, allow fluid to wet pipe interior for the following period:
 - 1) Concrete Pipe: 48 hours.
 - 2) Cement Mortar-lined Pipe: 24 hours.
 - 3) Other Pipe: Wetting period not required.
 - c. Provide minimum hydrostatic head during test of two feet above crown of upstream end of pipe segment tested.

- d. Add fluid from test container or from metered supply as required to maintain test water level within three inches of test head throughout the test.
 - e. Test duration shall be at least two hours.
 - f. Allowable Leakage Rates:
 - 1) Leakage is defined as the quantity of fluid that must be supplied to pipe segment tested to maintain hydrostatic head within three inches of test head during the test after pipe has been filled and exposed to required wetting period, plus quantity required to refill to original head at end of test.
 - 2) Leakage shall not exceed the following rates:
 - a) Gravity Sewer: 0.079 gallons per hour per 100 feet of pipe per inch in diameter in pipe.
 - b) Storm Drains: 0.79 gallons per hour per 100 feet of pipe per inch diameter of pipe.
3. Low Pressure Air:
- a. Plug and bulkhead ends and lateral connections of pipe segment to be tested.
 - b. Required test pressure shall be increased by an amount equal to the elevation of groundwater above invert of lowest point of pipe segment being tested.
 - c. Test in accordance with requirements of authority having jurisdiction.
 - d. If there are no Laws and Regulations covering the test, use test procedures described in the following standards:
 - 1) Concrete Pipe: ASTM C924.
- E. Bacteriological Testing:
- 1. Bacteriological testing for potable water lines, finished water lines, and other piping in accordance with the Buried Piping Schedule, is specified in Article 3.6 of this Section.

3.6 CLEANING AND DISINFECTION

- A. Cleaning, General: Clean pipe systems as follows:
- 1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in manner approved by Engineer, prior to placing in service.
 - 2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.
 - 3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with five percent sodium hypochlorite solution.
- B. Disinfection:
- 1. Disinfect all potable and finished water piping.

2. Suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by Engineer.
 - a. Prior to disinfection, clean piping as specified and flush thoroughly.
 - b. Conform to procedures described in ANSI/AWWA C651. Use continuous feed method of disinfecting, unless alternative method is acceptable to Engineer.
3. Water for initial flushing, testing, and disinfection will be furnished by Owner. Contractor shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for re-disinfection will be paid by Contractor to Owner at water utility's standard rates.
4. Chlorine shall be provided by Contractor.
5. Bacteriologic tests will be performed by Owner. Certified test laboratory report will be provided to Contractor, if requested.
6. Chlorine concentration in water entering the piping shall be between 50 and 100 ppm, such that minimum residual concentration of 25 mg/L remains after 24-hour retention period. Disinfect piping and all related components. Repeat as necessary to provide complete disinfection.
7. After required retention period, flush chlorinated water to closed drain line, unless otherwise acceptable to Engineer. Properly dispose of chlorinated water in accordance with Laws and Regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

3.7 BURIED PIPE HARNESS FORMULA

FORMULA FOR DETERMINATION OF BURIED PIPE HARNESSED LENGTHS

Lengths shall be based on the following formula:

$$L = \frac{T}{f \cdot \sum W}$$

$$T = 1.25 \cdot P \cdot A \cdot \sin \frac{\Delta}{2}$$

where: T = Thrust (lbs.)
 P = Test pressure (psi)
 A = Pipe area (sq. in.)
 Δ = Angle of bend.
 f = Friction factor between soil and pipe = 0.3*.
 ΣW = W_p + W_s + W_w.
 W_p = Weight of pipe (lbs. per linear foot).

W_s = Weight of soil (lbs. per linear foot)**.
 W_w = Weight of fluid (lbs. per linear foot).

* For ductile iron and steel pipe, the friction factor $f = 0.1$.

** Based on depth of cover on pipe, and outside diameter of pipe. Soil weight equals 100 lbs./ft³.

3.8 SCHEDULES

A. Schedules listed below, following the “End of Section” designation, are part of this Specification section.

1. Table 15051-A, Buried Piping Schedule.

TABLE 15051-A, BURIED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Lining	Pressure Class/ Thickness	Joint	Test (psig)	Remarks
SAN	4	EPDM	NONE	NONE	Sch 10	QD	HYD (100)	Flexible hose
WM	6	DI	CL	NONE	Class 53	RMJ	HYD (150)	Water Service
SSFM	8	DI	CL	NONE	Class 53	RMJ	HYD (100)	Secondary Sludge
PSFM	8	DI	CL	NONE	Class 53	RMJ	HYD (100)	Primary Sludge
SFM - TF	20	DI	CL	NONE	Class 53	RMJ	HYD (100)	Trickling Filter Recirculation
SFM	16, 24	DI	CL	PEW	Class 53	RMJ	HYD (100)	Connection to Force Main
SFM	24	HDPE	CE	PEW	DR 15.5	BFW	HYD (100)	Buried Force Main from wet well
SAN	10	HDPE	NONE	NONE	DR 11	BFW	HYD (10)	Bypass Sanitary Lines
SAN	48	RCP	EP	NONE	Class V	BS	HYD (10)	Influent sewer
STM	8, 15	RCP	NONE	NONE	Class V	BS	HYD (10)	Storm Lines

The following abbreviations are used in the Buried Piping Schedule:

A. Service Abbreviations:

Service	Abbrev.		Service	Abbrev.
Sanitary Sewer	SAN		Sewer Force Main	SFM
Water Main	WM		Primary Sludge Force Main	PSFM
Sewer Force Main – Trickling Filter	SFM-TF		Secondary Sludge Force Main	PSFM
Stormwater	STM			

B. Material Abbreviations:

Material	Abbrev.		Material	Abbrev.
Ductile Iron	DI		Reinforced Concrete Pipe	RCP
High Density Polyethylene	HDPE		Ethylene propylene diene monomer rubber	EPDM

C. Lining/Coating Abbreviations:

Lining	Abbrev.		Coating	Abbrev.
Cement Mortar Lined	CL		Polyethylene Wrapped	PEW
Ceramic Epoxy Lining	CE		Epoxy Lining	EP

D. Joint Abbreviations:

Joint Type	Abbrev.		Joint Type	Abbrev.
Bell and Spigot	BS		Restrained Mechanical Joint	RMJ
Quick Disconnect	QD		Butt Fusion Weld	BFW

E. Test Abbreviations:

Test	Abbrev.		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ()			

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SECTION 15052

EXPOSED PIPING INSTALLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:
 - a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections or other contracts.
 - b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.
 - c. Work on or affecting existing exposed piping.
 - d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.
 - e. Supports, restraints, and other anchors.
 - f. Field quality control, including testing.
 - g. Cleaning and disinfecting.
 - h. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.
2. Coordinate with appropriate piping Sections of Division 15, Mechanical.

C. Related Sections:

1. Section 09900, Painting.
2. Section 10400, Identification Devices.
3. Section 15050, Vibration, Seismic, and Wind Controls.
4. Section 15055, Pipe Hangers and Supports.
5. Section 15061, Ductile Iron Pipe.
6. Section 15120, Couplings, Adapters, and Specials for Process Piping.
7. Section 15121, Wall Pipes, Floor Pipes and Pipe Sleeves.

1.2 REFERENCES

- A. Standards referenced in this Section are:
1. ASME Boiler and Pressure Vessel Code.
 2. ASME B31.3, Process Piping.
 3. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
 4. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 5. ASTM B32, Specification for Solder Metal.
 6. AWS D1.1/D1.1M, Structural Welding Code-Steel.
 7. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 8. ANSI/AWWA C206, Field Welding of Steel Water Pipe.
 9. ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
 10. ANSI/AWWA C605, Standard for Underground Installation of PVC and PVCO Pressure Pipe and Fittings.
 11. ANSI/AWWA C606, Grooved and Shouldered Joints.
 12. ANSI/AWWA C651, Disinfecting Water Mains.
 13. AWWA M11, Steel Pipe - A Guide for Design and Installation.
 14. AWWA M23, PVC Piping - Design and Installation.
 15. AWWA M41, Ductile-Iron Pipe and Fittings.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Comply with requirements and recommendations of authorities having jurisdiction over the Work.
- B. The Work shall conform to vibratory, seismic, and wind requirements in accordance with Section 15050, Vibration, Seismic and Wind Controls.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Detailed drawings in plan and, as applicable, section.
 - b. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.
 - c. Laying schedules for concrete pipe and piping with restrained joints.
 2. Testing Plans, Procedures, and Testing Limitations

- a. Submit description of proposed testing methods, procedures, and apparatus, and obtain Engineer's approval prior to testing.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. Submit a certificate signed by manufacturer of each product certifying product conforms to applicable referenced standards.
 - b. Welder's Certificate to comply with Paragraph 3.1.E.7.c.
 - 2. Source Quality Control Submittals:
 - a. Submit copies of testing report for each test.
 - 3. Site Quality Control Reports:
 - a. Submit copies of testing report for each test.
- C. Closeout Submittals: Submit the following:
 - 1. Record Documentation:
 - a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by Engineer.
 - b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures. For straight runs of pipe provide offset dimensions as required to document pipe location.
 - c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
 - d. Conform to Section 01720, Record Documents.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 - 1. Deliver products to Site to ensure uninterrupted progress of the Work.
 - 2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.
- B. Storage:
 - 1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.
 - 2. Pipe and fittings other than thermoplastic materials may be stored outdoors without cover. Thermoplastic pipe and fittings stored outdoors shall be covered.
- C. Handling:

1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.
2. Avoid unnecessary handling of pipe.
3. Keep pipe interiors free of dirt and foreign matter.
4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Piping materials are specified in the Exposed Piping Schedule at the end of this Section. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 15, Mechanical.
- B. Markings and Identification:
 1. Pipe Markings:
 - a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
 - b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.
 2. Pipe Identification Markers and Arrows: Refer to Section 10400, Identification Devices.
- C. Appurtenances: Provide products that comply with:
 1. Section 15055, Pipe Hangers and Supports.
 2. Section 15120, Couplings, Adapters and Specials for Process Piping.
 3. Section 15121, Wall Pipes, Floor Pipes and Pipe Sleeves.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:

1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.
 2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from Engineer before proceeding.
 3. Provide pipe manufacturer's installation specialist at Site as specified on this Section.
- B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:
1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
 2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.
 3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.
 4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to Engineer.
- C. Piping Installation:
1. Conform to manufacturer's instructions and requirements of standards and manuals listed in this Section, as applicable:
 - a. Ductile Iron Pipe: ANSI/AWWA C600, AWWA M41.
 2. Install straight runs true to line and elevation.
 3. Install vertical pipe truly plumb in all directions.
 4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the Engineer.
 5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
 6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by Engineer provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.
 7. Protect and keep clean interiors, fittings, and valves of pipe that will convey potable water, chemicals, and other pipe designated by Engineer.
 8. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on

joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.

9. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by the Engineer.
10. Additional General Requirements for Thermoplastic Piping:
 - a. Utilize wide band supports as recommended by pipe manufacturer and approved by Engineer to minimize localized stresses.
 - b. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.
 - c. Provide anchored supports at elbows, valves, bends in piping, and at connections to equipment and tanks.
 - d. Spacing of supports shall be in accordance with the manufacturer's published recommendations at maximum design operating temperature of pipe.
 - e. Provide U-clamps with wide band circumferential contact.
 - f. Provide guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by pipe manufacturer.
 - g. Provide anchored supports to restrain joints that allow expansion. Minimize use of bellows style joints. Where required and approved by the Engineer provide bellows style joints with low axial force to take up pipe expansion. Flexible connectors may be used to absorb thermal movement when approved in writing by Engineer.

D. Jointing Pipe:

1. General:
 - a. Make joints in accordance with pipe manufacturer's recommendations and Contract Documents.
 - b. Cut piping accurately and squarely and install without forcing or springing.
 - c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
 - d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
2. Ductile Iron Mechanical Joint Pipe:
 - a. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
 - b. Lubricate plain end and gasket with soapy water or pipe manufacturer's recommended pipe lubricant, per ANSI/AWWA C111, just prior to slipping gasket onto plain end of joint assembly.
 - c. Place gland on plain end with lip extension toward plain end, followed by gasket with narrow edge of gasket toward the plain end.
 - d. Insert pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.

- e. Push gland toward socket and center it around pipe with the gland lip against the gasket.
- f. Insert bolts and hand tighten nuts.
- g. Deflect joint only after assembled when approved by Engineer.
- h. Make deflection after joint assembly, if approved by Engineer, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. Bolt torque shall be:

Pipe Diameter (inches)	Bolt Diameter (inches)	Range of Torque (ft-lbs)
3	5/8	45 to 60
4 to 24	3/4	75 to 90
30 to 36	1	100 to 120
42 to 48	1.25	120 to 150

- 3. Ductile Iron Flanged Joints:
 - a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised-face flanges. Use full-face gaskets for flat-face flanges, unless otherwise approved by Engineer or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
 - b. Tighten bolts in a sequence that provides equal distribution of bolt loads.
 - c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.
 - d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.
 - e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
 - f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with same coating specified in Section 09900, Painting, for material of pipe and fittings being joined.
- 4. Mechanical Coupling Joints:
 - a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings used.
 - b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with a wire brush to remove foreign matter.
 - c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to

installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.

- d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove the clamps from the coupling. Slide the coupling over the plain ends of the pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with a torque wrench to torque recommended by manufacturer.

E. Installing Valves and Accessories:

1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.
2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.
3. Position swing check valves and butterfly valves so that they do not conflict with upstream and downstream elements of the piping system.

F. Unions:

1. Install dielectric unions as specified in Section 15120, Couplings, Adapters and Specials for Process Piping, where dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
2. Provide a union downstream of each valve with screwed connections.
3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Transitions from One Type of Pipe to Another:

1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

H. Closures:

1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.2 THRUST RESTRAINT

- A. Provide thrust restraint on all pressure piping systems and where otherwise shown or specified.
- B. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Exposed Piping Schedule at end of this Section.

C. Restrained Pipe Joints:

1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
 - a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with a proprietary restrained joint system as specified in Section 15061. Ductile iron pipe, lugs, and tie rods, or other joint restraint systems approved by Engineer. Restrain ductile iron pipe connected by flexible couplings or flanged coupling adapters by harnessing across the coupling or adapter using tie rods or extended bolts connecting between flanges.

3.3 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:

1. Locations of existing piping shown on Drawings is approximate.
2. Determine the true location of existing piping to which connections are to be made, crossed, and that could be disturbed, and determine location of other facilities that could be affected by the Work.

B. Taking Existing Pipelines Out of Service:

1. Conform to Section 01700, Maintenance of Plant Operations.

C. Work on Existing Pipelines:

1. Cut or tap pipes as shown or required with machines and tools specifically designed for cutting or tapping pipelines.
2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
4. Conform to applicable requirements of Section 01700, Maintenance of Plant Operations and Section 01031, Additions, Modifications and Alterations to Existing Buildings.

3.4 PAINTING

- A. Field painting shall conform to Section 09900, Painting.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Installation Specialist:

1. Provide services of a competent installation specialist of the pipe manufacturer when pipe installation commences for:
 - a. Thermoplastic pipe.
2. Retain installation specialist at Site for a minimum of two days (eight hours per day at the Site) or until competency of the pipe installation crew has been satisfactorily demonstrated to Engineer.

B. Testing, General:

1. Test all piping, except as exempted in the Exposed Piping Schedule.
2. Notification:
 - a. Notify Engineer at least 48 hours prior to testing.
 - b. When authorities having jurisdiction are to witness tests, notify Engineer and authorities having jurisdiction in writing at least 48 hours in advance of testing.
3. Conduct all tests in presence of Engineer.
4. Remove or protect pipeline-mounted devices that could be damaged by testing.
5. Provide all apparatus and services required for testing, including:
 - a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain Owner's operations.
 - b. Temporary bulkheads, bracing, blocking, and thrust restraints.
6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
7. Unless otherwise specified, Owner will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into the pipe being tested. CONTRACTOR shall provide fluid for other types of testing required.
8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by CONTRACTOR and that fails the test shall be repaired upon authorization of Engineer or Owner. Repair of existing piping will be paid as extra work unless otherwise specified.

C. Test Schedule:

1. Refer to the Exposed Piping Schedule for type of test required and required test pressure.
2. Unless otherwise specified, the required test pressures are at lowest elevation of pipeline segment being tested.
3. For piping not listed in Exposed Piping Schedule:
 - a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires a separate test.
 - b. Disinfect for bacteriological testing piping that conveys potable water.
4. Test Pressure:
 - a. Use test pressures listed in Exposed Piping Schedule.
 - b. If test pressure is not listed in Exposed Piping Schedule, or if a test is required for piping not listed in the Exposed Piping Schedule, test pressure will be determined by the Engineer based on the maximum

anticipated sustained operating pressure and the methods described in the applicable ANSI/AWWA manual or standard that applies to the piping system.

D. Hydrostatic Testing:

1. Preparation for Testing:
 - a. For other piping follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined.
 - b. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.
2. Test Procedure:
 - a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.
 - b. Expel air from pipe as required. Obtain approval of Engineer prior to tapping pipe for expelling air.
 - c. Examine joints and valves, and make repairs to eliminate visible leakage.
 - d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
 - e. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.
 - f. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure.
 - g. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.
3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:
 - a. No Leakage: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
 - b. Rates based on formula or table in AWWA Manual M41:
 - 1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:
 - a) Bell and spigot and push-on joints.
 - b) Mechanical joints.
 - c) Bolted sleeve type couplings.
 - d) Grooved and shouldered couplings.
 - c. Rates based on formula or table in ANSI/AWWA C605:

1) Plastic pipe joined with O-ring gasket sealing members.

E. Examination of Welds:

1. Personnel performing examination of welds shall be qualified to at least Level II, in accordance with ASNT SNT-TC-1A.
2. Conform to ASME Boiler and Pressure Vessel Code Section V and applicable articles for examination of welds.
3. Visually examine all welds, Category D Fluid Service, in conformance with ASME B31.3.
4. Examine at least ten percent of welds using liquid penetrant examination.
5. If a defect is detected, all welds shall be examined by liquid penetrant examination.
6. At conclusion of liquid penetrant examination, remove penetrant test materials by flushing, washing, or wiping clean with applicable solvents.

3.6 CLEANING AND DISINFECTION

A. Cleaning, General: Clean pipe systems as follows:

1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by Engineer, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.
2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.
3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with a five percent hypochlorite solution.

B. Disinfection:

1. Disinfect all potable and finished water piping.
2. A suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by Engineer.
 - a. Prior to disinfection, clean piping as specified and flush thoroughly.
 - b. Conform to procedures described in ANSI/AWWA C651. Continuous feed method of disinfecting shall be used, unless alternative method is acceptable to Engineer.
3. Water for initial flushing, testing, and disinfection will be furnished by Owner. CONTRACTOR shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for re-disinfection will be paid by CONTRACTOR to Owner at the water utility's standard rates.
4. Chlorine shall be provided by CONTRACTOR.
5. Bacteriologic tests will be performed by Owner. A certified test laboratory report will be provided to CONTRACTOR, if requested.

6. Chlorine concentration in the water entering the piping shall be between 50 and 100 ppm, such that a minimum residual concentration of 25 mg/l remains after a 24-hour retention period. Disinfect the piping and all related components. Repeat as necessary to provide complete disinfection.
7. After required retention period, the chlorinated water shall be flushed to a closed drain line, unless otherwise directed by Engineer. Properly dispose of chlorinated water in accordance with applicable regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

3.7 EXPOSED PIPING SCHEDULE

- A. The schedules listed below, following the “End of Section” designation, are a part of this Specification section.
 1. Table 15052-A, Exposed Piping Schedule.

TABLE 15052-A, EXPOSED PIPING SCHEDULE

Service	Dia. (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test (psig)	Remarks
FM	6 to 24	DI	CL	P	Class 53	FLG	HYD (100)	Raw Sewage (Temporary Pump Station and Permanent Pump Station)
FOS	2	CS	none	none	Sch 40	Threaded	HYD (100)	Fuel Oil Supply Lines for Generator refer to spec 15592
CONT	4	PVC	none	none	Sch 40	Threaded	Air (15)	Secondary Containment for Fuel Oil Supply refer to spec 15592
Drain	4	CI	none	P		BS	HYD (10)	Valve pit drainage

The following abbreviations are used in the Exposed Piping Schedule:

A. Service Abbreviations:

Service	Abbrev.		Service	Abbrev.
Fuel Oil Supply	FOS		Secondary Containment	CONT

B. Material Abbreviations:

Material	Abbrev.		Material	Abbrev.
Ductile Iron	DI		Cast Iron	CI
Carbon Steel	CS		Polyvinyl Chloride Pipe	PVC

C. Lining/Coating Abbreviations:

Lining	Abbrev.		Coating	Abbrev.
Cement Mortar Lined	CL		Paint	P

D. Joint Abbreviations:

Joint Type	Abbrev.		Joint Type	Abbrev.
Flanged	FLG			

E. Test Abbreviations:

Test	Abbrev.		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ()		Air Test (test pressure in psig)	Air ()

++ END OF SECTION ++

SECTION 15055

PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to design, furnish, and install all hangers, supports and appurtenances necessary to complete the Work.
2. Materials for all hangers, guides and supports shall be as specified herein, unless otherwise shown on Drawings.
3. Contractor shall design all pipe hangers, supports, and appurtenances for small and medium diameter piping shown and specified.
 - a. Small and medium diameter piping shall be defined as pipe systems 24-inch diameter and smaller.
 - b. Pipe hangers, supports and appurtenances shall be in accordance with the requirements specified herein.
 - c. Where shown or indicated on the Drawings, Contractor shall locate or route small diameter piping (4-inch diameter or less) and supports to avoid conflicts with new and existing Work.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the pipe hangers and supports Work.

C. Related Sections:

1. Section 03300, Cast-In-Place Concrete.
2. Section 09900, Painting.
3. Section 15050, Vibration, Seismic and Wind Controls.
4. Section 15120, Couplers, Adapters, and Specials for Piping.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. ASTM A 575, Specification for Steel Bars Carbon, Merchant Quality, M-Grades.
2. FS A-A-1192, Federal Specification for Pipe Hangers.
3. MSS SP 58, Pipe Hangers and Supports-Materials, Design and Manufacture.
4. MSS SP 69, Pipe Hangers and Supports - Selection and Application.

1.3 QUALITY ASSURANCE

- A. Each type of pipe hanger or support shall be the product of one manufacturer.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single pipe hangers and supports manufacturer.
 - 2. The pipe hangers and supports equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pipe hangers and supports equipment manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Detailed drawings showing all hangers and supports for each piping system specified. Shop Drawings shall show location, installation, material, loads or forces, and deflection of all hangers and supports.
 - b. Each pipe system shall be analyzed for all loads and forces on the hangers and supports. Provide calculations of reaction forces to the structure to which they are fastened. Provide confirmation that hanger systems comply with support requirements and codes.
 - c. Submit and coordinate these with Shop Drawings required for all piping systems.
 - d. Shop drawings shall be signed and sealed by a registered Professional Engineer.
 - 2. Product Data:
 - a. Submit manufacturers' catalogs, literature, and engineering data on all hangers and supports. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP 58, MSS SP 69 and Federal Specification A-A-1192.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

2. Store materials in covered storage off the ground and prevent condensation.
- C. Acceptance at Site:
1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.
- D. Delivery, storage, and handling shall be in accordance with Section 01610, Transportation and Handling of Materials and Equipment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Hangers and supports shall meet with the following requirements:
1. Standard and fabricated hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
 2. Generally, run piping in groups where practicable and parallel to building wall. Provide minimum clearance of 1-inch between pipe and other work.
 3. Install hangers or supports at all locations where pipe changes direction.
 4. All hangers and supports shall be capable of adjustment after placement of piping.
 5. Different types of hangers or supports shall be kept to a minimum.
 6. All suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub.
 7. Support vertical piping at each floor and between floors by stays or braces to prevent rattling and vibration.
 8. Hanger rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
 9. Maximum support spacing unless otherwise shown or approved for standard weight steel pipe shall be as follows:

Pipe Size (inches)	Maximum Pipe Span ¹ (feet)			
	Steel	Copper	Plastic ²	Cast/Ductile Iron ⁴
3/8 to 3/4	5	6	Cont. ³	-
1	6	6	5	-
1-1/4	6	6	5	-
1-1/2	6	6	5	-
2	10	10	5	-
2-1/2	10	10	5	-
3	10	10	5	-

Pipe Size (inches)	Maximum Pipe Span ¹ (feet)			
	Steel	Copper	Plastic ²	Cast/Ductile Iron ⁴
4	12	12	5	12 feet for pressure pipe
6	12	12	5	
8	12	12	5	
10	12	-	5	
12	12	-	10	
14	12	-	-	
16	12	-	-	10 feet for soil pipe
18	12	-	-	
20	12	-	-	
24	12	-	-	

¹Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

²Span shown is for Schedule 80 CPVC pipe at 100°F. Spans for other plastics, other CPVC pipe Schedules and pipes at higher temperatures shall be shortened in accordance with the pipe manufacturer's recommendations.

³Continuous means pipe shall be in unistrut or similar channel.

⁴Pipe hanger and support selection shall be as shown and in this Section.

10. Maximum support spacing, unless otherwise shown for plastic pipe at ambient temperature, shall be one-half of the values specified for steel pipe.
11. Plastic pipe at temperature greater than 130°F shall be continuously supported in a metal cradle or tray.
12. Where proper hanger or support spacing does not correspond with joist or rib spacing, structural steel channels may be attached to joists or ribs and pipes suspended there from.
13. Prevent contact between dissimilar metals when supporting copper tubing, by use of copper plated, rubber or vinyl coated, or stainless steel hangers or supports.
14. Isolate thin walled stainless steel piping from carbon steel by use of plastic coated hangers or supports or by taping at points of contact with PVC or vinyl.
15. Supports and hangers shall be of a material that is compatible with the fluid being conveyed in such pipe being supported.
16. Anchors for pipe support systems shall be compatible or protected by a coating system which is compatible with the fluid being conveyed in such pipe being supported.

B. Expansion compensation shall be designed for individual exposed piping systems with the following Design Criteria:

1. $\Delta L = L \times \Delta T \times \alpha$, where:

- a. ΔL = pipe length change (inches).
 - b. L = pipe length between anchors (inches).
 - c. $\Delta T = 100$ ($^{\circ}\text{F}$).
 - d. α = coefficient of thermal expansion (inches/inches/ $^{\circ}\text{F}$).
2. Expansion compensation shall be designed as an integral part of the piping hanger, support and anchorage system.
 3. Expansion compensation shall be achieved via expansion joints specified in Section 15120, Couplers, Adapters, and Specials for Piping.

2.2 HANGERS AND SUPPORTS

- A. Hangers and supports where shown on the Drawings shall be in accordance with the details shown on the Drawings.
- B. Hangers and supports where not shown on the Drawings shall be designed by Contractor in accordance with the requirements of MSS SP 58, at a minimum.
- C. Materials:
 1. Unless otherwise shown on Drawings or specified herein, materials for all hangers, guides and supports shall be as follows:
 - a. Type 316 Stainless Steel for hangers, guides and supports located outdoors, submerged, or in corrosive environment.
 - b. Hot Dip Galvanized Steel for hangers, guides and supports located indoors or in pipe galleries.
 - c. Painted carbon steel for all outdoor odor control duct supports.
 - d. Corrosive areas are indicated on the General Code Criteria Drawings.
- D. Products and Manufacturers: Provide one of the following:
 1. Anvil International, Inc.
 2. Elcen.
 3. B-Line.
 4. Unistrut Corporation.
 5. Or equal.

2.3 ACCESSORIES

- A. Hanger rods shall be made from ASTM A 575, with square head nut on top and running thread on bottom end.
- B. Concrete Inserts:
 1. Concrete inserts shall be MSS SP 58 malleable Type 18.
 2. Manufacturers: Provide products of one of the following:
 - a. Unistrut Corporation, Wayne, Michigan.
 - b. Elcan Metal Products, Company, Franklin Park, Illinois.
 - c. B-Line.
 - d. Anvil International, Inc.

- e. Or equal.
- C. Steel Beam Clamps:
 - 1. Steel beam clamps shall be of malleable iron and conform to MSS SP 58 Type 28.
- D. Inserts for Pipe Insulation:
 - 1. Insulated pipe, larger than 1-1/2-inches in diameter, shall be supported by a rigid insert to protect the insulation. A steel metal saddle of sufficient gauge to carry the weight of the pipe and its fluid without deforming shall extend 2-inches minimum on each side of the rigid insert. The joints between insert and insulation shall be sealed before saddle is installed. Sizes up to 6-inches IPS shall be MSS SP 58, Type 40, and for sizes over 10-inches shall be MSS SP 58, Type 39.
- E. Brackets:
 - 1. Brackets for wall mounting shall conform to MSS SP 58 Type 32 or 33, as required.
- F. Pipe Roll:
 - 1. To provide for pipe expansion, pipe shall be supported on adjustable malleable or steel pipe rolls, Type 46.
- G. Fabricated Pipe Rack:
 - 1. Pipes shall be supported and anchored to the fabricated pipe rack as shown. Clamps, rollers, and supports for piping shall conform to the general requirements of MSS SP 69.

2.4 PAINTING

- A. Clean and prime ferrous metal surfaces in the shop in accordance with the requirements of Section 09900, Painting.
- B. Field painting shall conform to the requirements of Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.
- B. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

- C. Locate hanger, supports to prevent vibration or swaying and to provide for expansion and contraction.
1. Temperature differential specified in this Section.
 2. Support piping independently so that equipment is not stressed by piping weight or expansion.
 3. For Uninsulated Copper Pipe or Tubing: Clamps and supports, electroplated copper finish. Instrumentation tubing shall be supported in steel or aluminum troughs with covers. All tubing layout and connections shall be as approved by the manufacturer of the equipment.
 4. Uncoated Hangers, Rods and Supports: Dip in zinc chromate primer before installation.
 5. Maximum spacing for horizontal piping:
 - a. See Table specified in Paragraph 2.1.9.
 - b. Additional supports at:
 - 1) Change in direction.
 - 2) Branch piping and runouts over five feet.
 - 3) Concentrated loads due to valves, strainers or other similar items.
 6. Hanger types for horizontal piping, except as noted and shown:
 - a. Forged steel adjustable clevis type, rod support for all services.
 - b. Slide Bases:
 - 1) Pipe stand, brackets, trapeze or other equivalent structural support.
 - 2) For piping 2-inches or larger.
 - c. For pipe and covering provide:
 - 1) Saddles for rollers or slide bases.
 - 2) Protective shields or saddles for all other types of supports.
 - d. Threaded Steel Rods:
 - 1) Two inch vertical adjustment with two nuts each end for positioning and locking.
 - 2) Size hanger rods according to the schedule below, unless otherwise noted:

Nominal Pipe (Inches)	Rod Diameter (Inches)
2 and less	3/8
2-1/2 to 3-1/2	1/2
4	5/8
6	3/4
8 through 12	7/8
14 through 18	1
20 through 30	1-1/4

- 3) For Double Rod Hangers: One size smaller than above.
- 4) Connection to Structure for Piping to 2-Inches: Concrete inserts, or expansion shields in shear into sides of beams.
- 5) Connection to Structure for Piping 2-1/2-Inch or Larger: Concrete inserts, beam clamps or suitable bridging.

7. Vertical Piping:
 - a. Base Support: Base elbow or welded equivalent.
 - 1) Bearing plate on structural support.
 - b. Guides not to exceed:
 - 1) 25 feet for piping to 2-inches.
 - 2) 36 feet for piping 2-1/2-inches or larger.
 - c. Top Support:
 - 1) Special hanger or saddle in horizontal connection.
 - 2) Provisions for expansion.
 - d. Intermediate Supports: Steel pipe clamp at floor.
 - 1) Bolted and welded to pipe.
 - 2) Extension ends bearing on structural steel or bearing plates.
 - e. For Multiple Pipes: Coordinate guides, bearing plates and accessory steel.
8. Insulated Piping:
 - a. Horizontal Pipe Shields at Supports:
 - 1) Minimum 120 degree arc.
 - 2) Length equal to diameter of insulation 12-inch minimum.
 - 3) To 6-Inch Pipe Size: No. 18 USSG galvanized steel.
 - b. Vertical Pipe Shields at Guides:
 - 1) Full 360 degree arc, securely banded.
 - 2) Length equal to diameter of insulation, 12-inch minimum.
 - 3) To 6-Inch Pipe Size: No. 18 USSG galvanized steel.

- D. Install items to be embedded before concrete placement.
- E. Fasten embedded items securely to prevent movement during concrete placement.
- F. Install hangers and support units on piping systems in accordance with manufacturer's recommendations.
- G. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations.
- H. Bring all pipe systems up to operating pressures and temperatures. Cycle systems to duplicate operating conditions. Correct all support malfunctions.

+ + END OF SECTION + +

SECTION 15061

DUCTILE IRON PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
2. Extent of piping is shown on the Drawings. Piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:

1. Section 02200, Earthwork.
2. Section 09900, Painting.
3. Section 15051, Buried Piping Installation.
4. Section 15052, Exposed Piping Installation.
5. Section 15120, Couplers, Adapters, and Specials for Piping.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).
3. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
4. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
5. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
6. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
7. ASTM B117, Practice for Operating Salt Spray (Fog) Apparatus.
8. ASTM C283, Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
9. ASTM D714, Test Method for Evaluating Degree of Blistering of Paints.
10. ASTM D792, Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

11. ASTM D2000, Standard Classification System for Rubber Products in Automotive Applications.
12. ASTM D5162, Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates.
13. ASTM E96, Test Methods for Water Vapor Transmission of Materials.
14. ASTM G14, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
15. ASTM G95, Test Methods for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).
16. ANSI/AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
17. ANSI/AWWA C110, Ductile Iron and Gray Iron Fittings for Water.
18. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
19. ANSI/AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
20. ANSI/AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Service.
21. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
22. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
23. ANSI/AWWA C606, Grooved and Shouldered Type Joints.
24. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
25. NACE RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
26. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
27. NSF/ANSI 61, Drinking Water System Components - Health Effects.
28. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
29. SSPC Painting Manual, Volume 1, Para. XIV.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

- a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
- b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions, and shall be able to show evidence of at least five installations in satisfactory

operation in the United States that are similar applications to the specified service.

- c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.

B. Supply and Compatibility:

1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.

C. Regulatory Requirements:

1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation:

1. Shop Drawings:
 - a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.
2. Product Data:
 - a. Surface preparation and application reports and procedures as required for lining and coating of pipe and fittings. Ductile iron pipe and fitting manufacturer and manufacturer and applicator of lining and coating, as specified, shall mutually determine recommended surface preparation and application methods, and provide written verification of mutually selected method in the submittals.
3. Samples:
 - a. Submit Sample of pipe and fitting with each type of lining, for use at

the Site to verify continuity, surface gloss, and color, as applicable, via visual inspection.

4. Test Procedures: For linings and coatings in pipe and fittings.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.
 - b. Submit certificate signed by applicator of the linings and coatings stating that product to be applied conforms to applicable referenced standards and that the applicator shall conform to the Contract Documents.
2. Source Quality Control Submittals:
 - a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.
 - b. Lining and coating test coupons.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General:
 1. Piping systems shall be suitable for their intended use.
 2. Joints shall be as specified in Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by Engineer.
- B. Ductile Iron Pipe, Joints, and Fittings:
 1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
 - a. Pressure Rating: As specified in piping schedule in Section 15052, Exposed Pipe Installation. If not otherwise specified, use Special Thickness Class 53.
 2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
 - a. Pressure Class: As specified in piping schedules in Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation.

- b. Special Thickness Class: As specified in piping schedules in Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation.
- 3. Pipe Joints:
 - a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 15052, Exposed Pipe Installation.
 - 1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.
 - 2) Bolts: Comply with ANSI B18.2.1.
 - a) Exposed: ASTM A307, Grade B.
 - b) Buried or Submerged: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
 - 3) Nuts: Comply with ANSI B18.2.2.
 - a) Exposed: ASTM A563, Grade A, Heavy hex.
 - b) Buried or Submerged: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.
 - b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - 1) Glands: Ductile iron.
 - 2) Gaskets: Plain tip.
 - 3) Bolts and Nuts: High strength, low alloy steel.
 - 4) Manufacturers: Provide products of one of the following:
 - a) Clow Water Systems Company
 - b) Atlantic States Cast Iron Pipe Company
 - c) McWane Cast Iron Pipe Company
 - d) Griffin Pipe Products Co.
 - e) U.S. Pipe and Foundry Co.
 - f) Or equal.
 - c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - 1) Gaskets: Vulcanized SBR, unless otherwise specified.
 - 2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
 - 3) Products and Manufacturers: Provide one of the following:

- a) Tyton or Fastite Joint by Clow Water Systems, Atlantic States Cast Iron Pipe Company, Canada Pipe Company, Ltd., McWane Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, and Griffin Pipe Products Company.
 - b) Fastite Joint by American Cast Iron Pipe Company.
 - c) Tyton Joint by U.S. Pipe and Foundry Company.
 - d) Or equal.
 - 4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111.
 - a. Material: Ductile iron.
 - b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe.
 - 5. Mechanical Joint Fittings: Comply with ANSI/AWWA C153, ANSI/AWWA C110 and ANSI/AWWA C111.
 - a. Material: Ductile iron.
 - b. Glands: Ductile iron.
 - c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.
- C. Lining, General:
 - 1. Surface Preparation:
 - a. Initial Surface Inspection: Surface to be lined shall be inspected by pipe and fitting manufacturer and applicator, if applicator is other than pipe and fitting manufacturer. Inspecting parties shall inspect surface to be coated and mutually determine recommended surface preparation method.
 - b. Surface Preparation: Prepare surface in accordance with recommended method.
 - c. Finished Surface Inspection: Lining applicator shall inspect finished surface prior to application to determine acceptability. If surface is unacceptable, repeat surface preparation as necessary.
- D. Cement-mortar Lining:
 - 1. Where specified in piping schedules included with Section 15051, Buried Piping Installation and Section 15052, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.
- E. Couplings:
 - 1. Refer to Section 15120, Couplings, Adapters, and Specials for Process Piping.

F. Specials:

1. Transition Pieces:
 - a. Provide suitable transition pieces (adapters) for connecting to existing piping.
 - b. Unless otherwise shown or indicated, expose existing piping to determine material, dimensions, and other data required for transition pieces.
2. Taps:
 - a. Provide taps where shown or required for small-diameter piping or instrumentation connections.
 - b. Provide corporation stops where shown or required.
 - c. Where pipe wall thickness or tap diameter will not allow engagement of 5 full threads, provide tapping saddle with outlet joints conforming to requirements of Paragraph 2.1.B.3.a of this Section for four-inch through 12-inch diameter pipe, and Paragraph 2.1.B.3.b. for 14-inch through 54-inch diameter pipe.
 - d. For flanged connections on tapping saddle outlet branch, counterbore flange in accordance with MSS SP-60 dimensions. Inside diameter of outlet shall be 1/4-inch greater than nominal diameter.
3. Tangential Outlets:
 - a. Provide tangential outlet fittings where shown or indicated.
 - b. Weld-on fittings are acceptable.
 - c. Flanged and grooved end joints are not allowed.

G. Drain Piping – Cast Iron Soil Pipe and Fittings

1. Pipe and Fittings: ASTM A 74.
2. Weight: Service Weight.
3. Joints:
 - a. Compression:
 - 1) Gasket: Neoprene Rubber, ASTM C 564, CISPI HSN.
 - 2) Lubricant: As recommended by pipe manufacturer.
 - b. Calked:
 - 1) Lead: FS QQ C 40, Type I, Grade AA.
 - 2) Jute Packing: FS HH P 117, Type I.

2.2 MARKING FOR IDENTIFICATION

- A. In addition to identification markings specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
1. Name or trademark of manufacturer.
 2. Weight, class or nominal thickness, and casting period.
 3. Country where cast.
 4. Year the pipe was produced.
 5. Letters “DI” or “Ductile” shall be cast or metal stamped

- B. In addition to identification markings specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
 - 1. Flange manufacturer's mark, size, and letters "DI" cast or stamped on the flanges.
 - 2. Fabricator's mark if other than flange manufacturer.
 - 3. Length and weight.
- C. In addition to identification markings specified in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation, also stamp, mark, and identify fittings with:
 - 1. Manufacturer's identification.
 - 2. Pressure rating.
 - 3. Nominal diameters of openings.
 - 4. Country where cast.
 - 5. Number of degrees or fraction of the circle on bends.
 - 6. Letters "DI" or "Ductile" cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

- A. General Coating Requirements:
 - 1. Coating types are specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
- B. Exposed Pipe and Fittings:
 - 1. Surface Preparation:
 - a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
 - b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.
 - c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
 - 2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09900, Painting.
 - 3. Field painting shall comply with Section 09900, Painting.
- C. Buried Pipe and Fittings:
 - 1. Asphaltic Coating: Where specified in piping schedule in Section 15051, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.
- B. Visually inspect at the Site coated or lined pipe and fittings with Engineer and compare to approved Samples to verify lining continuity, surface gloss, and color, as applicable. Notify pipe manufacturer of damaged or unacceptable products. Pipe manufacturer shall visit the Site and perform testing to verify conformance with the Contract Documents to determine if products require replacement or repair. Repair or replace unacceptable products at no cost to Owner.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

- A. For buried piping installation and testing, refer to Section 15051, Buried Piping Installation.
- B. For exposed piping installation and testing, refer to Section 15052, Exposed Piping Installation.

++ END OF SECTION ++

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SECTION 15065

CONCRETE PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals shown, specified, and required to furnish and install reinforced concrete pressure pipe and pre-stressed concrete cylinder pressure pipe and fittings.
2. Extent of concrete pipe to be provided is shown and specified in piping schedules included in Section 15051, Buried Piping Installation.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before concrete pipe work.

C. Related Sections:

1. Section 15051, Buried Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO, Policy on Geometric Design of Highways and Streets.
2. ANSI/ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
3. ANSI/ASTM A82, Specification for Steel Wire, Plain for Concrete Reinforcement.
4. ANSI/ASTM A185, Specification for Steel Welded Wire Reinforcement, Plain for Concrete.
5. ANSI/ASTM A283/A283M, Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
6. ANSI/ASTM A496, Specification for Steel Wire, Deformed, for Concrete Reinforcement.
7. ANSI/ASTM A497/A497M, Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
8. ANSI/ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
9. ANSI/ASTM A663/A663M, Specification for Steel Bars, Carbon, Merchant Quality Mechanical Properties.
10. ANSI/ASTM A1011/1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

11. ANSI/ASTM A1018/1018M, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
12. ANSI/ASTM C14, Specification for Concrete Sewer, Storm Drain and Culvert Pipe.
13. ANSI/ASTM C33, Specification for Concrete Aggregates.
14. ANSI/ASTM C76, Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
15. ANSI/ASTM C150, Specification for Portland Cement.
16. ANSI/ASTM C595, Specification for Blended Hydraulic Cements.
17. ANSI/ASTM C1433, Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers.
18. ANSI/AWWA C207, Steel Pipe Flanges for Waterworks Service-Sizes 4-inch through 144-inches.
19. ANSI/AWWA C301, Prestressed Concrete Pressure Pipe, Steel Cylinder Type.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturer:
 - a. Manufacturer shall have a minimum of five years of experience producing concrete pipe and fittings, and shall be able to document satisfactory service in at least five installations.
- B. Component Supply and Compatibility:
 1. Each type of concrete pipe and associated fittings shall be products of one manufacturer.
 2. Concrete pipe Supplier shall review, approve, and prepare all Shop Drawings and submittals for all components furnished under this Section.
 3. Components shall be suitable for specified service conditions.
- C. Quality of materials, process of manufacture, and finished pipe shall be subject to inspection by Engineer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings:
 - a. Detailed drawings and data on piping and fittings, where applicable, and appurtenances. Submit with Shop Drawings required under Section 15051, Buried Piping Installation.
 2. Product Data:

- a. Detailed product data on pipe, fittings, gaskets, fastening hardware where applicable, and appurtenances. Submit with Shop Drawings required under Section 15051, Buried Piping Installation.
- B. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. Submit certificate signed by manufacturer of each product certifying that products conform to applicable referenced standards.
 - 2. Supplier Instructions:
 - a. Pipe manufacturer instructions for handling, storing, and installing products.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 15051, Buried Piping Installation.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. General:
 - 1. Pipe shall be designed for an external live loading, including impact, equal to AASHTO H-20 loading with earth cover as shown.
- B. Service Conditions:
 - 1. Internal Working Pressure: 12psig
 - 2. Internal Transient Pressure: 40 psi
 - 3. Internal Field Test Pressure: 15 psi
Refer to Section 15051, Table 15051-A, Buried Piping Schedule and Contract Drawings.
 - 4. pH Range of Pipe Contents: 5.0 to 9.0.

2.2 MATERIALS, CONCRETE PRESSURE PIPE

- A. Pipe and fittings shall conform to requirements of ANSI/AWWA C301. Pipe shall have the following features: welded steel cylinder with steel joint rings welded to its ends; steel cylinder encased in concrete, reinforcement consisting of high-tensile wire wound around outside of the core in one or more layers at a predetermined stress and securely fastened at its ends; coating of dense mortar or concrete covering the core and wire, except surfaces of joint rings; self-centering joint with watertight preformed rubber gasket. For embedded cylinder pipe at least one-third of total core thickness shall be outside of cylinder. Embedded cylinder pipe shall be used in sizes 54-inches and larger. For pipe 16-inch to 48-inch diameter, lined cylinder pipe may be used, with a core of concrete lining

inside of steel cylinder. Fittings shall be fabricated from welded steel sheet or plate, and be lined and coated with cement mortar.

B. Pipe Materials:

1. Cement for concrete work in accordance with ANSI/ASTM C150, Type I.
2. Aggregates for concrete work in accordance with ANSI/ASTM C33.
3. Steel for cylinders, joint and fittings in accordance with ANSI/ASTM A1011/1011M, ANSI/ASTM A1018/1018M or ANSI/ASTM A283/A283M.
4. Steel for reinforcing in accordance with ANSI/ASTM A663/A663M, Grade 80; ANSI/ASTM A615/A615M, Grade 40; or ANSI/ASTM A497/A497M.
5. Rubber for gaskets shall contain not less than 50 percent by volume of first-grade natural crude or first-grade synthetic rubber. Remainder of compound shall consist of pulverized fillers, free of rubber substitutes, reclaimed rubber, and other deleterious substances.

2.3 MATERIALS, REINFORCED CONCRETE PIPE FOR CULVERTS, STORM DRAINS, AND SEWERS

A. Pipe and fittings shall conform to requirements of ANSI/ASTM C76. Pipe shall be free of fractures and surface roughness. Ends of pipe shall be normal to the walls and center of pipe. Joints shall be designed so that, when sections are laid together, they make a continuous line of pipe with smooth interior free of irregularities in flow line.

B. Pipe Materials:

1. Cement for concrete work shall be in accordance with, ANSI/ASTM C150 or ANSI/ASTM C595.
2. Aggregates shall conform to ANSI/ASTM C33.
3. Steel wire bar reinforcement shall be in accordance with ANSI/ASTM A82 or ANSI/ASTM A496.
4. Steel wire fabric reinforcement shall be in accordance with ANSI/ASTM A185.

C. Pipe shall be Class V. Quality of materials, process of manufacture and finished pipe shall be subject to inspection and approval by Engineer.

2.4 MATERIALS, PRECAST REINFORCED CONCRETE BOX SECTIONS FOR CULVERTS, STORM DRAINS, AND SEWERS

A. Reinforced concrete box sections shall conform to requirements of ANSI/ASTM C1433. Box sections shall be type Table 2. Ends shall be male and female so that when sections are laid together they make a continuous line with smooth interior pipe free of irregularities in flow line.

B. Construction Materials:

1. Steel wire reinforcement shall be in accordance with, ANSI/ASTM A82 or ANSI/ASTM A496.
2. Steel wire fabric reinforcement shall be in accordance with ANSI/ASTM A185 or ANSI/ASTM A497/A497M.
3. Cement for concrete work shall be in accordance with, ANSI/ASTM C150.
4. Aggregates shall conform to ANSI/ASTM C33.

2.5 PIPE CLOSURES

- A. Pipe layout submitted by Supplier shall reflect Contractor's planned schedule for operations and the Progress Schedule. Pipe closures shall be designed by pipe manufacturer for pressure required and shall be located in straight runs of pipe. Number, design, and location of closure pieces shall be as shown or subject to approval of Engineer.
- B. Contractor may either cut closure cylinder to required length in field or, if time allows, have pipe manufacturer supply required length based on exact field measurements.
- C. Extra payment will not be made for closures. Extra compensation will not be paid for concrete required for protecting cylinder and joint rings.

2.6 WALL FITTINGS

- A. Unless otherwise shown on the Drawings connect to structures by casting a fabricated bell wall fitting into concrete. Fabricated bell wall fitting shall consist of a bell ring suitable for connecting to steel spigot, steel pipe section, and waterstop ring, all welded together to form a complete unit, with a laying length equal to width of wall in which it is installed. For restrained joints, provide additional length to accommodate bell-bolt, harnessed clamp, or snap ring connection. Fitting shall have a welded fabric or wire mesh reinforced mortar lining furnished to interior diameter of connecting pipeline.
- B. Connect flanged piping to special fabricated flange wall fittings where shown. Fabricated flange wall fitting shall consist of a steel flange, steel pipe section, waterstop ring, and a bell ring suitable for connecting steel spigot to be provided, all welded together to form a complete unit, with a laying length equal to width of wall in which it is installed. Fitting shall have a welded fabric or wire-mesh reinforced mortar lining finished to interior diameter of connecting pipe. Flange shall be stress-relieved after welding to steel pipe section and then machined. Drill and tap flange to receive stud bolts. Flange shall conform to AWWA C207 for steel flanges, Class D, with ANSI B16.1, Class 125 drilling.

2.7 MARKING FOR IDENTIFICATION

- A. All pipeline materials shall be stamped, marked, or identified with the following information:
1. Name or trademark of manufacturer.
 2. Pipe class and specification designation.
 3. Size and length dimensions.
 4. Date and place of manufacture.
 5. Pipe 24-inches and larger shall also be marked on pipe interior as above.
 6. Name of Owner.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. For buried piping installation, refer to Section 15051, Buried Piping Installation.

+ + END OF SECTION + +

SECTION 15066
STEEL AND STAINLESS STEEL PIPE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for providing steel and stainless steel pipe and cast, forged and fabricated steel fittings, stainless steel fittings, flanges, unions and couplings, complete with coating, wrapping, lining, insulation, and painting.
- B. The following index of this Specification is presented for convenience:

Article	Title	Page
Part 1	General.....	15066-1
1.01	Section Includes	15066-1
1.02	Related Specifications.....	15066-2
1.03	Payment.....	15066-2
1.04	References.....	15066-2
1.05	Design Requirements	15066-4
1.06	Submittals	15066-4
1.07	Quality Assurance.....	15066-5
1.08	Delivery, Storage And Handling.....	15066-5
Part 2	Products.....	15066-6
2.01	Steel Pipe	15066-6
2.02	Steel Fittings	15066-6
2.03	Flanges And Flanged Joints	15066-8
2.04	Couplings	15066-8
2.05	Expansion Joints	15066-9
2.06	Wall Sleeves.....	15066-9
2.07	Coatings And Linings	15066-9
2.08	Stainless Steel Tubing And Fittings.....	15066-10
2.09	Double Containment Pipe	15066-10
Part 3	Execution	15066-12
3.01	Installation.....	15066-12
3.02	Cleaning.....	15066-14
3.03	Testing.....	15066-14
3.04	Painting	15066-15
3.05	Schedules	15066-15

1.02 RELATED SPECIFICATIONS

- A. Specification 09900 - Painting.
- B. Specification 15052 - Exposed Piping Installation.
- C. Specification 15055 - Pipe Hangers and Supports.
- D. Specification 15061 - Ductile Iron Pipe.

1.03 PAYMENT

- A. Payment for work furnished and installed under this Section shall be included in the lump sum price bid for the Contract, as described in Section 01150 – Measurement and Payment.
- B. No separate payment will be made for painting, coating, wrapping, insulation, lining and testing, gaskets, bolts, nuts and other appurtenances and material required to assemble the lines; the cost thereof shall be included in the prices bid for the pipe.

1.04 REFERENCES

- A. AWWA C207 - Steel Pipe Flanges for Waterworks Service - Size 4 In. Through 144 In.
- B. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
- C. AWWA M11 - Steel Pipe - A Guide for Design and Installation.
- D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- E. ASTM A105/A105M - Forgings, Carbon Steel, for Piping Components.
- F. ASTM A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- G. ASTM A139 - Electric-Fusion (ARC)-Welded Steel Pipe (NPS4 and Over).
- H. ASTM A193/A193M - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- I. ASTM A197 - Cupola Malleable Iron.
- J. ASTM A240 - Heat-Resisting Chromium and Chromium Nickel Stainless Steel plate, Sheet and Strip for Pressure Vessels.
- K. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

L.	ASTM A276	-	Stainless and Heat-Resisting Steel Bars and Shapes.
M.	ASTM A283/A283M	-	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars.
N.	ASTM A307	-	Carbon Steel Bolts and Studs, 50,000 psi Tensile.
O.	ASTM A312/A312M	-	Seamless and Welded Austenitic Stainless Steel Pipes.
P.	ASTM A380	-	Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems.
Q.	ASTM A403/A403M	-	Wrought Austenitic Stainless Steel Piping Fittings.
R.	ASTM A530	-	General Requirements for Specialized Carbon and Alloy Steel Pipe.
S.	ASTM A536	-	Ductile-Iron Castings.
T.	ASTM A774	-	As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
U.	ASTM A778	-	Welded, Unannealed Austenitic Stainless Tubular Products.
V.	ASTM B98	-	Copper Silicon Alloy Rod, Bar, and Shapes.
W.	ASTM F491	-	Specification for Poly (Vinylidene Fluoride) (PVDF) Plastic-Lined Ferrous Metal Pipe and Fittings.
X.	ASTM F492	-	Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
Y.	ASME B1.1	-	Unified Inch Screw Threads (UN and UNR Thread Form).
Z.	ASME B16.1	-	Cast Iron Flanges and Flanged Fittings, Class 25, 125, 250, 800.
AA.	ASME B16.3	-	Malleable-Iron Screwed Fittings, 125 and 250 lb.
BB.	ASME B16.4	-	Cast Iron Threaded Fittings.
CC.	ASME B16.5	-	Pipe Flanges and Flanged Fittings, with Appendices.
DD.	ASME B16.9	-	Wrought-Steel Butt Welding Fittings.
EE.	ASME B16.11	-	Forged Steel Fittings, Socket-Welding and Threaded.
FF.	ASME B16.21	-	Non-Metallic Gaskets for Pipe Flanges.

- GG. ASME B18.2.1 - Square and Hex Bolts and Screws.
- HH. ASME B31.1 - Power Piping.
- II. ASME B36.19M - Stainless Steel Pipe.
- JJ. National Sanitation Foundation (NSF) - 61 - Drinking Water System Components - Health Effects.

1.05 DESIGN REQUIREMENTS

- A. In general, pipes shall conform to the applicable provisions of the Code for Pressure Piping, ASME B31.1 and its Supplements and specifically to Chapters 2, 4, and 5 of Section 6 - Fabrication Details except for plumbing and low pressure (15 psig maximum) heating lines.
- B. Pipe and fittings shall conform to the New York State Building Code in respect to plumbing and other applications covered by these codes.
- C. Only NSF61-approved materials shall be used in potable water lines.

1.06 SUBMITTALS

- A. The Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions and Section 01300 - Submittals. Working drawings and shop drawings shall include, but not be limited to:
 1. Flanged, screwed, welding and mechanical coupling fittings and pipe, couplings, harnessing and special fittings. When special designs or fittings are required, the work shall be shown in large detail and the special or fitting completely described and dimensioned.
 2. Fully dimensioned layout of pipe, fittings, couplings, sleeves, expansion joints, supports, anchors, harnessing, valves, and equipment. Pipe size, type and materials shall be labeled on the drawing and the schedule included.
 3. Cross sections showing elevation of pipe, fittings, sleeves, couplings, supports, anchors, harnessing, valves, and equipment.
 4. Schedules of pipe, fittings, and valves; such schedules shall indicate the material and schedule number of thickness of all pipe, the material and class of all fittings, and the rating and description of all valves.
 5. Details of pipe coating, wrapping, lining, insulation, and painting.
 6. Expansion joints, flexible piping, and flexible couplings with harness details where such harnesses are specified or where required, for a complete working installation.
 7. Locations where pipe and valve identification signs will be placed.
 8. Catalog data for pipe, couplings, harnessing and fittings.

9. Other piping appurtenances.
- B. Quality Control: Submit the following certifications:
 1. Certificate of compliance for pipe, fittings, couplings, sleeves, cleanouts, and harnessing.
 2. Certificate from an independent testing laboratory, approved by the County, for each welder assigned to the welding of pipe, fittings, and pipeline equipment.

1.07 QUALITY ASSURANCE

- A. The pipe and fittings covered by these Specifications shall be provided by the Contractor through qualified manufacturers experienced in the fabrication and manufacture of the pipe materials specified herein. The pipe and fittings shall be designed, fabricated, and installed in accordance with the standards specified.
- B. Certified welders, having current certificates conforming to the requirements of the ASME code, shall be utilized to perform all welding on steel pipes. Welders shall be qualified under the requirements of Section IX Welding Qualifications of the ASME Boiler and Pressure Vessel Code.
- C. The manufacturer's name or trademark, the year of manufacture, and the ASTM or API specification number shall be rolled or permanently inscribed on the pipe surface at the manufacturer's plant. As an alternate, the manufacturer's name or trademark, year of manufacture, and ASTM or API specification number may be stenciled on the pipe surface. Pipe 1-1/2 inches and less in nominal diameter shall be bundled and tagged.
- D. Pipe and fittings manufactured outside of the continental United States must meet all the requirements of the latest ASTM standards referred to hereinbefore and, unless waived in writing by the County, shall undergo physical tests and chemical analyses to prove compliance therewith. Such tests and analyses shall be performed by an independent testing laboratory approved by the County. If the testing laboratory is located outside the United States, then the Contractor shall pay all costs for two County personnel to witness such tests. The test samples shall be selected and tested in conformance with ASTM requirements. The County may at its discretion visit the test facility and witness the tests. The cost of all physical tests and chemical analyses shall be borne by the Contractor.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Pipe, fittings, and couplings shall be delivered, stored and handled in accordance with Division 1, General Requirements and as follows.
- B. When required for maintaining its circular shape and preventing distortion, each length of pipe shall be temporarily braced with an approved type of internal spider in each end of the pipe during erection.
- C. Handling Coated Pipe:

1. Coated pipe shall be protected at all times and handled with equipment designed to prevent damage to the coating, such as stout wide canvas slings and wide padded skids. The use of bare chains, cables, hooks, metal bars or narrow skids in contact with the coating will not be permitted. All pipe handling and hauling equipment shall meet the approval of the Engineer before use. Ample provision shall be made for the prompt and efficient repair of all abrasions and injuries. Care shall be exercised in laying and cradling the pipe to prevent injury to the coating.
2. When shipped by rail, pipes shall be loaded on properly padded saddles not less than six inches in width. Pipes shall be separated so that they do not bear against each other, and the whole load shall be securely fastened together and to the cars to prevent movement in transit.
3. All pipe coating injured in any way during transit or laying shall be satisfactorily repaired prior to placing the backfill.

PART 2 PRODUCTS

2.01 STEEL PIPE

- A. Dimensions for steel pipe shall be in accordance with ASME B36.10M and as specified herein.

Pipe Diameter (in.)	Schedule/Thickness	Standard
Up to and Including 12	Refer to section 15052	ASTM A53

2.02 STEEL FITTINGS

- A. Fittings shall be manufactured to standard dimensions, suitable for the pressures specified. Fittings shall be provided of the same or heavier wall thickness as the pipe of which they are a part. Strength, physical and chemical requirements, shall meet or exceed the requirements specified for the pipe.
- B. Fittings used in diesel fuel pipelines 2-inch diameter or smaller shall be of the socket weld type, except as shown or specified otherwise.
- C. Fittings used in pipelines 2-1/2-inch diameter or larger shall be of the seamless steel welded type or flanged type, except as shown or specified otherwise.
- D. Unions: Welded unions shall be used on all steel pipelines 2-inch diameter and smaller.
 1. An adequate number of unions of the welded or flanged type shall be provided in each main pipe and each branch to facilitate the dismantling or removal of any branch line or any part thereof or the section of the main pipe to which it connects, without disturbing adjacent branch lines or their related main pipeline.

E. Screwed Fittings:

1. Screwed fittings 2-inches and smaller shall be malleable iron flat band fittings, ASME B16.3, 125 pounds. For high pressure service, conform to ASME B16.3, 250 lbs. Malleable iron shall conform to the requirements of ASTM A197.
2. Where shown or specified, screwed end fittings of cast iron, conforming to the requirements of ASME B16.4, 125-pound standards for general service and 250-pound for high pressure service shall be provided. Cast iron shall meet the requirements of ASTM A126.
3. All threads shall be clean cut and smooth conforming to the American Standard for Pipe Threads, ASME B1.1. Fittings shall be with right and/or left hand threads as required.
4. Unions and railroad unions and union elbows and tees shall be malleable iron fitted with brass to iron seats unless otherwise specified.

F. Socket Welding Fittings:

1. Where shown or specified, steel socket welding fittings shall be provided on 2 inches and smaller services for diesel oil or where otherwise shown. Steel socket fittings shall conform to the requirements of ASME B16.11 with steel conforming to ASTM A105/A105M, Grade 2. Fittings shall be rated at 2000 pounds (minimum).
2. Socket welding fittings shall be welded in conformity with the applicable provisions of the Code for Pressure Piping, ASME B31.1.

G. Butt Welding Fittings:

1. Butt welding fittings shall meet the requirements of ASME B16.9.
2. Outlets for welded connections that are made with welded half coupling shall be of the butt welding type.
3. Outlets for threaded connections shall be made with threaded half couplings.

H. Flanged Fittings

1. Where shown on the Contract Drawings or where specified, cast iron or steel flanged fittings shall be provided.
2. Cast iron flanged fittings for general service shall conform to the requirements of ASME B16.1.
3. Steel flanged fittings shall utilize forged steel slip-on flanges. Fittings shall be Class 125 and Class 250 fittings conforming to the requirements of ASME B16.5, 150 pound or 300 pound, respectively, as specified, except flanges that are plain faced shall be provided. Provide Class 125 fittings conforming to AWWA C207, Class B.

4. Cast steel flanged fittings shall be assembled with forged steel flanges of the same pressure rating, conforming to the requirements of ASME B16.5.

2.03 FLANGES AND FLANGED JOINTS

- A. Flanges: Unless otherwise shown, all flanges for steel pipe, except blind flanges shall be of the slip-on welding type with hubs meeting the requirements of ASME B16.5.
 1. Slip-on flanges shall be welded to the steel pipe at the hub and at the pipe end in conformity with the Code for Pressure Piping, ASME B31.1, Section 6.
 2. Plain faced blind flanges in accordance with ASME B16.5 shall be provided.
 3. Steel 150 pound welding flanges shall be used for assembly with Class 125 cast iron flanged fittings, steel 300 pound flanges with Class 250 cast iron flanged fittings.
- B. Flanged Joints: Flanged joints shall be made with bolts and a nuts.
 1. Bolts and nuts shall meet the requirements of ASTM A307 Grade B. Bolts shall conform to the dimensional requirements of ASME B18.2.1 with rolled threads conforming to ASME B1.1, Coarse Series, Class 2 fit. Bolts and nuts shall be of American Standard heavy unfinished hexagonal type.
 2. Bolts shall be provided with a 1/4-inch projection beyond the nut when joint with gasket is assembled.
- C. Gaskets: Full face gaskets shall be provided for pipe sizes 12 inches in diameter and smaller with dimensions in conformity with the requirements of ASME B16.21, unless specified otherwise. Gaskets shall be as thin as the finish and accuracy of the surfaces will permit.
 1. Gasket material which is provided shall be specifically recommended for the service by the gasket manufacturer and as approved by the Engineer.

2.04 COUPLINGS

- A. Where shown on the Contract Drawings, specified in the Specifications or required for the convenience of installation, pipe couplings conforming to the requirements of Specification 15120 - Couplings, Adapters, and Specials for Piping shall be furnished and installed.
- B. Harnessed sleeve-type couplings shall be used close to the connecting point for pipe connections to pumps and other equipment handling fluids or gases under 200 °F susceptible to damage or binding due to pipe strain unless other types of flexible connections are shown or specified.
- C. Where pipelines pass from a concrete structure into earth, flexible couplings shall be installed at the face of the structure and at a point about four feet from the structure to protect the pipe against damage by displacement or settling.

2.05 EXPANSION JOINTS

- A. Where shown on the Contract Drawings, specified, or required, the Contractor shall provide internally guided, packed sleeve type expansion joints, in which the traverse slip section functions correctly without leakage at the maximum estimated expanded position at full operating pressure.
- B. Unless specified otherwise, on pipes 3 inches nominal diameter and smaller, expansion joints with screwed ends, of all bronze or brass construction shall be provided.
- C. On pipelines 4 inches and larger, expansion joints with ANSI Class 125 flanged ends, cast semi-steel bodies and brass sleeves shall be provided.
- D. Ample space shall be provided for packing, with packing material suitable for the service and pressure specified. Where specified or shown, integrally cast anchor bases suitable for anchor bolting shall be provided.
- E. Expansion joints shall be installed so that the traverse can move only in a direction parallel to its center line in conformity with the requirements of the Code for Pressure Piping, ASME B31.1, Paragraph 612.

2.06 WALL SLEEVES

- A. Suitable steel pipe sleeves shall be provided at all points where pipes pass through the walls or floors of structures, and where wall castings are not provided.
- B. Steel sleeves smaller than 12 inches in diameter shall be provided not less than Schedule 40. Steel sleeves shall be provided with an intermediate collar located at the center of the wall. The O.D. of the collar shall be four inches greater than the O.D. of the sleeve, fabricated from steel plate with a minimum thickness equal to the sleeve thickness and double welded to the sleeve.
- C. Modular mechanical-type seals consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall sleeve shall be provided. The elastomeric element shall be of the size, quantity, type and material that the manufacturer recommends for the intended service and that will provide an effective hydrostatic seal.

2.07 COATINGS AND LININGS

- A. General: Carbon steel pipes shall be lined and coated in accordance with the piping schedule included in Specifications Section 15052.
 - 1. All bolts, nuts, couplings and the like shall be coated after the joint has been made.
 - 2. Painting shall be in accordance with Specification 09900.
 - 3. Pipe and fittings that are to be encased in concrete shall not be painted.

4. Caps, plugs, sleeves and valve box castings shall receive a liquid epoxy coating as specified section 09900 - Painting
- B. Galvanizing: Galvanizing shall be provided in accordance with ASTM A53 where shown or specified.

2.08 STAINLESS STEEL TUBING AND FITTINGS

- A. Type 316L stainless steel, seamless tubing shall be in accordance with ASTM A269 for pipe sizes less than 1-1/2 inches.
- B. Wall Thickness:
 1. Tubing shall be as follows:

Nominal Size (Inches)	Rating (psi)	Wall Thickness (Inches)
1/4	3000	0.035
3/8	2500	0.035
1/2	2500	0.049
5/8	2500	0.049
3/4	2500	0.065
1	2000	0.065

- C. Type 316 stainless steel, flareless tube fittings in conformity with ASTM A276 shall be provided.
- D. Dielectric insulating joints or fittings shall be provided at connections between exterior piping and interior piping.
- E. All stainless steel tubing shall be precleaned, pickled and passivated after fabrication in accordance with the applicable sections of ASTM A380, except where otherwise specified in the Specification.

2.09 DOUBLE CONTAINMENT PIPE

- A. Pipe:

All straight sections, fittings and other accessories shall be factory prefabricated to job dimensions and designed to minimize the number of field connections. The containment shall be drainable and air pressure testable. The double containment pipe shall be as manufactured by OmegaFlex, Perma-Pipe, Rovanco or approved equal.

1. All fuel oil supply to the generator shall be double-pipe containment type. The outer containment pipe shall extent from the generator belly tank down to the remote filling station.

B. Carrier Pipe:

1. Inner carrier pipe shall be carbon steel and comply with the requirements specified herein. All joints shall be socket welded for pipe sizes 2 inches and below and butt welded for sizes above 2 inches.

2. Fittings:

Carbon steel pipe fittings shall be as follows:

- a. Socket welded fittings 2,000 lb. rating for nominal pipe size 2 inches and smaller.
- b. Butt weld fittings for nominal pipe size 2-1/2-inches and larger.

C. Containment Pipe:

1. The outer secondary containment conduit shall be a multilayered composite fiberglass reinforced thermosetting resin pipe comprised of a 2-part corrosion barrier not less than 45 mils thick and a filament wound structural wall. The glass to resin ratio for the inner surface, corrosion barrier and structural wall shall not be greater than 20:80, 30:70, and 70:30, respectively.
2. The outer layer shall contain .2 to .3% by weight of ultraviolet inhibitors for protection of section installed outdoor.
3. Structural Wall:
 - a. The structural wall of the filament wound secondary containment conduit shall have the following minimum properties:

<u>ASTM Test</u>	<u>Value Strength</u>
Hoop D1599	40,000 psi
Axial Compression D695	18,000 psi
Axial Tension D2105	20,000 psi

Flexural D790

20,000 psi

Modulus of Elasticity

Hoop

D638 3.0×10^6 psi

Axial

D2105 1.5×10^6 psi

Flexural

D790 1.5×10^6 psi

- b. Wall thickness shall be 150 mils for sizes 14 inches and below.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Pipe and fittings in accordance with the manufacturer's recommendations and approved shop drawings.
- B. Welding of Pipe and Fittings:
1. No field welding of stainless steel will be permitted.
 2. Welding of steel butt-welding fittings, steel fabricated fittings and steel pipe shall be in strict conformity with the Code for Pressure Piping, ASME B31.1, Section 6 and its Supplements. Certificates of qualification of current issue, conforming to the requirements of the Code, shall be submitted to the Engineer before proceeding with any pipe welding.
 3. Backing rings shall be used for all pipe welding butt joints unless otherwise specified. Backing rings shall be of carbon steel with spacer nubs that strike-off or melt with the weld.
- C. Expansion:
1. Ample provisions for flexibility in all pipelines shall be made to compensate for expansion.
 2. Adequate expansion devices shall be provided to allow the lines to expand and contract freely without damage to any part of the piping system.
 - a. Expansion devices in the form of expansion joints, expansion couplings, swivel or swing joints or pipe bends, including such anchors as may be shown, specified or required to make the devices effective shall be provided.
 - b. If expansion devices are not required, all runs of pipe subject to expansion shall be fabricated shorter than their theoretical length to the

extent that there is freedom to expand without increasing the stresses imposed when cold.

3. Swing Joints:

- a. On pipelines 2 inches or less, rated at water working pressures up to 150 psi, screwed end swing or swivel joints may be used; otherwise expansion shall be taken up with nipples and fittings as required.
- b. A sufficient number of fittings and pipe lengths in connection with swing joints shall be provided to assure the absence of distortion of either the pipelines or branches. Branch tees from the risers shall be located so that when the branch lines therefrom expand by heat, the branches will continue to drain properly.

D. Erecting Uncoated Pipes:

1. Uncoated pipe shall be erected in accordance with the best piping practice with a minimum exposure to the elements and to other corrosive conditions.
2. Before erection, all uncoated pipes shall be placed on end and hammered to remove scale and loose particles.
3. Screwed end pipe: Pipe ends shall be reamed after pipe is cut to final length. Threads shall be cleanly cut to the dimensions of the American Standard for Pipe Threads, ASME B1.1. All burrs, dirt and foreign matter shall be removed and an application of pipe compound given to the threads of both pipe and fittings before assembly. Compound shall be eliminated at the inside of the joint. Once a joint has been tightened, it shall not be backed off unless all threads are re-cleaned and new compound applied.
4. Pipe compounds: For general service use an approved mastic metallic compound, Teflon tape, or approved equal shall be used. On oil lines, an approved compound resistant to oil shall be used. For potable water lines a NSF61 approved pipe compound shall be used.
5. All piping shall be erected to accurate lines and grades, permanently supported as shown, specified or required. Where temporary supports are used during construction, sufficient strength and rigidity shall be provided to prevent shifting or distortion of the pipe.
6. Expansion couplings shall be adjusted after installation so that the pipelines will be fluid-tight through the full range of operating conditions.

E. Venting. All pipelines for liquids shall be provided with adequately sized, approved, air or gas vent valves at all high points in the lines, even though such vent valves may not be shown on the Contract Drawings and/or approved shop drawings.

1. Where vent valves are so located that liquids discharged therefrom would cause damage to structure or equipment, the vent valve shall be piped to the nearest gutter or drain in an approved manner.
- F. Drainage:
1. Pipelines for air, gas or steam shall be provided with approved means for condensate drainage even though such means may not be shown on the Contract Drawings and/or approved shop drawings. Drainage from gas lines shall be provided through an approved, double valved, manually operated condensate trap or as otherwise shown.
 2. An approved means for draining low points in all liquid system pipes shall be provided whether or not such drainage systems are shown on the Contract Drawings and/or approved shop drawings.
- G. Hangers and Supports: All pipelines shall be permanently erected with supporting devices furnished and installed in conformity with requirements of Specifications 15055 - Pipe Hangers and Supports and the applicable provisions of the Code for Pressure Piping, ASME B31.1, Section 6.
- H. Connection of Cast Iron Bell and Spigot Pipe to Steel Pipe: Where connection is required between steel and cast iron pipe, a sleeve-type transition coupling meeting the requirements of Specification 15120 - Couplings, Adapters, and Specials for Piping shall be provided.
- I. Insulation: Where shown or specified, insulation shall be provided in conformity with the Detailed Specification for pipes and fittings that are exposed to atmosphere after installation.
- J. Reducing Fittings: Ample fittings shall be used for all changes in pipe size. Bushings shall not be used.
- K. Pipe Identifications Signs: Where shown or specified, pipe identification signs shall be furnished and installed in conformity with Specification 15076 - Piping and Equipment Identification.
- 3.02 CLEANING
- A. During construction, all piping shall be thoroughly cleaned before placement and the lines kept free from foreign matter of whatever origin. The pipes shall be left thoroughly clean to the satisfaction of the Engineer.
- 3.03 TESTING
- A. All pipes shall be flushed clean and tested after installation.
- B. Pipes shall be tested for leaks and repaired as required in accordance with Specification 02505 - Leakage Tests.
- C. Pressure test shall be as specified in the Detailed Specifications.

3.04 PAINTING

- A. Where shown, specified or required, pipes shall be painted in conformity with the requirements of Specification 09900 - Painting.

3.05 SCHEDULES

- A. Schedules of the piping that is to be constructed using the pipe materials and methods specified herein are contained in Specification 15052.

+ + END OF SECTION + +

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SECTION 15067

THERMOPLASTIC PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install thermoplastic piping and fittings.
2. Extent of piping is shown and shall be in accordance with piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before thermoplastic piping Work.

C. Related Sections:

1. Section 15051, Buried Piping Installation.
2. Section 15052, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. AASHTO, Standard Specifications for Highway Bridges.
2. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
3. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
4. ASTM D2464, Specification for Threaded Poly (Vinyl Chlorinated) (PVC) Plastic Pipe Fittings, Schedule 80.
5. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
6. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
7. ASTM F437, Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
8. ASTM F439, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
9. ASTM F441/F441M, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

10. ASTM F656, Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
11. NSF 14, Plastic Piping Systems Components and Related Material.
12. ANSI/NSF 61, Drinking Water System Components - Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have a minimum of five years experience producing thermoplastic pipe and fittings substantively similar to the materials specified, and shall be able to submit documentation of satisfactory service in at least five completed installations in operation for at least five years each.
2. Installer:
 - a. Engage a single pipe installer who shall be responsible for all thermoplastic pipe Work, and who shall employ only tradesmen with specific skills and experience in the type of Work required.
 - b. Installer shall have a minimum of five years experience installing thermoplastic pipe and fittings substantively similar to the materials specified and substantively similar to or larger than the scope of thermoplastic piping Work on the Project, and shall be able to submit documentation of satisfactory experience in at least five completed installations in operation for at least five years each.

B. Component Supply and Compatibility:

1. Obtain all materials included in this Section, regardless of component Supplier, from a single thermoplastic pipe Supplier. All pipe of each material type shall be furnished by the same manufacturer.
2. Thermoplastic pipe Supplier shall review and approve to prepare all Shop Drawings and other submittals for all materials furnished under this Section.
3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by thermoplastic pipe Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Submit piping layout Shop Drawings in accordance with Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
2. Product Data:
 - a. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Submit manufacturer's certificate of compliance standards referenced in this Section.
2. Source Quality Control Submittals:
 - a. When requested by Engineer, submit results of source quality control tests.
3. Qualifications Statements:
 - a. Submit qualifications of manufacturer when requested by Engineer.
 - b. Submit qualifications of installer when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 SERVICE CONDITIONS

A. General:

1. Pipe materials shall be suitable for services intended. Refer to piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
3. Comply with NSF 14.
4. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated on the Drawings.
5. Pipe, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in ANSI/NSF 61 as being suitable for contact with potable water, and shall comply with requirements of the authorities having jurisdiction at the Site.

2.2 POLYVINYL CHLORIDE (PVC) PIPING

- A. PVC Pipe – General Applications: Unless otherwise shown or indicated, PVC pipe shall comply with the following:
 1. Manufacturers: Provide products of one of the following:
 - a. Ipex, Inc.
 - b. Spears Manufacturing Company.
 - c. Or equal.
 2. Material: Unless otherwise specified, comply with the following:
 - a. Type and Grade: Type 1, Grade 1.

- b. Wall Thickness: Schedule 80 complying with ASTM D1784 and ASTM D1785, and US Product Service PS 21-70 as having same outside diameter dimension as cast-iron pipe.
 - c. Temperature Rating: Rated for temperature to 140 degrees F.
 - d. Color: gray.
- 3. Fittings: Type, grade, schedule, and color of fitting shall match the associated pipe.
 - a. Solvent Weld: Comply with ASTM D2467.
 - b. Threaded: Threaded fittings shall comply with ASTM D2464.
 - c. Flanged: Provide flanged fittings with Viton or Teflon gaskets.
- 4. Joints:
 - a. Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.
 - b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.
 - c. Flanged: Provide with backup flange minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.

2.3 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPING

A. CPVC Pipe – General Applications: Unless otherwise shown or indicated, CPVC pipe shall comply with the following:

- 1. Manufacturers: Provide products of one of the following:
 - a. Ipex, Inc.
 - b. Spears Manufacturing Company.
 - c. Or equal.
- 2. Material: Comply with ASTM F441/F441M and US Product Standard PS 21-70 as having same outside diameter as iron pipe. Comply with the following:
 - a. Type and Grade: Type IV, Grade 1.
 - b. Wall Thickness: Schedule 80.
 - c. Temperature Rating: Rated to 210 degrees F.
 - d. Color: Gray.
 - e. Manufacture pipe and fittings with minimum of two percent of titanium oxide for ultraviolet protection.
- 3. Fittings: Type, grade, schedule, and color of fittings shall match the associated pipe.
 - a. Solvent Welded: Fittings shall comply with ASTM F439 for socket type.
 - b. Threaded: Shall comply with ASTM F437.
 - c. Flanged: Provide flanged fittings with Viton or Teflon gaskets.

4. Joints:
 - a. Solvent Welded: Use primer and solvent cement recommended by CPVC pipe manufacturer. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.
 - b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.
 - c. Flanged: Provide with backup flanges minimum 1/8-inch thick. Backup flanges and connecting bolts shall be Type 304 stainless steel.

2.4 CLEAR FLEXIBLE PVC (CFPVCT) TUBING

- A. Flexible Tubing: Unless otherwise shown or indicated, flexible tubing shall be as follows:
 1. Manufacturers: Provide products of one of the following:
 - a. Nalgene 980.
 - b. Finger Lakes FLEX GP70.
 - c. Or equal.
 2. Material: Material shall comply with FDA CFR 21. Unless otherwise shown or indicated, PVC tubing shall be:
 - a. Utility grade.
 - b. Color: Clear for visible flow.
 - c. Temperature Rating: 40 to 100 degrees F.
 - d. Pressure Rating: 15 psi.
 3. Fittings: Fitting shall be hose barb.

2.5 IDENTIFICATION

- A. Pipe material identification requirements are in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

2.6 SOURCE QUALITY CONTROL

- A. Shop Tests:
 1. Pipe manufacturer shall maintain continuous quality control program.
 2. Where applicable and when requested by Engineer, submit results of source quality control tests specified in reference standards.
 3. CPVC plastic molding materials used for manufacturing pipe and fittings under this Section shall be tested for compliance with ASTM D1784.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

- A. For buried piping installation, refer to Section 15051, Buried Piping Installation.
- B. For exposed piping installation, refer to Section 15052, Exposed Piping Installation.

+ + END OF SECTION + +

SECTION 15073

HIGH DENSITY POLYETHYLENE DRAINAGE PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, test, and place in satisfactory service the High-Density Polyethylene (HDPE) storm pipe and fittings as shown.
2. The extent of HDPE pipe and fittings to be furnished is shown and in the piping schedules included in Section 15051, Buried Piping Installation.

B. Coordination:

1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, the HDPE process pipe Work.

C. Related Sections:

1. Section 02200, Earthwork.
2. Section 15051, Buried Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, Inc., (ASTM).
 - a. ASTM D 638, Test Method for Tensile Properties of Plastics.
 - b. ASTM D 696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics between - 30°C and 30°C with a Vitreous Silica Dilatometer.
 - c. ASTM D 746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
 - d. ASTM D 790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - e. ASTM D 1238, Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
 - f. ASTM D 1248, Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - g. ASTM D 1505, Test Method for Density of Plastics by the Density-Gradient Technique.
 - h. ASTM D 1525, Test Method for Vicat Softening Temperature of Plastics.

- i. ASTM D 1598, Test Method for Time-to-Failure of Plastic Pipe under Constant Internal Pressure.
- j. ASTM D 1599, Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings.
- k. ASTM D 1603, Test Method for Carbon Black in Olefin Plastics.
- l. ASTM D 1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.
- m. ASTM D 2122, Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
- n. ASTM D 2240, Test Method for Rubber Property-Durometer Hardness.
- o. ASTM D 2290, Test Method for Apparent Hoop Tensile Strength of Plastic Reinforced Plastic Pipe by Split Disk Method.
- q. ASTM D 2412, Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- r. ASTM D 2657, Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
- s. ASTM D 2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
- t. ASTM D 2837, Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
- u. ASTM D 3035, Specification for Polyethylene (PE) Plastic Pipe (DR-PR), Based on Controlled Outside Diameter.
- v. ASTM D 3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
- w. ASTM D 3350, Specification for Polyethylene Plastics Pipe and Fittings Materials.
- x. ASTM F 412, Terminology Relating to Plastic Piping Systems.
- y. ASTM F 714, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- z. ASTM F 1248, Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

- 1. Manufacturer shall have a minimum of five years experience producing substantial similar type materials and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- 2. HDPE process pipe and fittings shall be the product of a single manufacturer.
- 3. The HDPE process pipe and fittings manufacturer shall have an established Quality Assurance Program responsible for inspecting incoming and outgoing materials.
- 4. The HDPE process pipe and fittings manufacturer shall have an established Quality Assurance program responsible for assuring the long-term performance of materials and products.

5. The HDPE process pipe and fitting manufacturer shall maintain permanent Quality Assurance/Quality Control (QA/QC) records.

1.4 SUBMITTALS

- A. Submit these with Shop Drawings required under Section 15051, Buried Piping Installation.
- B. Action Submittals: Submit the following:
 1. Product Data:
 - a. Manufacturer's specifications including dimensions, allowable height of cover and installation instructions

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Sections 15051, Buried Piping Installation.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Piping shall have a smooth interior surface with annular exterior corrugations. Provide products of one of the following:
 1. N-12, Advanced Drainage Systems, Inc (ADS)
 3. Or equal.
- B. Pipe shall conform to ASTM F2648 and ASTM F2306.
- C. Joint Performance:
 1. Pipe joints shall be watertight in accordance with ASTM D3212.
 2. Gasketed connections shall incorporate a closed-cell synthetic expanded rubber gasket meeting the requirements of ASTM D1056 Grade 2A2.
 3. Gaskets shall be installed by the pipe manufacturer, and covered by a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant shall be used on the gasket and bell during assembly.
 4. Bells shall be reinforced with a bell tolerance device.
- D. Fittings:
 1. HDPE meeting the properties specified for the pipe
 2. Either molded or fabricated.
 3. Designed specifically for the pipe furnished and manufactured by the pipe manufacturer.
 4. Shall conform to ASTM F2306

- E. Pipe class shall be as specified in piping schedule in Section 15051, Buried Piping Installation.

2.2 SOURCE QUALITY CONTROL

- A. Shop Tests:
 - 1. Piping manufacturer shall maintain continuous quality control program.
 - 2. Where applicable and when requested by ENGINEER, submit results of source quality control tests specified in reference standards.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

- A. Refer to Section 15051, Buried Piping Installation.
- B. Pipe Placement:
 - 1. Grade control equipment shall be of type to accurately maintain design grades and slopes during installation of pipe.
 - 2. Dewatering: Remove standing water in trench before pipe installation.
 - 3. Unless otherwise specifically stated, install pipe in accordance with manufacturer's recommendations and ASTM D2321.
- C. Joints: Install coupling and fasten per manufacturer's recommendations.
- D. Connections:
 - 1. Make connections to existing pipe by using a polyethylene coupling. Remake damaged existing joints.
 - 2. Make connections to existing manholes and drainage structures by cutting into the floor or bench of the manhole or drainage structure and forming a new channel.

3.3 LEAKAGE TESTS

- A. Refer to Section 15051, Buried Piping Installation.

+ + END OF SECTION + +

SECTION 15100

PROCESS AND CIVIL VALVES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install valves and appurtenances, complete and operational.
2. Valves specifically excluded from this Section include valves for plumbing work, heating and ventilation work, those for fuel oil piping, chlorine gas valves, and any and all valves specifically included with equipment.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves work.

C. Related Sections:

1. Section 02200, Earthwork.
2. Section 03300, Cast-in-Place Concrete.
3. Section 05051, Anchor Systems.
4. Section 09900, Painting.
5. Section 15051, Buried Piping Installation.
6. Section 15052, Exposed Piping Installation.
7. Section 15061, Ductile Iron Pipe.

D. The following index of this Section is included for convenience:

Part 1 - General

- 1.1 Description
- 1.2 References
- 1.3 Quality Assurance
- 1.4 Submittals
- 1.5 Delivery, Storage and Handling

Part 2 - Products

- 2.1 General
- 2.2 Valve Boxes

- 2.3 Resilient-Seated Gate Valves
- 2.4 Eccentric Plug Valves (Four Inches and Larger)
- 2.5 Stainless Steel Ball Valves
- 2.6 Swing Check Valves
- 2.7 Sewage Air Release Valves
- 2.8 Quick Disconnect Couplings
- 2.9 Flow Through Plugs
- 2.10 Appurtenances for Metallic Valves
- 2.11 Anchorages and Mounting Hardware
- 2.12 Tools, Lubricants and Spare Parts
- 2.13 Painting of Exposed Valves, Hydrants and Appurtenances
- 2.14 Inspection and Witness Shop Tests

Part 3 - Execution

- 3.1 Inspection
- 3.2 Installation
- 3.3 Field Quality Control
- 3.4 Manufacturer's Services
- 3.5 Supplements

1.2 REFERENCES

- A. Standards referenced in this Section are listed below:
 - 1. AISI 1144, Carbon Steel, as Rolled.
 - 2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
 - 3. ANSI B16.5, Pipe Flanges and Flanged Fittings.
 - 4. ANSI/NSF 61 Drinking Water Components – Health Effects.
 - 5. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - 6. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
 - 7. ASTM A536, Specification for Ductile Iron Castings.
 - 8. ASTM B98/B98M, Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
 - 9. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron and Pressure Pipe and Fittings.
 - 10. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.
 - 11. ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 12. AWWA C502 - Dry-Barrel Fire Hydrants
 - 13. AWWA C501, Cast-Iron Sluice Gates.
 - 14. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
 - 15. AWWA C509, Resilient-Seated Gate Valves for Water-Supply Service.

16. AWWA C515 - Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service.
17. AWWA C520, Knife Gate Valve, Sizes 2 In. Through 92 In.
18. AWWA C540, Power-Actuating Devices for Valve and Slide Gates.
19. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
20. SSPC SP-6, Commercial Blast Cleaning.
21. SSPC SP-10, Near White Blast Cleaning.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 1. Manufacturer shall have minimum of five years of experience producing substantially similar materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation for at least five years.
- B. Component Supply and Compatibility:
 1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.
 2. Supplier of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of process valve Supplier is furnishing.
 3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the manufacturer.
- C. Design Criteria
 1. All valves and appurtenances shall be new and in perfect working condition. Valves shall be designed for continuous use with a minimum of maintenance and service required and shall perform the required function without exceeding the safe limits for stress, strain or vibration. In no case will used or damaged valves be acceptable.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Shop Drawings: Submit the following for Valves Four Inches and Larger:
 - a. Installation drawings showing orientation of valve in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
 - b. Controls for and control characteristics of modulating valves.

- c. Power and control wiring diagrams, including terminals numbers for electric-motor actuators.
 - d. Calculations for sizing of electric actuators.
 - e. Calculations for sizing of operating mechanism with extension stems.
 - f. Calculations for sizing of gear actuators.
 - 2. Product Data:
 - a. Product data sheets.
 - b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.
 - c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.
 - d. Cv values and hydraulic headloss curves (for Valves 4 Inches and Larger).
 - 3. Samples:
 - a. If requested by Engineer, furnish one foot of chain for chainwheel-operated valves.
 - 4. Testing Plans: Submit plan for shop testing of each valve for which shop testing is specified, including testing plan's and test facility's limitations proposed.
- B. Informational Submittals: Submit the following for Valves 4 Inches and Larger:
- 1. Certificates:
 - a. Certificates of compliance with referenced standards, where applicable, including those of AWWA, NSF, and others required by Engineer. For each valve specified to be manufactured and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.
 - 2. Manufacturer Instructions: Submit manufacturer's instructions for handling, storing, and installing valves and appurtenances. Provide templates and setting drawings for valves and appurtenances that require anchor bolts or similar anchorages.
 - 4. Source Quality Control Submittals:
 - a. Submit four copies of shop test results and inspection data, certified by manufacturer.
 - 5. Field Quality Control Submittals: Submit results of field tests required.
 - 6. Supplier's Reports: When requested by Engineer, submit written report of results of each visit to Site by Supplier's serviceman, including purpose and time of visit, tasks performed and results obtained.
 - 7. Qualifications Statements: When requested by Engineer, submit manufacturer's qualifications demonstrating compliance with the Specifications, including list of existing installations with contact names and telephone number(s) for each.

- C. Closeout Submittals: Submit the following for Valves 4 Inches and Larger:
 - 1. Operations and Maintenance Data:
 - a. Furnish operation and maintenance manuals in accordance with Section 01730, Operation and Maintenance Data.
 - b. Furnish complete nameplate data for each valve and electric actuator in operations and maintenance manuals.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.
 - 2. Inspect boxes, crates, and packages upon delivery to Site and notify Engineer in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
- B. Furnish covers for all openings.
 - 1. All valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
 - 2. All valves smaller than 3-in shall be shipped and stored as above except that heavy card board covers may be furnished instead of wood.
- C. Storage and Protection:
 - 1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures.
 - 2. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.
 - 3. Store equipment to permit easy access for inspection and identification.
 - 4. Any corrosion in evidence at the time of Owner acceptance shall be removed, or the valve shall be removed from the job.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Valves, General:
 - 1. Provide each valve with manufacturer's name and rated pressure cast in raised letters on valve body.
 - 2. Provide valves with Type 316 stainless steel nameplate attached with Type 316 stainless steel screws. Nameplates shall have engraved letters displaying the following minimum information:

- a. Valve size.
 - b. Pressure and temperature ratings.
 - c. Application (other than water and wastewater).
 - d. Date of manufacture.
 - e. Manufacturer's name.
 3. Provide valves to turn clockwise to close, unless otherwise specified.
 4. Provide valves with permanent markings for direction to open.
 5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Gear actuator and valve components shall be able to withstand minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.
 6. All buried valves shall open clockwise.
- B. Valve Materials:
1. Valve materials shall be suitable for the associated valve's service or application, as shown.
 2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
 3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.
 4. Clean and descale fabricated stainless steel items in accordance with ASTM A380 and the following:
 - a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.
 - b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.
- C. Valve Joints:
1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.
 2. Buried Valves: Unless otherwise specified, provide with mechanical or push-on joints, restrained or unrestrained, as required by piping with which valve is installed.
 3. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.2 VALVE BOXES

- A. All buried valves shall be provided with extension shafts, operating nuts and valve boxes as follows:
 - 1. Top of the operating nut shall be located 6 in. below the rim of the valve box.
 - 2. Valve boxes shall be the "Dwyer" style, with 8-3/8-in or 6-3/8-in cover, as manufactured by Bibby Ste. Croix of Hamilton, Ontario, Canada; Bingham & Taylor of Culpepper, Virginia; or equal and shall be a heavy-pattern cast iron, three-piece, telescoping type box with dome base suitable for installation on the buried valves.
 - 3. Inside diameter shall be at least 4-1/2-in.
 - 4. Barrel length shall be adapted to the depth of cover, with a lap of at least 6-in when in the most extended position.
 - 5. Covers shall be cast iron with integrally-cast direction-to- open arrow. Aluminum or plastic are not acceptable. A means of lateral support for the valve extension shafts shall be provided in the top portion of the valve box.
 - 3. The upper section of each box shall have a top flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve and shall be oval.
 - 4. An approved operating key or wrench shall be furnished.

2.3 RESILIENT-SEATED GATE VALVES

- A. Valves 3-in through 36-in shall be manufactured in accordance with AWWA C515 and as specified herein. Valves shall be:
 - 1. The RS series resilient wedge gate valve (available in 4-in through 36-in) by M&H Valve Company of Anniston, Alabama;
 - 2. The Series 2361 ductile iron resilient wedge gate valve (available in 14-in through 36-in) by Mueller Company of Decatur, Illinois;
 - 3. Or equal.
- B. General:
 - 1. Type:
 - a. For interior and exposed service, provide outside screw and yoke (OS&Y) rising-stem valves, unless otherwise specified.
 - b. Provide position indicators for NRS valves used in exposed service.
 - 2. Minimum Rated Working Pressure: 200 psig.
 - 3. Maximum Fluid Temperature: 150 degrees F.
 - 4. Provide valves with fully encapsulated resilient wedges, unless otherwise specified.
 - 5. Valves should be provided with a minimum of two O-ring stem seals.
 - 6. Extension stems:
 - a. Provide extension stems to bring operating nut to six inches below valve box cover.

- b. Materials of Stems and Stem Couplings: Type 316 stainless steel.
 - c. Maximum Slenderness Ratio (L/R): 100
 - d. Provide top nut and bottom coupling of ductile iron or cast-iron with pins and set screws of Type 316 stainless steel.
 - 7. Wrench Nuts:
 - a. Provide wrench nuts on buried valves of nominal two-inch size.
 - b. Arrow indicating direction of opening the valve shall be cast on the nut along with the word "OPEN".
 - c. Material: Ductile iron or cast-iron.
 - d. Secure nut to stem by mechanical means.
 - 8. Valves shall be non-rising stem.
 - 9. Buried Valves shall have mechanical joint ends compliant with AWWA C111 unless otherwise noted.
- D. Materials of Construction: Shall conform to AWWA C509 and shall be as follows:
- 1. Valve Body, Bonnet, and Stuffing Box: Cast-iron.
 - 2. Wedge: Cast-iron, symmetrically and fully encapsulated with molded rubber having minimum 1/8-inch thickness.
 - 3. Extension stems and stem couplings:
 - a. Materials of Stems and Stem Couplings: Type 316 stainless steel.
 - b. Pins and set screws: Type 316 stainless steel.
 - 4. Wrench nut: ductile iron or cast iron.
 - 5. Rubber Items: Buna-N or other synthetic rubber suitable for the application.
 - 6. Internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts, and washers shall be Type 316 stainless steel.
- E. Interior Coating:
- 1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be heat activated fusion bonded epoxy coated and comply with AWWA C550.
- F. Testing:
- 1. Test valves in valve manufacturer's shop in accordance with AWWA C509.

2.4 ECCENTRIC PLUG VALVES (FOUR INCHES AND LARGER)

- A. Manufacturers: Provide products of one of the following:
- 1. DeZurik.
 - 2. Clow Valve Company (a division of McWane).
 - 3. Or equal.
- B. General:
- 1. Provide eccentric-type plug valves each with rectangular ports conforming to AWWA C517 and as specified in this Section.
 - 2. Sizes: Four-inch diameter and larger.

3. Minimum Rated Working Pressure: 175 psig.
4. Maximum Fluid Temperature: 180 degrees F.
5. Minimum Port Area:
 - a. Valves 20-inch Diameter and Smaller: 80 percent of nominal pipe area.
 - b. Valves Larger than 20-inch Diameter: 70 percent of nominal pipe area.
6. Packing and packing gland shall be externally adjustable and accessible without disassembling valve and without removing the actuator.
7. Valves shall provide drip-tight, one-directional shutoff at rated pressures.
8. Plug shall have cylindrical seating surface eccentrically offset from center of plug shaft. Interface between plug face and body seat, with plug in closed position, shall be externally adjustable in the field with valve in the line while under pressure.
9. Plug shall be supported to top bearing by using spring that is externally adjustable.
10. All plug valves shall allow pigging of the piping with line-size pigs.

C. Materials of Construction:

1. Body: Cast Iron ASTM A126 Class B, or Ductile-iron ASTM A536 Grade 65-45-12.
 - a. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.
2. Plug:
 - a. Core shall be one piece with integral shafts: Cast Iron ASTM A126 Class B, or Ductile-iron, ASTM A536 Grade 65-45-12.
 - b. Plug Facing: Neoprene or Buna-N.
 - c. For valves up to eight-inch diameter, plugs shall be fully encapsulated with rubber. For valves larger than eight-inch diameter, provide plugs with rubber facing. Minimum thickness of rubber lining shall be 1/8-inch. Rubber hardness shall be a minimum of 70 (Shore A) durometer. Rubber-to-metal bond shall withstand minimum 75-pound pull conforming to ASTM D429 Method B.
3. Seats: Minimum 1/8-inch welded overlay of minimum 90 percent pure nickel on surfaces contacting plug face. Seats shall provide contact area of at least 1/2-inch width all around.
4. Stem Bearings: Sintered, oil impregnated, permanently lubricated of Type 316 stainless steel.
5. Stem Seal: Multiple neoprene V-ring type.
6. All internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts and washers shall be Type 316 stainless steel.

D. Materials of Construction for plug valves used for grit applications:

1. Comply with materials of construction specified in Article 2.4.C herein with the following exceptions.
2. Body shall be lined with tmemec series 141

3. Plug:
 - a. For all grit plug valves plugs shall be fully encapsulated with rubber.
 4. Stem Seal: Multiple neoprene or Buna V-ring type.
- E. Shop Testing:
1. Operational Tests:
 - a. To demonstrate that complete assembly is workable, successfully operate each valve (with actuator mounted directly on valve) three times from fully closed to fully open position and reverse under no-flow condition.
 2. Leakage Tests:
 - a. Test each valve for leaks while valve is in closed position.
 - b. Test valves at rated pressures. During test, valves shall be drip-tight. Test duration shall be at least five minutes for valves up to 20-inch diameter and ten minutes for valves larger than 20-inch diameter. Tests shall be repeated successfully with pressure in the unseating direction.
 3. Hydrostatic Test: Test valves to an internal hydrostatic pressure equivalent to twice rated pressure of valve. During hydrostatic test, there shall be no leakage through metal, end joints, and shaft seal, nor shall any part be permanently deformed. Duration of hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least one minute for valves eight-inch diameter and smaller, three minutes for valves 10-inch through 20-inch diameter, and ten minutes for valves 24-inch diameter and larger.
- F. Gear Actuators for Manually-operated Valves:
1. Provide gear actuators on buried and exposed valves, except valves four-inch diameter and smaller located less than five feet above operating floor. Gas service valves shall be provided with worm gear actuators.
 2. Size gear actuators for valves eight-inch diameter and smaller for 175 psig differential pressure.
 3. Provide actuators capable of holding associated valves in any intermediate position without creeping or vibrating.
 4. Provide valve position indicator on each actuator. Provide stop-limiting devices for open and closed position. For buried and submerged service actuators, provide position indicators in valve box.
 5. Provide adjustable stop to adjust seating pressure.
 6. Make packing accessible for adjustment without requiring removal of actuator from valve, except for valves in buried and submerged service.
 7. Diameter ratio of handwheel or chainwheel and gear sector shall be less than two.
 8. For buried and submerged valves, gear actuator shall be grease-packed and designed to withstand submersion, and shall be drip-tight in water 20 feet deep, with self-adjusting packing.
 9. Provide each actuator with gearing totally enclosed.

10. Operator shaft and gear sector shall be supported on permanently lubricated bronze or stainless steel bearings.
11. Provide metal-encased spring loaded seals in top and bottom covers of gear housing, or O-ring seals.
12. Actuators shall be provided to produce indicated torque with maximum pull of 80 pounds on handwheel or chainwheel and maximum input of 150-foot pounds on operating nuts, for both seating and unseating heads equal to maximum differential pressure rating of valve.
13. Actuator components between input and stops shall be designed to withstand, without damage, a pull of 200 pounds for handwheel or chainwheel actuators and input torque of 300-foot pound for operating nuts when operating against stops.
14. Materials of Construction:
 - a. Housing: Cast-iron, ASTM A126 Class B.
 - b. Gear Sector: Cast-iron ASTM A126 Class B, or ductile iron ASTM A536.
 - c. Worm Shaft: Steel, AISI 1144, hardened and tempered to an average Rc 40 and within range of Rc 35-45.
 - d. Bearings: Bronze oil-impregnated, or stainless steel.
 - e. Hardware, including bolts, nuts, washers, set screws, and pins, shall be Type 316 stainless steel.

2.5 STAINLESS STEEL BALL VALVES

- A. Manufacturers: Provide products of one of the following:
 1. Victaulic Company.
 2. Milwaukee Valve.
 3. Or equal.
- B. General:
 1. Type: Quarter turn, full port ball valve.
 2. Sizes: Smaller than 4 Inches.
 3. Rating: 300 psig.
 4. End Connections: NPT Threaded.
- C. Materials of Construction:
 1. Body: Type 316 Stainless Steel.
 2. Ball: Type 316 Stainless Steel.
 3. Seats: PTFE.
 4. Stem: Type 316 Stainless Steel.
 5. Handle, Bolts, Nuts, and Washers: Type 304 Stainless Steel.
 6. Handle cover: Plastic.

2.6 SWING CHECK VALVES

- A. Manufacturers: Provide products of one of the following:

1. APCO Willamette Valve & Primer Corp.
2. Crispin Valve
3. G.A. Industries.
4. Or equal.

B. General:

1. Provide valves conforming to AWWA C508 and as specified herein.
2. Sizes: Four-inch through 24-inch diameter.
3. Type: Resilient-seated.
4. Rated Working Pressure:
 - a. Smaller than 12-inch Diameter: 175 psig.
 - b. 12-inch Diameter and Larger: 150 psig.
5. Provide valves suitable for horizontal or vertical mounting.
6. Check valves shall have clear waterway with full-open area equal to nominal pipe size.
7. Provide check valves with outside adjustable weight and lever.
8. Provide valves larger than six-inch diameter with adjustable air cushion chambers.
9. Valve seats shall be mechanically attached and shall be field replaceable.

C. Materials of Construction: All materials of construction shall conform to AWWA C508 and shall be as follows:

1. Body, Disc, Cover and Gland: Cast-iron or ductile iron.
2. Disc Arm: Ductile iron.
3. Hinge Shaft: Type 316 stainless steel.
4. Hinge Shaft Bushings: Bronze, or Type 316 stainless steel for sewage service.
5. Shaft End Plate: Type 316 stainless steel.
6. Body Seat: Type 316 stainless steel.
7. Follower Ring for Rubber Seat on Disc: Type 316 stainless steel.
8. Disc Center Pin Assembly: Type 316 stainless steel.
9. Air Cushion Chamber:
 - a. Chamber and Plunger: Bronze.
 - b. Linkages and Pins: Type 316 stainless steel.
 - c. Air Check Valve and Tubing: Brass or stainless steel.
10. Rubber Items:
 - a. Applications Up to 180-degree F Fluid Temperature: Buna-N or other synthetic rubber suitable for the application.
 - b. Applications 180-degrees F and Greater Fluid Temperature: Viton, or other synthetic rubber suitable for the application.
11. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.
12. Gland Packing: Graphite and Kevlar.

D. Interior Coating:

1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.
- E. Limit Switches:
1. Provide each actuator with “end of travel” limit switches to allow control of desired end position for each direction of travel.
 2. Provide open and close limit switches geared to drive mechanism and in step at all times, whether unit is operated electrically or manually, and whether or not actuator is powered by electric power supply. Friction devices or set-screw arrangements shall not be used to maintain the setting.
 3. Limit switch gearing shall be appropriately lubricated.
 4. Provide driven mechanism totally enclosed to prevent entrance of foreign matter and loss of lubricant.
- F. Testing:
1. Test each valve in manufacturer’s shop in accordance with AWWA C508.
 2. Allowable Leakage at Rated Pressures: Zero.

2.7 SEWAGE AIR RELEASE VALVES

- A. Manufacturers: Provide products of one of the following:
1. G.A. Industries, Series 925.
 2. APCO.
 3. Vent-O-Mat.
 4. Val-Matic.
 5. Or equal.
- B. General:
1. All sewage air release and vacuum valves shall be specifically designed for operation on sewage and wastewater applications.
 2. Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice nozzle on a natural rubber seal affixed into the control float.
 3. Valves shall remain leak-tight in the absence of air.
 4. Pressure Rating: 150 pounds per square inch minimum, unless otherwise specified in the Valve Schedule.
- C. Construction:
1. The valve shall have an integral anti-surge orifice mechanism which shall operate automatically to limit surge pressures rise or shock induced by closure to less than two times the valve rated working pressure.
 2. Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice nozzle on a natural rubber seal affixed into the control float.
 3. Valves shall remain leak-tight in the absence of air.

D. Materials of Construction:

- a. Compact Tubular Single-Chamber Body and Cover: stainless steel.
- b. Hollow Direct Acting Float: stainless steel.
- c. Solid Cylindrical Large Orifice Control Float: stainless steel.
- d. Nozzle: stainless steel
- e. Woven Dirt-Inhibitor Screen: stainless steel.
- f. Seat: Buna-N.
- g. Seals: nitrile rubber.
- h. Lever Arms: Bronze or stainless steel.

2.8 QUICK DISCONNECT COUPLINGS

A. Quick Disconnect Couplings:

- 1. Stainless Steel Construction – General Requirements:
 - a. All coupling assemblies shall have a minimum pressure and temperature rating of 300 pounds per square inch and 225 degrees F.
 - b. Provide finger rings for all sizes 1-1/2 inch and above.
 - c. Size and Location: As shown on the Drawings and as specified.
 - d. Provide increaser or reducer fittings when connection is required for dissimilar size.
- 2. Adapter with Female NPT:
 - a. Construction: Stainless steel.
 - b. Manufacturer and Model No.:
 - 1) Dover Corp. OPW Division, 633-A,
 - 2) Dixon Valve and Coupling Company, Global A-SS,
 - 3) Or equal.
- 3. Coupler with Female NPT:
 - a. Construction: Stainless steel.
 - b. Gasket: Buna-N or other material as required to be compatible with fluid being handled.
 - c. Manufacturer and Model No.:
 - 1) Dover Corp. OPW Division, 633-D,
 - 2) Dixon Valve and Coupling Company, Global D-SS,
 - 3) Or equal.
- 4. Adapter Cap:
 - a. Construction: Stainless steel.
 - b. Manufacturer and Model:
 - 1) Dover Corp. OPW Division, 634-B,
 - 2) Dixon Valve and Coupling Company, Global B-SS,
 - 3) Or equal.

2.9 FLOW THROUGH PLUG

- A. Manufacturers:
 - 1. Lansas Products , Super-Flow Plug
 - 2. Petersen Products,
 - 3. Or Equal
- B. General:
 - 1. Flow through plug shall be used for the construction of the Diversion Chamber, as shown on the Contract Drawings.
 - 2. Pipe Size: 48"
 - 3. Flow Range: 0-16 MGD
 - 4. Flow Characteristics: Raw Wastewater
 - 5. Pressure: gravity flow, 5 psi maximum

2.10 APPURTENANCES FOR METALLIC VALVES

- A. General:
 - 1. For valves located less than five feet above operating floor, provide levers on four-inch diameter quarter-turn valves, and provide handwheels on all other valves, unless otherwise shown or specified.
 - 2. For valves located five feet or more above operating floor, provide chain operators.
 - 3. Where indicated, provide extension stems and floorstands.
- B. Handwheels:
 - 1. Conform to applicable AWWA standards.
 - 2. Material of Construction: Ductile iron, or cast aluminum.
 - 3. Arrow indicating direction of opening and word "OPEN" shall be cast on trim of handwheel.
 - 4. Maximum Handwheel Diameter: 2.5 feet.
- C. Chain Operators:
 - 1. Chains shall extend to three feet above operating floor.
 - 2. Provide 1/2-inch stainless steel hook bolt to keep chain out of walking area.
 - 3. Materials of Construction:
 - a. Chain: Type 316L stainless steel.
 - b. Chainwheel: Recessed groove type made out of Type 316 stainless steel.
 - c. Guards and Guides: Type 316L stainless steel.
 - 4. Chain Construction:
 - a. Chain shall be of welded link type with smooth finish. Chain that is crimped or has links with exposed ends is unacceptable.

5. Provide geared operators where required to position chainwheels in vertical position.
- D. Crank Operator:
1. Crank operator shall be removable and fitted with rotating handle.
 2. Maximum Radius of Crank: 15 inches.
 3. Materials:
 - a. Crank: Cast-iron or ductile iron.
 - b. Handle: Type 304 stainless steel.
 - c. Hardware: Type 304 stainless steel.
- E. Extension Stems and Floor Stands:
1. Conform to the applicable requirements of AWWA C501 for sizing of complete lifting mechanism.
 2. Bench and Pedestal Floor Stands:
 - a. For valves requiring extension stems, provide bench or pedestal floor stands with handwheel or crank as indicated. Provide provisions for using portable electric actuator for opening and closing of valves.
 - b. Type: Heavy-duty with tapered roller bearings enclosed in a weatherproof housing, provided with positive mechanical seals around lift nut and pinion shaft to prevent loss of lubrication and to prevent moisture from entering housing. Provide lubrication fitting for grease. For valves conveying water that is potable or that will be treated to become potable, grease shall be food-grade and ANSI/NSF 61-listed. Base shall be machined.
 - c. Materials of Construction:
 - 1) Housing: Cast-iron, ASTM A126, Class B.
 - 2) Lift Nut: Cast bronze, ASTM B98/B98M.
 - 3) Grease Fitting: Stainless steel.
 - 4) Bolting: Type 316 stainless steel.
 3. Wall brackets for floor stands shall be Type 316L stainless steel construction.
 4. Extension Stems:
 - a. Materials of Stems and Stem Couplings: Type 316 stainless steel.
 - b. Maximum Slenderness Ratio (L/R): 100.
 - c. Minimum Diameter: 1.5-inch.
 - d. Threads: Acme.
 - e. Provide stem couplings where stems are furnished in more than one piece. Couplings shall be threaded and keyed or threaded and bolted and shall be of greater strength than the stem.
 - f. Weld to bottom of extension stem a Type 316 stainless steel cap suitable for square end of valve stem.
 5. Bottom Couplings: Ductile iron with Type 316 stainless steel pin and set screw.
 6. Stem Guides:

- a. Material: Type 316 cast stainless steel with bronze bushing for stem. For submerged service, Type 316 cast stainless steel with stainless steel bushing for stem.
- b. Maximum Stem Length Between Guides: Seven feet.
- c. Stem guides shall be adjustable in two directions.
- 7. Furnish stem cover of clear butyrate plastic or Grade 153 Lexan with cast adapter for mounting cover to bench and floor stands. Provide stem cover with gasketing and breathers to eliminate water intrusion into operator and condensation within cover. Provide stem cover with mylar tape with legible markings showing valve position at one-inch intervals and open and close limits of valve.

2.11 ANCHORAGES AND MOUNTING HARDWARE

- A. General:
 - 1. Comply with Section 05051, Anchor Systems, except as modified in this Section.
 - 2. Obtain bolts, nuts, and washers for connection of valve and appurtenances to concrete structure or other structural members from valve Supplier.
 - 3. Bolts, nuts, and washers shall be of ample size and strength for purpose intended. Anchorages in concrete shall be at least 5/8-inch diameter.
 - 4. Provide stem guide anchorages of required strength to prevent twisting and sagging of guides under load.
 - 5. Materials: Provide bolts and washers of Type 316 stainless steel and nitrided nuts. Bolts shall have rolled threads. Bolts and nuts shall be electropolished to remove burrs.

2.12 TOOLS, LUBRICANTS AND SPARE PARTS

- A. Provide T-handle operating wrenches for buried valves.
- B. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion. Lubricants for equipment associated with conveying potable water or water that will be treated to become potable shall be food-grade and ANSI/NSF 61-listed.
- C. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.

2.13 PAINTING OF EXPOSED VALVES, HYDRANTS AND APPURTENANCES

- A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in manufacturer's shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to Section 09900, Painting, unless otherwise specified.

2.14 PAINTING OF BURIED VALVES AND HYDRANTS

- A. The interior ferrous metal surfaces, except finished or bearing surfaces, shall be blast cleaned in accordance with SSPC SP-10 and painted with two coats of an approved two-component epoxy coating specifically formulated for potable water use. The coating shall be NSF certified to Standard 61.
- B. Exterior ferrous metal surfaces of all buried valves and hydrants shall be blast cleaned in accordance with SSPC SP-6 and given two shop coats of an approved two-component coal tar epoxy paint.

2.15 INSPECTION AND WITNESS SHOP TESTS

- A. Allow for Engineer and Owner to inspect and witness valve tests at valve manufacturer's facility.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
- B. During installation of all valves and appurtenances, verify that all items are clean, free of defects in material and workmanship and function properly.
- C. All valves shall be closed and kept closed until otherwise directed by the Construction Manager.

3.2 INSTALLATION

- A. General:
 - 1. Install valves and appurtenances in accordance with:
 - a. Supplier's instructions and the Contract Documents.
 - b. Requirements of applicable AWWA standards.
 - c. Applicable requirements of Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - 2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.
 - 3. Position swing check valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.

B. Exposed Valves:

1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
2. Operators:
 - a. Install valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by Engineer.
 - b. Avoid placing operators at angles to floors or walls.
 - c. Orient chain operators out of way of walking areas.
 - d. Install valves so that indicator arrows are visible from floor level.
 - e. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.
3. Floor Stands and Stems:
 - a. Install floor stands as shown and as recommended by manufacturer.
 - b. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by manufacturer.
 - c. Provide sleeves where operating stems pass through floor. Extend sleeves two inches above floor.

C. Buried Valves:

1. Clean and manually operate buried valves before installation.
2. Install valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four feet on all sides of box, or to undisturbed trench face if less than four feet.
3. Set buried valves with the stem vertically aligned in the center of the valve box.
4. Before backfilling, coat all exposed portions of any bolts with two coats of bituminous paint.
5. Support the valve box during backfilling and maintain in vertical alignment with the top flush with finish grade. Set the valve box so as not to transmit traffic loads to the valve.
6. Provide flexible coupling next to each buried valve.

D. Plug Valves:

1. Install plug valves that are in horizontal liquid piping with stem horizontal and plugs on top when valve is open. Plug shall be on upstream end when valve is closed.
2. Install plug valves that are in vertical liquid piping with plug at top when closed or as recommended by valve Supplier.
3. Supplier shall tag or mark plug valves to indicate proper mounting position.

E. Tapping Sleeves and Valves

1. The proper authority shall be contacted and their permission granted prior to tapping a "live" line. The required procedures and time table shall be followed exactly.

2. Installation shall be made under pressure and flow shall be maintained. The diameters of the tap shall be not less than 1/4-in less than the inside diameter of the branch line.
3. The entire operation shall be conducted by workers experienced in the installation of tapping sleeves and valves. The tapping machine shall be furnished by the Contractor.
4. Determine the location of the line to be tapped to confirm that the proposed location will be satisfactory and that no interference will be encountered such as joints or fittings. No tap or sleeve will be made closer than three feet from a pipe joint.
5. Tapping sleeve and valve with boxes shall be set squarely centered on the line to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks or other permanent restraint acceptable to the Construction Manager shall be provided behind all tapping sleeves. Proper tamping of supporting pipe bedding material around and under the valve and sleeve is mandatory for buried installations.
6. After completing the tap, the valve shall be flushed to ensure that the valve seat is clean. All proper regulatory procedures (including disinfection) shall be followed exactly.

3.3 FIELD QUALITY CONTROL

- A. Field Tests:
 1. Adjust all parts and components as required to provide correct operation of valves.
 2. Conduct functional field test on each valve in presence of Engineer to demonstrate that each valve operates correctly.
 3. Verify satisfactory operation and controls of motor operated valves.
 4. Demonstrate satisfactory opening and closing of valves at specified criteria requiring not more than 40 pounds effort on manual actuators.
 5. Test ten percent of valves of each type by applying 200 pounds effort on manual operators. There shall be no damage to gear actuator or valve.
 6. All testing equipment required shall be furnished by the Contractor.

3.4 MANUFACTURER'S SERVICES

- A. Furnish the services of a qualified representative of the tapping equipment manufacturer to provide on-site instruction during wet tapping of the existing water mains indicated on the Drawings.
- B. Provide services of qualified factory-trained service technicians to check and approve installation of valves:
 1. Supplier's serviceman shall perform the following:
 - a. Supervise unloading of the equipment.
 - b. Instruct Contractor in installing equipment.
 - c. Supervise installation of equipment.

- d. Inspect and adjust equipment after installation and ensure proper operation.
- e. Instruct Owner's personnel in operating and maintaining the equipment.
2. Manufacturer's representative shall make a minimum of 4 visits, with a minimum of 4 hours onsite for each visit. First visit shall be for unloading supervision (if specified) and instruction of Contractor in installing equipment; second visit shall be for assistance in installing equipment; third visit shall be for checking completed installation and start-up of system; fourth visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.
3. Training: Furnish services of Supplier's qualified factory trained specialists to instruct Owner's operations and maintenance personnel in recommended operation and maintenance of equipment.
5. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.5 SUPPLEMENTS

- A. The supplements listed below, following "End of Section" designation, are a part of this Specification Section:
 1. Table 15100-A, Schedule of Valves.

TABLE 15100-A, PROCESS AND CIVIL VALVE SCHEDULE

Valve Description	Type	Service	Size (in)	Operator	Remarks
Process Valves					
Pump Check Valve	CV	RS	16, 24	Manual	FLG
Pump Plug Valve	PV	RS	6, 16, 24	Manual	FLG
Bypass Pump Check Valve	CV	RS	12	Manual	FLG
Bypass Pump Plug Valve	PV	RS	12, 24	Manual	FLG
Generator Ball Valve	BV	FOS	½, 2	Manual	FLG
Force Main Isolation Valve	GV	RS	24	Manual	RMJ

The following abbreviations are used in the Valves Schedule:

A. Valve Type Abbreviations:

Valve Type	Abbrev.		Valve Type	Abbrev.
Check Valve	CV		Gate Valve	GV
Plug Valve	PV		Ball Valve	BV

B. Service Abbreviations:

Service	Abbrev.		Service	Abbrev.
Raw Sewage	RS		Fuel Oil Supply	FOS

C. Joint Abbreviations:

Joint Type	Abbrev.		Joint Type	Abbrev.
Flanged	FLG		Restrained Mechanical Joint	RMJ

++ END OF SECTION ++

SECTION 15120

COUPLINGS, ADAPTERS, AND SPECIALS FOR PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all couplings, adapters, and specials for piping.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before couplings, adapters, and specials for piping work.

C. Related Sections:

1. Section 09900, Painting.
2. Section 15051, Buried Piping Installation.
3. Section 15052, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
2. ANSI B16.39, Malleable Iron Threaded Pipe Unions.
3. ASME B31, Standards of Pressure Piping.
4. ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated, Welded and Seamless.
5. ASTM A105/A105M, Specification for Carbon Steel Forgings and Piping Applications.
6. ASTM B169/B169M Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar.
7. ASTM B650, Specification for Electro-Deposited Engineering Chromium Coatings of Ferrous Substrates.
8. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
9. AWWA C606, Grooved and Shouldered Joints.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer shall have at least five years experience producing substantial

similar products to those specified and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.

- B. Component Supply and Compatibility:
 - 1. Obtain each type of coupling, adapter, and special for piping product included in this Section, regardless of component manufacturer, from a single couplings, adapters, and specials manufacturer.
 - 2. Supplier shall prepare, or review, and approve all submittals for components furnished under this Section.
 - 3. Components shall be suitable for specified service conditions and be integrated into overall assembly by the Supplier.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Submit piping layout Shop Drawings in accordance with Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - 2. Product Data:
 - a. Submit product data on each type of coupling, expansion joint, and other piping specialties and accessories, including gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.
- B. Informational Submittals: Submit the following:
 - 1. Certificates:
 - a. When requested by Engineer submit certificate attesting to compliance with standards referenced in this Section, signed by manufacturer.
 - 2. Manufacturer's Instructions:
 - a. Provide instructions for handling, storing, installing, and adjusting of products.
 - 3. Source Quality Control:
 - a. When requested by Engineer, submit results of source quality control tests.
 - 4. Qualifications Statements:
 - a. Submit qualifications of manufacturer when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 – PRODUCTS

2.1 COUPLINGS

- A. Sleeve-type, Flexible Couplings:
1. Pressure and Service: Same as connected piping.
 2. Products and Manufacturers: Provide products of one of the following:
 - a. Style 253/38, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
 - b. No. 441/411/413, by Smith Blair, Inc.
 - c. Style FC Series, by Ford.
 - d. Or equal.
 3. Material: Ductile Iron.
 4. Gaskets: Suitable for specified service, as recommended by manufacturer.
 5. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and with nitrided stainless nuts.
 6. Harnessing:
 - a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - b. Tie adjacent flanges with bolts of corrosion-resistant alloy steel. Provide flange-mounted stretcher bolt plates to be designed by manufacturer, unless otherwise approved. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers.
 - c. On plain-end piping, for harnessing couplings, provide anchor restraint system such as Dresser Piping Specialties STAR Anchor Style 443, or equal.
 - d. Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by Engineer for pipe size, wall thickness, and test pressure required. Provide minimum 5/8-inch diameter bolts.
 6. Harnessing:
 - a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
 - b. Harnessing shall conform to details shown. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers.
 - c. On plain end piping, for harnessing couplings, provide anchor restraint system such as Dresser Piping Specialties STAR Anchor Style 443, or equal.
 7. Remove pipe stop(s) if used, unless otherwise shown or specified.

B. Flanged Coupling Adapters:

1. Products and Manufacturers: Provide one of the following:
 - a. Style 911, by Smith Blair, Inc.
 - b. EBAA, Series 2100
 - c. Or Equal
3. Pressure and Service: Same as connected piping.
4. Material: Ductile iron.
5. Gasket: SBR per ASTM D2000
6. Bolts and Nuts: Alloy steel, corrosion-resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and nitrided stainless nuts.

C. Dismantling Joint:

1. Products and Manufacturers: Provide one of the following:
 - a. Romac Industries – Style DJ400
 - b. Smith-Blair – Style 975
 - c. Or Equal
2. Flange spool AWWA Class D Steel Ring Flange, compatible with ANSI Class 125 and 150 bolt circles
3. End ring and body: ASTM A536 65-45-12 ductile iron
4. Gaskets: Shall match connecting pipe gasket material
5. bolts and nuts: 304 stainless steel
6. tie rods: 304 stainless steel
7. coating: fusion bonded epoxy

D. Mechanical Joint Restraint:

1. Products and Manufacturers: Provide one of the following:
 - a. Romac Industries
 - b. EBAA Iron Inc
 - c. Or Equal
2. MJ Restraint shall conform to ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53.
3. Gland: shall be grade 65-45-12 ductile iron in accordance with ASTM A536
4. Gripping Wedges: Shall be ductile iron ASTM A536-84 and heat traced within range of 370 to 470 BHN.
5. Working pressure: Shall be a minimum of 250 psi.

E. Transition Coupling (DI to HDPE)

1. Products and Manufacturers: Provide one of the following:
 - a. Romac Industries, model 501
 - b. Smith and Blair, model 411
 - c. Or Equal
2. Transition coupling shall conform to AWWA C219
3. Castings: Shall be ductile iron conforming to ASTM A 536

4. Gaskets: Shall be SBR conforming to ASTM D 2000 MBA 710
5. Nuts and Bolts: Shall be steel conforming to AWWA C111.
5. Working pressure: Shall be a minimum of 150 psi.

F. Restrained Coupling

1. Products and Manufacturers: Provide one of the following:
 - a. EBAA, Series 3800
 - b. Smith and Blair, model 471
 - c. Or Equal
2. Restrained coupling shall conform to AWWA C219
3. Castings: Shall be ductile iron conforming to ASTM A 536
4. Gaskets: Shall be SBR conforming to ASTM D 2000 MBA 710
5. Nuts and Bolts: Shall be steel conforming to AWWA C111.
5. Working pressure: Shall be a minimum of 150 psi.

2.2 MISCELLANEOUS SPECIALTIES AND ACCESSORIES

A. Dielectric Connections:

1. General: Where copper pipe connects to steel pipe, cast-iron pipe, or ductile iron pipe, provide either dielectric union or an insulating section of rubber or plastic pipe. When used, insulating section shall have minimum length of 12 pipe diameters.
2. Manufacturers: Provide products of one of the following:
 - a. Epco Sales, Inc.
 - b. Watts Regulator Company.
 - c. Capitol Manufacturing Company.
 - d. Or equal.
3. Dielectric Unions: Rated for 250 psi, ANSI B16.39.
4. Insulating Sections: Rated for same pressure as associated piping test pressure. Material shall be suitable for the application and service.

2.3 PAINTING

A. Shop Painting:

1. Clean and prime-coat ferrous metal surfaces of products in the manufacturer's shop in accordance with Section 09900, Painting, unless otherwise specified in this Section
2. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound that shall be maintained during storage and until products are placed into operation.

B. Field painting shall conform to Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect materials for defects in material and workmanship. Verify compatibility of products with pipe, fittings, valves, and appurtenances.

3.2 INSTALLATION

- A. Installation:
 - 1. Install piping specialties in accordance with the Contract Documents and manufacturer's instructions.
 - 2. For buried installations, refer to Section 15051, Buried Piping Installation.
 - 3. For exposed installations, refer to Section 15052, Exposed Piping Installation.
- B. Adjust expansion joints as required to ensure that expansion joints will be fully extended when ambient temperature is at minimum operating temperature, and fully compressed at maximum operating temperature for the system in which expansion joints are installed.

+ + END OF SECTION + +

SECTION 15121

WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all floor pipes, pipe sleeves, wall pipes, other wall pieces, and escutcheons to complete the Work.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate with the installation of floor pipes, pipe sleeves, wall pipes, other wall pieces and escutcheons that must be installed with or within formwork, walls, partitions, ceilings and panels.

C. Related Sections:

1. Section 03300, Cast-In-Place Concrete.
2. Section 07920, Joint Sealants.
3. Division 15, Sections on Piping, Valves, and Specials.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
2. American Water Works Association, (AWWA).

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of the component manufacturer from a single wall pipes, floor pipes and pipe sleeves manufacturer.
2. The wall pipes, floor pipes and pipe sleeves manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the wall pipes, floor pipes and pipe sleeves manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Detailed drawings and data on all wall and floor pipe, and pipe sleeves. Submit and coordinate these with Shop Drawings required for all piping systems.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wall and Floor Pipes:
 - 1. Material: Same as specified for the piping connected to wall or floor pipe, unless otherwise approved by ENGINEER.
 - 2. End Connections: As shown.
 - 3. Thickness: Same as specified for the piping connected to wall or floor pipe.
 - 4. Collars: Provide collars at mid-point of wall for anchorage and watertightness.
 - 5. Pipes ends shall be flush with wall face, unless otherwise shown.
 - 6. Drill and tap flanged ends and mechanical joint bells for studs. Provide studs of same material as connected piping, except submerged and buried studs shall be of Type 316 stainless steel.
- B. Pipe Sleeves:
 - 1. Ferrous and Plastic Pipe: Use standard weight galvanized steel pipe, unless otherwise shown.
 - 2. Copper Pipe: Use Type K hard drawn copper pipe, unless otherwise shown.
 - 3. Cast or Ductile Iron Pipe: Ductile iron furnished with integral wall collar.
 - a. Dimensions: As required for mechanical joint pipe to pass through sleeve. Length as required.
 - 4. Provide sleeves with water collars as shown on the Drawings.
- D. Link Seals:
 - 1. General Use: Provide link type mechanical seals of EPDM material, suitable for 20 psi working pressure, corrosive service and accessible from one side, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.
 - a. Products and Manufacturers: Provide one of the following:
 - 1) Link-Seal Model C, as manufactured by GPT Industries.
 - 2) Pen Seal Model ES, as manufactured by Proco Products, Inc.

3) Or equal.

E. Wall and Ceiling Plates:

1. Bare pipes passing through walls and ceilings in finished rooms: Provide escutcheon plates of cast brass or cast-iron nickel plated, clevis or split ring and hinged with set screws.
2. Provide plated escutcheon plates of 18-gauge steel for insulated pipes passing through walls and ceilings in finished rooms.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall and Floor Pipes: Install as shown and in accordance with approved Shop Drawings.

B. Pipe Sleeves:

1. Use sleeves wherever pipes pass through walls, partitions, floors, and roofs, unless otherwise shown.
2. Extend all sleeves through floor slabs a minimum of 2-inches above finished floor.
3. Anchor sleeves to concrete and masonry walls as shown or otherwise approved.
4. All sleeves through walls shall be flush with wall face.
5. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
6. Use link type seals to seal sleeve against hydrostatic pressure. Size sleeves to provide annular space required to suit the link type mechanical seals that are used.
7. Do not install sleeves and pipes through structural members, unless specifically shown and approved by ENGINEER.
8. Size sleeves to provide annular space as follows:

<u>Pipe Size:</u>	<u>Sleeve ID Minus Pipe Or Insulation OD:</u>
Less than 2-inches	1/2-inches to 3/4-inches
2-inches to 4-inches	3/4 inches to 1-1/4-inches
6-inches to 12-inches	1-1/4 inches to 2-inches
Over 12-inches	2-inches to 3-inches

C. Install wall and ceiling plates in accordance with the manufacturer's recommendations and approved Shop Drawings.

++ END OF SECTION ++

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SECTION 15518

HANGERS AND SUPPORTS FOR HVAC DUCTWORK, PIPING, AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install hangers and supports complete with required appurtenances for HVAC ductwork, piping, and equipment.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the hangers and supports for HVAC ductwork, piping, and equipment Work.
- C. Related Sections:
 - 1. Section 03600, Grouting.
 - 2. Section 05051, Anchor Systems.
 - 3. Section 05120, Structural Steel Framing.
 - 4. Section 05501, Miscellaneous Metal Fabrications.

1.2 REFERENCES

- A. American National Standards Institute (ANSI).
 - 1. ANSI B1.1 – Unified Inch Screw Threads (ASME B1.1).
- B. American Society of Civil Engineers (ASCE).
 - 1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM A36/A36M – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A47/A47M – Standard Specification for Ferritic Malleable Iron Castings.
 - 3. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 6. ASTM A575 – Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.

7. ASTM A668/A688M – Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
- D. American Welding Society (AWS).
 1. AWS B2.1 – Specification for Welding Procedure and Performance Qualification.
- E. Federal Specifications (FS).
 1. FS WW-H-171 – Hangers and Supports, Pipe.
- F. Manufacturers Standardization Society (MSS).
 1. MSS SP 58 – Pipe Hangers and Supports-Materials, Design and Manufacture.
 2. MSS SP 69 – Pipe Hangers and Supports - Selection and Application.
- G. National Fire Protection Association (NFPA).
 1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
- H. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 1. HVAC Duct Construction Standards – Metal and Flexible.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturer:
 - a. Minimum of five years of experience producing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years.
 2. Professional Engineer:
 - a. Engage a registered professional engineer legally qualified to practice in the jurisdiction where the Project is located and experienced in providing engineering services of the kind indicated.
 - b. Submit qualifications data.
 - c. Responsibilities include but are not necessarily limited to:
 - 1) Carefully reviewing system performance and design criteria stated in the Contract Documents.
 - 2) Preparing written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
 - 3) Preparing or supervising the preparation of design calculations and related drawings, Shop Drawings, testing plan development, test-result interpretation and a comprehensive engineering analysis verifying compliance of the system with the requirements of the Contract Documents.
 - 4) Signing and sealing all calculations and design drawings, and Shop Drawings.
 - 5) Certifying that:

- a) It has performed the design of the system in accordance with the performance and design criteria stated in the Contract Documents, and
 - b) The said design conforms to all applicable local, state and federal codes, rules and regulations, and to the prevailing standards of practice.
- 3. Installer:
 - a. Engage an experienced installer to perform the work of this Section who has specialized in installing hangers and supports for HVAC ductwork, piping, and equipment similar to that required for this Project and who is acceptable to manufacturer.
 - b. Submit name and qualifications to Engineer along with the following information on a minimum of three successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the hangers and supports for HVAC ductwork, piping, and equipment.
 - 3) Amount of area installed.
- 4. Welding:
 - a. Qualify processes and operators in accordance with AWS B2.1 as appropriate for material to be welded.
 - b. Provide certification that operators employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single hangers and supports for HVAC ductwork, piping, and equipment manufacturer.
 - 2. Require the hangers and supports for HVAC ductwork, piping, and equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the hangers and supports for HVAC ductwork, piping, and equipment manufacturer.
- C. Regulatory Requirements:
 - 1. International Building Code (IBC).
 - 2. National Fire Protection Association (NFPA).
 - 3. Local and State Building Codes and Ordinances.
 - 4. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, and installation details.
 - b. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 - c. Drawings showing floor supported components and installation arrangement.
2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Complete component list.
 - c. Detailed description of each component.
 - d. Catalog cut sheets for each component.
 - e. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
 - f. Other technical data related to specified material and equipment as requested by Engineer.
3. Delegated Design Submittals:
 - a. 1/4-inch scale HVAC ductwork, piping, and equipment layouts, dimensioned to show length of runs, with all expansion joints, alignment guides, anchors and appurtenances required for proper control of HVAC ductwork, piping, and equipment forces. The drawings shall include all forces acting on the HVAC ductwork, piping, and equipment and the corresponding reactions of the compensation and anchor devices provided.
 - b. All drawings, design calculations, and a letter indicating that the hanger and support systems have been properly designed shall be signed and sealed by a registered professional engineer legally qualified to practice in the jurisdiction where the Project is located.

B. Informational Submittals: Submit the following:

1. Certificates:
 - a. Independent certification reports.
2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
3. Source Quality Control Submittals:
 - a. Factory test reports.
4. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.
 - b. Professional Engineer, when requested by Engineer.
 - c. Installer, when requested by Engineer.
 - d. Welding, when requested by Engineer.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
 - 1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
 - 2. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of that Work.
 - 3. Comply with manufacturer's recommendations for rigging of equipment.
- B. Storage and Protection:
 - 1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
 - 2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
 - 1. All boxes, crates and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Design Criteria:
 - 1. Designs generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.
 - 2. Accurate weight balance calculations shall be made to determine the required force at each hanger and support location and the weight load at each force concentration point.
 - 3. Hangers and supports shall be capable of supporting and restraining HVAC ductwork, piping, and equipment in all conditions of operation. They shall allow free expansion and contraction, and prevent excessive stress resulting from transferred weight being induced into the HVAC ductwork, piping, and equipment.
 - 4. Hangers and supports shall be designed so that they cannot become disengaged by movements of the supported HVAC ductwork, piping, and equipment.
 - 5. Rod length shall be limited to a maximum length of eight linear feet.
 - 6. HVAC ductwork, piping, and equipment that cannot be hung by rod and hanger arrangement shall be floor or wall supported.

7. All structural components shall be designed based on static and dynamic loads imposed by the supported HVAC ductwork, piping, and equipment and shall include a safety factor of 2 for the yield strength. Minimum angle sizes shall be 2-inch x 2-inch x 1/4-inch.
8. Load ratings, materials and installation shall be consistent with the recommendations from the latest edition of MSS SP 58, MSS SP 69, and FS WW-H-171.
9. Where equipment is subject to wind, design anchorage to supporting structure to resist wind loads per applicable building code using wind load factors indicated on structural Drawings.
10. Hanger and support design calculations for all HVAC ductwork, piping, and equipment shall be signed and sealed by a registered professional engineer legally qualified to practice in the jurisdiction where the Project is located.

2.2 MANUFACTURERS

- A. Manufacturer: Provide product of one of the following:
 1. Erico International Corporation.
 2. Anvil International.
 3. Or equal.

2.3 DETAILS OF CONSTRUCTION

- A. Materials:
 1. Hangers, supports, restraints, and appurtenances located indoors shall be Type 316 stainless steel.
 2. Hangers, supports, restraints, and appurtenances located outdoors shall be Type 316 stainless steel.
 3. Steel used for the support of uninsulated copper piping or plastic piping shall be PVC coated.
- B. Components of hangers and supports shall conform to the following:
 1. Bolts: ASTM A307, Grade A, unless otherwise specified below.
 2. Forgings: ASTM A668/A688M.
 3. Malleable Iron: ASTM A47/A47M.
 4. Rods and Bars: ASTM A575.
 5. Threads: Unified Screw Threads, Class 2A and 2B, ANSI B1.1.
 6. Structural Steel: ASTM A36/A36M.
- C. Hanger Attachments: The following types of attachments shall be considered acceptable:
 1. Adjustable Steel Clevis: FS WW-H-171E, Type 1.
 2. Steel Double Bolt Pipe Clamp: FS WW-H-171E, Type 3.
 3. Steel Pipe Clamp: FS WW-H-171E, Type 4.
 4. Adjustable Swivel Pipe Ring: FS WW-H-171E, Type 6.
 5. Adjustable Steel Band Hanger: FS WW-H-171E, Type 7.
 6. Riser Clamp: FS WW-H-171E, Type 8.

7. Light-Duty Clevis Hanger: FS WW-H-171E, Type 12.
8. Long Clips: FS WW-H-171E, Type 26.
9. Offset J-Hooks: FS WW-H-171E, Type 27.
10. Steel Pipe Covering Protection Saddle: FS WW-H-171E, Type 40A.
11. Insulation Protection Shield: FS WW-H-171E, Type 41.
12. Pipe Saddle Support: FS WW-H-171E, Type 37.
13. Pipe Stanchion Saddle: FS WW-H-171E, Type 38.
14. Pipe Saddle Support with Base: FS WW-H-171E, Type 36.
15. Adjustable Roller Hanger: FS WW-H-171E, Type 42.

D. Structural Attachments: The following types of attachments shall be considered acceptable:

1. Side Beam Clamp: FS WW-H-171E, Type 20.
2. Center I-Beam Clamp: FS WW-H-171E, Type 21.
3. Welded Steel Bracket: FS WW-H-171E, Types 32 and 33.
4. Side Beam Bracket: FS WW-H-171E, Type 35.

E. Hanger Rod Attachments: Use as required to complete assembly:

1. Forged Steel Clevis: FS WW-H-171E, Type 14.
2. Adjustable Turnbuckle: FS WW-H-171E, Type 15.
3. Forged Steel Welders Eye Nut: FS WW-H-171E, Type 17.

F. Concrete anchorage shall be provided in accordance with Section 05051, Anchor Systems.

G. Structural steel shall be provided in accordance with Section 05120, Structural Steel Framing.

H. Miscellaneous metal fabrications shall be provided in accordance with Section 05501, Miscellaneous Metal Fabrications.

2.4 SOURCE QUALITY CONTROL

A. Shop Tests:

1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that the package meets the specified performance requirements including manufacturer's data report.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Surface Preparation:
 - 1. Attachment to hollow core slabs or double tee slabs shall be provided in accordance with details shown on the structural drawings to prevent damage to pre-stressing strands.

3.3 INSTALLATION

- A. General:
 - 1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
 - 2. Install in accordance with Laws and Regulations.
 - 3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
 - 4. Installation to conform to requirements of all local and state codes.
- B. Ductwork:
 - 1. The construction and installation of hangers and supports for ductwork shall conform to the recommendations given in the SMACNA HVAC Duct Construction Standards, except as specified.
 - 2. Hanger rods shall have threaded ends.
 - 3. All ductwork shall be supported from trapeze type hangers. No sheet metal duct hangers or straps will be allowed.
 - 4. A pair of rods shall be provided at each duct support point.
 - 5. For nonmetal ductwork, there shall be not less than a 1/4-inch buildup of FRP over the duct at each support. Each support shall be furnished with a 1/8-inch thick Teflon sheet to shield the duct from the support.
- C. Piping:
 - 1. Insulated pipes with vapor barriers shall have an insulation protection shield conforming to FS WW-H-171E, Type 41 tack-welded to hanger.
 - 2. Insulated pipes without vapor barriers shall have a steel protection saddle conforming to FS WW-H-171E, Type 40A.

3. All uninsulated copper piping shall be supported by plastic coated steel pipe attachments.
4. All piping shall be braced as required, to prevent sway in any direction.
5. All insulated piping 3-inch diameter and larger shall be supported by roller hangers with saddles conforming to FS WW-H-171E, Type 42.
6. Additional supports shall be placed immediately adjacent to any change in direction.
7. Supports for Vertical Piping:
 - a. Provide riser clamp placed under hub, fitting or coupling with approved solid bearing on steel sleeve at each floor level.
 - b. Where riser clamps are used with plastic piping they shall be modified so as not to exert any compressive forces on the pipe.
 - c. Support spacing shall not exceed code requirements.
8. Allow clearances for expansion and contraction of piping.

D. Anchorages and Base Plates:

1. Provide anchorages in new or existing concrete, as applicable, in accordance with equipment manufacturer's recommendations and the Contract Documents. Install anchors in accordance with Section 05051, Anchor Systems.
2. Where used, pour concrete bases up to one inch below equipment baseplate or support leg as applicable. Base with equipment mounted shall then be accurately shimmed to grade and spaces between filled with non-shrink grout in accordance with Section 03600, Grouting. After grout has reached its initial set, exposed edges shall be neatly cut back 1/2 inch.

3.4 ADJUSTING

- A. Adjust all equipment for proper settings.

3.5 CLEANING

- A. Thoroughly clean all equipment and accessories prior to installation.
- B. Remove all dirt, rust, dust, etc. from equipment and accessories after installation.
- C. Remove and dispose of all debris and waste from the Site resulting from installation.

3.6 SCHEDULES

- A. Hangers and Supports for Ductwork:
1. Spacing:
 - a. Ductwork shall be supported at distances not exceeding the spacing specified below:
 - 1) Metal Ductwork:
 - a) Maximum Spacing: 10 feet.

2. Hanger Rod Sizes:
 - a. Hanger rods shall be sized based on static and dynamic loads imposed by the supported ductwork and shall include a safety factor of 2 for the yield strength.
 - b. Rod load shall not exceed rod manufacturer's recommended capacity.

B. Hangers and Supports for Piping:

1. Spacing:
 - a. Piping shall be supported at distances not exceeding the spacing specified below or in accordance with MSS SP 69:
 - 1) Copper Tube:
 - a) Maximum Horizontal Spacing: 6 feet.
 - b) Maximum Vertical Spacing: 10 feet.
 - 2) Copper Pipe:
 - a) Maximum Horizontal Spacing: 12 feet.
 - b) Maximum Vertical Spacing: 10 feet.
 - 3) Steel Pipe:
 - a) Maximum Horizontal Spacing: 12 feet.
 - b) Maximum Vertical Spacing: 15 feet.
 - 4) PVC Pipe:
 - a) Maximum Horizontal Spacing: 4 feet.
 - b) Maximum Vertical Spacing: 6 feet.
2. Hanger Rod Sizes:
 - a. Hanger rods shall be sized based on static and dynamic loads imposed by the supported piping and shall include a safety factor of 2 for the yield strength.
 - b. Rod load shall not exceed rod manufacturer's recommended capacity.

C. Hangers and Supports for HVAC Equipment:

1. Provide spacing and hanger rod sizes in accordance with equipment manufacturer's installation instructions.

++ END OF SECTION ++

SECTION 15592

FACILITY FUEL-OIL PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install fuel-oil piping complete and operational with required accessories.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the fuel-oil piping Work.

C. Related Sections:

1. Section 09900, Painting.
2. Section 15052, Exposed Piping Installation.
3. Section 15055, Pipe Hangers and Supports.
4. Section 15100, Process and Civil Valves.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:

1. American National Standards Institute, (ANSI).
 - a. ANSI B16.3, Malleable Iron Treaded Fittings.
 - b. ANSI B36.10, Welded and Seamless Wrought Steel Pipe.
 - c. ANSI B125.1, Welded and Seamless Steel Pipe.
2. American Society for Testing and Materials, (ASTM).
 - a. ASTM A 53/A 53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - b. ASTM A 126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - c. ASTM B 283, Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).
3. Federal Specifications, (FS).
 - a. FS HH-1-558B, Insulation Blocks, Boards, Blankets, Felts, Sleeving, Pipe Fitting Covering.
 - b. FS WW-V-51F, Class B, Type 1 and Class A, Type IV, Valve, Angle, Check and Globe, Bronze (125, 150, and 200 pound).
 - c. FS WW-V-54, Valve, Gate, Bronze (125, 150, and 300 pound) Threaded Ends.
 - d. FS WW-V-58, Valves, Gate, Cast-Iron; Threaded and Flanged (for Land Use).

4. Institute of Electrical and Electronic Engineers, (IEEE).
5. National Electrical Code, (NEC).
6. National Electrical Manufacturers' Association, (NEMA).
7. National Fire Protection Association, (NFPA).
8. Underwriters' Laboratories, Incorporated, (UL).

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 1. Manufacturer shall have a minimum of five years of experience of producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Installer's Qualifications:
 1. Engage a single installer regularly engaged in fuel-oil piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
 2. Engage a single installer for the entire fuel-oil piping system with undivided responsibility for performance and other requirements.
- C. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 1. American National Standards Institute, (ANSI).
 2. Institute of Electrical and Electronic Engineers, (IEEE).
 3. National Electrical Code, (NEC).
 4. National Electrical Manufacturers' Association, (NEMA).
 5. National Fire Protection Association, (NFPA).
 6. Underwriters' Laboratories, Incorporated, (UL).
 7. Local and State Building Codes and Ordinances.
 8. Permits: CONTRACTOR shall obtain and pay for all required permits, fees and inspections.
- D. Component Supply and Compatibility:
 1. Obtain all equipment included in this Section, regardless of the component manufacturer, from a single fuel-oil piping manufacturer.
 2. The fuel-oil piping equipment manufacturer to review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the fuel-oil equipment manufacturer.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:

Long Beach WPCP Consolidation
Pump Station Conversion

15592-2
01722 of 1950

1. Shop Drawings:
 - a. 1/4-inch scale piping layouts, dimensioned to show length of piping runs, pipe sizes, support spacing and expansion provisions.
 - b. Drawings showing fabrication methods, assembly, accessories, installation details.
 - c. Complete equipment list.
 - d. Submit pipe schedule with laminate construction, sizes, thickness, vacuum pressure, weight per foot pressure, spans, joint type and flange data.
 - e. Details of installation, including pipe supports.
 2. Product Data:
 - a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
 - b. Other technical data related to specified material and equipment as requested by ENGINEER.
 - c. Detailed description of each component.
 - d. Catalog cut sheets.
 - e. Gasket material.
 - f. Flexible connections.
- B. Informational Submittals: Submit the following:
1. Supplier Instructions:
 - a. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 2. Qualifications Statements:
 - a. Installer's qualifications.
- C. Closeout Submittals: Submit the following
1. Operations and Maintenance Manuals:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operations and Maintenance Data.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports.

Protect steel members and packaged materials from corrosion and deterioration.

2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.
- C. Acceptance at Site:
1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer's instructions.

1.6 GENERAL REQUIREMENTS

- A. The Contract Documents show the general arrangement and extent of the Work to be completed. The exact location and arrangement of all parts shall be determined as the Work progresses. The exact location of all parts of the Work must be governed by the general building plans and the actual building conditions.
- B. The Drawings show an indication of the arrangement of equipment, piping, valves, etc., and are as nearly correct as can be determined in advance of the actual construction of the Work. The piping, equipment, etc. found to interfere with the construction of the building, plumbing apparatus and piping, electrical wiring or other obstructions, etc., must be changed in location to clear such obstructions.
- C. The connections shown to the various units are intended as an indication only. The actual connections at the time of installation to be made and arranged to suit the requirements of each particular case and adequately provide for expansion and perfect circulation and minimize the amount of space required for the same.
- D. The Drawings show the general arrangement of all systems. Should local conditions necessitate rearrangement of one or more of the systems, CONTRACTOR, before proceeding with the Work, shall prepare and submit complete drawings showing all details of the proposed rearrangement for written approval.
- E. The Drawings do not show all offsets, fittings, accessories and details, which may be required. CONTRACTOR shall carefully examine all of the General Construction, Electrical, Mechanical, Structural and other Drawings and the respective Specifications for conditions which may affect the installation of the Work, and shall arrange the Work accordingly, furnishing all required items to meet such conditions which are not specified as work "by others", to complete the systems to the true extent of the Contract Documents.

PART 2 - PRODUCTS

2.1 PIPING

A. Steel Pipe:

1. Pipe:
 - a. Reference, ANSI B36.10 and ANSI B125.1.
 - b. Type: Seamless steel pipe.
 - c. Weight: Schedule 40.
 - d. Finish: Black, unless otherwise noted.
 - e. End Finish: Plain.
2. Fittings:
 - a. Threaded:
 - 1) Reference: ANSI B16.3.
 - 2) Type: Malleable iron.

B. Containment Pipe:

1. General: All containment pipe systems shall be factory manufactured type piping systems. No field fabricated systems will be allowed. The system shall consist of carrier pipes, containment pipe, carrier pipe supports, special fittings, and end seals. The containment piping system shall be pre-fabricated and supplied by one manufacturer.
2. Carrier Pipe: Carrier pipes shall conform to Section 2.1.A of this specification.
3. Inner Pipe Supports: All pipe shall be aligned and supported within the casing with supports compatible with both the inner and outer pipes, and designed to allow free air and fluid movement within the containment pipe. The supports will be designed and spaced to carry the weight of the carrier pipes full of fluid while allowing the carrier pipe to expand and contract.
4. Outer Containment Casing: schedule 40 clear PVC designed to withstand 250 °F at 10 psig. The piping shall enable visual identification of leakage.
5. Fittings: All fittings and accessory items shall be factory prefabricated and made of the same materials as the containment. Fittings shall be capable of withstanding a 15 psi air test. All carrier and jacket fittings shall be air tested at the factory with the test reports for each fitting sent to the ENGINEER upon shipment of the pipe to the Site.
6. End Seals: Terminal ends of the system shall be equipped with end seals manufactured of the same material and to the same standards as the fittings.
7. Installation: The installation shall be made in accordance with the Contract Documents and manufacturer's installation drawings. The prefabricator shall provide a field service instructor on Site to train CONTRACTOR in all phases of the installation.
8. Manufacturers: Provide a complete engineered containment pipe system of one of the following:
 - a. IPEX
 - b. Rovanco Piping Systems.
 - c. Or equal.

2.2 PIPE INSULATION (NOT USED)

2.3 VALVES AND APPURTENANCES

- A. Manufacturers: Provide products of one of the following, except where noted:
 - 1. Stockham Valves & Fittings, Inc.
 - 2. Lunkenheimer Company.
 - 3. Or equal.
- B. Carbon Steel Ball Valves:
 - 1. Reference: ASTM B 283.
 - 2. Type: Two piece body with full port opening.
 - 3. Construction:
 - a. Body: Carbon Steel.
 - b. Ball: Stainless Steel.
 - c. Stem: Stainless Steel.
 - d. Stem seal: PTFE.
 - e. Seats: Reinforced Teflon.
 - 4. Non-blow out stem design.
 - 5. Quarter turn operation.
 - 6. Pressure Rating: Class 150, 600 psi WOG.
 - 7. End Connections: Screwed.
- C. Top Seal Fill Cap:
 - 1. Type: Heavy-duty corrosion resistant cap with padlockable toggle lever.
 - 2. Materials:
 - a. Cap and Link: Duratuff.
 - b. Pins: Stainless steel.
 - c. Gasket: Buna-N.
 - d. Color: Gray.
 - 3. Provide corrosion resistant padlock.
 - 4. Provide top seal adaptor between fill riser pipe and fill cap.
 - 5. Products and Manufacturers: Provide one of the following:
 - a. Dover Resources Company, OPW Division, Model OPW 634TT cap with 633T adaptor.
 - b. Or equal.

2.4 HANGERS AND SUPPORTS

- A. CONTRACTOR shall provide and install all hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances as required to mount equipment where shown. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances located outdoor shall be Type 316L stainless steel and those located in non-corrosive areas shall be painted galvanized steel.

2.5 REMOTE DIESEL FUEL FILL PORT

- A. CONTRACTOR shall provide remote fill port for ground level filling of fuel oil tank. Remote diesel fuel fill port shall be as manufactured by Clay & Bailey Manufacturing Company or approved equal.
 - 1. Model #: 6100-09-1810
 - 2. Type: 7-gallon
 - 3. Size: 3-inch
 - 4. Construction:
 - a. Body: 12GA Mild Steel
 - b. Lid: Non-sparking Aluminum
 - 5. Fittings: 2 1/2-inch Type 316 stainless steel camlock fitting for fuel supply hose. Fittings shall conform to the requirements of Section 15100 - Process and Civil Valves.
 - 6. Valves: 1/2-inch Type 316 stainless steel ball valve for drainage; 2-inch Type 316 stainless steel ball valve for fuel supply hose. Valves shall conform to the requirements of Section 15100 - Process and Civil Valves.
- B. The containment pipe system shall be pitched to drain back into the remote diesel fuel fill port. Watertight plastic adapters shall be installed at pipe entry points into the remote fill port.

2.6 PAINTING

- A. All piping and accessories shall be painted in accordance with the requirements of Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Install all items as shown, specified, and as recommended by the manufacturer.
 - 2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
 - 3. Present conflicts between piping systems and/or equipment and/or structures to ENGINEER, in writing, who will determine corrective measures to be taken.
 - 4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.
 - 5. Installation to conform to requirements of all local and state codes.
 - 6. Provide dielectric couplings between dissimilar metals.
 - 7. Protection: Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
- B. Piping:

1. All fuel-oil piping shall be Schedule 40 Black Steel. All fuel-oil supply and return piping shall sloped back to the storage tanks.
2. Fuel-oil piping located within the containment piping shall have welded connections; all other fuel-oil piping shall have threaded connections.
3. All fuel-oil vent piping located outside shall be galvanized steel.
4. Install vertical pipe truly plumb in all directions.
5. Install piping parallel or perpendicular to building walls. Piping at odd angles and 45 degree runs across corners will not be accepted, unless specifically shown.
6. Install piping generally as shown when specific locations and elevations are not indicated.
7. Provide temporary caps or plugs over all pipe openings at the end of each day's Work, or when otherwise required or directed, to prevent foreign material from entering the piping systems.
8. Cutting: Cut pipe from measurements taken at Site, not from the Drawings.
9. All piping to be tested for tightness before being covered, enclosed or placed in use.

C. Joints:

1. General:
 - a. Make joints in accordance with the pipe manufacturer's recommendations and the supplemental specifications below.
 - b. Cut pipe accurately and squarely and install without forcing or springing.
 - c. Ream out all pipe to full inside diameter after cutting.
 - d. Remove all cuttings and foreign matter from the inside of piping before installation.

D. Unions:

1. Provide unions where shown and where necessary to install or dismantle piping.
2. Provide dielectric couplings between ferrous and nonferrous piping connections.

E. Testing:

1. All equipment which may be damaged from overpressure shall be isolated from the test.
2. Piping shall be tested and proved tight under a compressed air pressure of not less than 1-1/2 times the working pressure under which it is to be used, but not less than 75 psig for four hours.

3.2 FIELD QUALITY CONTROL

A. Field Tests:

1. Fill all systems and fully test all equipment, valves, etc. in operation.
2. Check for excessive vibration while all systems are operating.

3. Installed systems and components will not be released to OWNER unless all systems have been tested and approved by the ENGINEER.
- B. Inspection:
1. Examine areas to receive equipment, piping, valves and accessories for:
 - a. Defects that adversely affect execution and quality of the Work.
 - b. Deviations beyond allowable tolerances for piping and accessories.
 - c. Start the Work only when conditions are satisfactory.
 2. The ENGINEER reserves the right to reject and/or authorize replacement of equipment, piping and accessories found to defective.

3.3 CLEANING

- A. Cleaning:
1. Thoroughly clean all piping, fittings, valves and accessories prior to installation.
 2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
 3. Remove and dispose of all debris and waste from the Site resulting from installation.

+ + END OF SECTION + +

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SECTION 15738
DUCTLESS SPLIT HEAT PUMP SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to furnish and install ductless split heat pump system complete and operational with accessories.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the ductless split heat pump system Work.
- C. Related Sections:
 - 1. Section 01730, Operation and Maintenance Data.
 - 2. Section 10400, Identification Devices.
 - 3. Section 15518, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

1.2 REFERENCES

- A. Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
 - 1. AHRI 210/240 – Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - 1. ASHRAE Standard 15 – Safety Standard for Refrigeration Systems.
- C. American Society for Testing and Materials (ASTM).
 - 1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 3. ASTM B280 – Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- D. National Electrical Code (NEC).
- E. National Electrical Manufacturers Association (NEMA).
- F. Underwriters Laboratories Inc. (UL).
 - 1. UL 1995 – Heating and Cooling Equipment.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer:
 - a. Minimum of five years experience producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section regardless of the component manufacturer from a single ductless split heat pump system manufacturer.
 - 2. Require the ductless split heat pump system manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the ductless split heat pump system manufacturer.
- C. Regulatory Requirements:
 - 1. National Electrical Code (NEC).
 - 2. National Fire Protection Association (NFPA).
 - 3. Underwriters Laboratories Inc. (UL).
 - 4. Local and State Building Codes and Ordinances.
 - 5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.
- D. Certifications:
 - 1. Ductless split heat pump system shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the National Electric Code.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Drawings showing fabrication methods, assembly, accessories, installation details, and wiring diagrams.
 - b. Detailed drawings of each individual component's wiring diagrams.
 - c. Detailed drawings of control panel layout.
 - d. Detailed installation drawing of each individual component showing:
 - 1) Mounting requirements.
 - 2) Locations (panel, field, etc.).
 - 3) Piping, and wiring connections, labeled and coded.
 - e. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.
 - 2. Product Data:

- a. Manufacturer's literature, illustrations, specifications, weight, dimensions, required clearances, materials of construction, and performance data for all equipment.
- b. Complete component list.
- c. Detailed description of each component.
- d. Catalog cut sheets for each component.
- e. Fan performance curves with operating points.
- f. Deviations from Contract Documents. Any exceptions to the Contract Documents must be clearly defined. Contractor shall be responsible for any additional expenses that may occur due to any exception made.
- g. Lubricant Specification: Furnish lubricant specification for type and grade required for equipment furnished.
- h. Other technical data related to specified material and equipment as requested by Engineer.

B. Informational Submittals: Submit the following:

- 1. Certificates:
 - a. Certification of unit painting systems in accordance with "Finishing" Paragraph in this Section.
 - b. Independent certification reports:
 - 1) UL Label or equal.
 - 2) AHRI Label.
- 2. Manufacturer Instructions:
 - a. Instructions and recommendations for handling, storing, protecting the equipment.
 - b. Installation Data.
 - c. Instructions for handling, start-up, and troubleshooting.
- 3. Source Quality Control Submittals:
 - a. Written report presenting results of required shop testing.
 - b. Factory test reports.
- 4. Field Quality Control Submittals:
 - a. Written report presenting results of required field testing.
- 5. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service personnel, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
- 6. Qualifications Statements:
 - a. Manufacturer, when requested by Engineer.

C. Closeout Submittals: Submit the following:

- 1. Operations and Maintenance Data:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.

- b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operation and Maintenance Data.
 - 2. Warranty Documentation:
 - a. General warranty.
 - b. Special warranties on materials and equipment.
- D. Maintenance Material Submittals: Furnish the following:
 - 1. Spare Parts:
 - a. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended, and the unit price of each part.
 - 2. Tools:
 - a. Two sets of fin combs for each fin spacing required.
 - 3. Tools shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

1.5 WARRANTY

- A. General Warranty: The special warranties specified in this Paragraph shall not deprive Owner of other rights or remedies Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under the Contract Documents. The obligations of Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special warranties.
- B. Special Warranties on Materials and Equipment:
 - 1. Provide manufacturer's written warranty, running to the benefit of Owner, agreeing to correct, or at option of Owner, remove or replace materials or equipment specified in this Section found to be defective during a period of years as listed below after the date of Substantial Completion.
 - a. Compressors shall carry a minimum 6 year non-prorated warranty.
 - b. All other components not listed above shall carry a minimum 5 year non-prorated warranty.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Equipment Description:
 - 1. Units shall be completely factory assembled and tested, and internally piped and wired. Units shall consist of indoor air conditioners (indoor units) with filters, evaporator coils, supply fans, motors, and remotely located outdoor heat pumps (outdoor units).
 - 2. Units shall include all unit mounted controls, wiring, and accessories.

3. Indoor units and refrigerant pipes shall be purged with dry air before shipment from the factory.
4. Outdoor units shall be pre-charged with refrigerant for a minimum of 70 feet of refrigerant tubing.

B. Design Criteria:

1. Design conditions shall be as indicated on the Equipment Schedule.
2. Units shall conform and be certified to the latest editions of ASHRAE Standard 15 and UL 1995.

C. Performance Criteria:

1. Minimum performance data for each unit shall be as indicated on the Equipment Schedule. Provided equipment shall not exceed scheduled total power.
2. Units shall meet or exceed the Energy Efficiency Ratio (EER) shown on the Equipment Schedule when tested in accordance to the latest editions of AHRI Standard 210/240.
3. Outdoor units shall be capable of cooling operation down to 0 degree F ambient temperature without additional low ambient controls.
4. Outdoor units configured as heat pumps shall be capable of heating operation down to -13 degree F ambient temperature.
5. Outdoor units shall be able to operate with a maximum height difference of 100 feet between indoor and outdoor units.
6. System shall be capable of operating up to a minimum refrigerant tubing length of 100 feet between indoor and outdoor units without the need for line size changes, traps or additional oil.

2.2 DETAILS OF EQUIPMENT

A. Ceiling-Recessed Cassette Air Conditioners:

1. Product and Manufacturer: Provide one of the following:
 - a. Model PLA, as manufactured by Mitsubishi Electric.
 - b. X Series, as manufactured by Sanyo.
 - c. Or equal.
2. Cabinet:
 - a. Cabinet shall be formed from galvanized sheet metal coated with high-density foam insulation.
 - b. Cabinet shall be for recessed mounting and provided with four corner mounting supports behind removable corner pockets in grille assembly allowing adjustment of mounting height from front of unit.
 - c. White grille assembly shall be attached to the front of the cabinet to provide supply air vanes in four directions and a center mounted return air section. Four-way grille shall allow two, three, or four-way blow.

- d. Cabinet panel shall have provisions for a field installed filtered outside air intake.
- e. Cabinet shall have a knock-out to provide a branch air duct for conditioning a secondary space.
- 3. Evaporator Coil:
 - a. Coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. All tube joints shall be brazed with PhosCopper or silver alloy.
 - b. Coil shall be pressure tested at the factory.
 - c. Coil shall be furnished with a condensate pan and drain.
 - d. Unit shall include a built-in, automatic condensate pump that will be able to raise condensate 23 inches above the drain pan. The condensate pump shall be equipped with a positive acting liquid level sensor to shut down the indoor unit if liquid level in the drain pan reached maximum level.
- 4. Supply Fans:
 - a. Direct drive, turbo propeller fan shall be driven by a single motor.
 - b. Multi-speed fan motor shall have permanently lubricated bearings.
 - c. Fan shall have a selectable AUTO fan setting that will adjust the fan speed based on the difference between controller setpoint and sensed space temperature.
- 5. Vanes:
 - a. Motorized adjustable air outlet system shall provide two-way, three-way, or four-way airflow with switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
 - b. Vane angles shall be individually adjustable from the remote controller to customize the airflow pattern for the conditioned space.
 - c. Vanes shall have five fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
 - d. Vanes shall have the selectable capability to randomly cycle the vanes up and down to evenly heat the space in the heating mode.
- 6. Filter:
 - a. Return air shall be filtered by means of an easily removable, washable polypropylene honeycomb filter.

B. Outdoor Units:

- 1. Product and Manufacturer: Provide one of the following:
 - a. Model PUZ, as manufactured by Mitsubishi Electric.
 - b. CH Series, as manufactured by Sanyo.
 - c. Or equal.
- 2. Units shall be configured as an air-source heat pump and shall include a four-way solenoid valve and compressor muffler.
- 3. Cabinet:

- a. Casing shall be fabricated of galvanized steel.
 - b. Mounting feet shall be provided and shall be welded to the base of the cabinet.
 - c. Removable panel sections shall allow easy access to all serviceable parts.
 - d. Fan grill shall be constructed from ABS plastic.
 - e. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas.
4. Condenser Fans:
- a. Direct drive fan and motor shall be configured for horizontal discharge airflow.
 - b. Fan blades shall be of aerodynamic design for quiet operation and the fan motor bearings shall be permanently lubricated.
 - c. Fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front.
 - d. Fan shall be provided with a raised guard to prevent external contact with moving parts.
5. Condenser Coil:
- a. Copper tubing with flat aluminum fins.
 - b. Protected with an integral metal guard.
6. Compressors:
- a. Hermetically sealed, variable speed, rotary or scroll type. Compressor shall be equipped with an internal thermal overload.
 - b. Driven by inverter circuit to control compressor speed.
 - c. In lieu of a crankcase heater, minimal amount of current shall be automatically and intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant during the off cycle to prevent liquid accumulation.
 - d. Mounted so as to avoid transmission of vibration.
7. Refrigeration System:
- a. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be control by a microprocessor controlled step motor.
 - b. System shall include an accumulator, high pressure safety switch, refrigerant line filter driers (strainers), Schrader type service fittings (stop valves) for liquid and suction connections, and service ports.

2.3 ACCESSORIES

A. Hangers and Supports:

- 1. Hangers and supports shall be provided in accordance with Section 15518, Hangers and Supports for HVAC Ductwork, Piping, and Equipment.

B. Refrigerant Piping and Insulation:

1. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, Type ACR, meeting ASTM B280 requirements.
2. Refrigerant piping shall be individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material.
3. Insulation shall have a maximum thermal conductivity of 0.27 Btu-in/hr-sq ft-degree F at 75 degrees F and a maximum water vapor transmission of 0.08 perm-in.
4. Insulation shall have a maximum Flame Spread Index of 25 and a maximum Smoke Developed Index of 50 when tested in accordance with ASTM E84.

C. Stainless Steel Protective Jacketing:

1. All refrigerant piping outdoors shall be provided with protective jacketing.
2. Product and Manufacturer: Provide one of the following:
 - a. Model Strap-On, as manufactured by Pabco-Childers Metals.
 - b. Model Insul-Mate, as manufactured by RPR Products, Inc.
 - c. Or equal.
3. Material: Smooth Type 316 stainless steel, Standard 2B mill finish.
4. Thickness: 0.016-inch.
5. Moisture Retarder: 3-mil thick coextrusion of polyethylene and DuPont's Surlyn.
6. Fastening: Continuous modified Pittsburgh Z-lock longitudinal seam with self-gauging 2-inch built-in overlap.
7. Bands: 1/2-inch stainless steel bands with wing seals.
8. Fittings:
 - a. Type: Pre-fabricated Type 316 stainless steel fittings.
 - b. Thickness: 0.016-inch.

D. Outdoor units shall be provided with wind baffle for low ambient cooling operation.

E. BACnet communication card for interfacing with the HVAC Control and Monitoring System Panel.

2.4 FINISHING

A. Outdoor units shall be provided with a full seacoast protection package which include the following features:

1. Casings shall be fabricated with alloyed galvanized sheet metal with thermoset polyester-resin coating on internal and external surfaces.
2. Compressor covers shall be fabricated with galvanized-aluminum sheet metal with thermoset polyester-resin coating on internal and external surfaces.
3. Electrical panels shall be fabricated with galvanized-aluminum sheet metal with thermoset polyester-resin coating on external surface.

4. Fan motor supports shall be fabricated with galvanized steel with thermoset polyester-resin coating on internal and external surfaces.
5. Printed circuit boards shall be coated with epoxy resin and polyurethane top coat on external surface.

2.5 CONTROLS

- A. Sequence of Operations:
 1. AC-1 thru 3 shall each be controlled by its own factory provided thermostat controller set to maintain the space at 78°F for cooling and 55°F for heating.
- B. Unit shall be completely factory wired with the necessary controls, starters, contactors and terminal blocks for power and control wiring.
- C. A color-coded circuit diagram of the approved electrical drawing shall be provided with the unit.
- D. All electrical components shall bear the UL label.
- E. Unit shall be designed for single point electrical connection. All necessary power transformers shall be factory provided and installed.
- F. The system shall be capable of satisfactory operation within voltage limits of 198 VAC to 253 VAC, 1 Phase, 60 Hz.
- G. The power to the indoor unit shall be supplied from the outdoor unit. A factory provided three AWG-14 wire conductors with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. The outdoor unit shall have Pulse Amplitude Modulation circuit to utilize 98 percent of input power supply.
- H. The control system shall consist of a minimum of two microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. The outdoor unit shall be controlled by the microprocessor located in the indoor unit using 24 VDC pulse control signal.
- I. The indoor unit control board shall have auxiliary control contact connectors to provide:
 1. Heat Recovery.
 2. Back-up Heat.
 3. Remote Switch.
 4. Central Control.
 5. IP Terminal.
- J. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and

processing commands from a wireless or wired controller, providing emergency operation and controlling the outdoor unit.

- K. The system shall include a 3-minute time delay mechanism, an automatic restart function when power is restored after power interruption, and a test run switch.
- L. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the controller panel.
- M. Remote Controllers:
 - 1. Wired, Wall Mounted:
 - a. Remote controller shall be approximately 5-inch by 5-inch in size and white in color with a light-green LCD display.
 - b. The control voltage from the wired controller to the indoor unit shall be 12/24 VDC.
 - c. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices. Up to two wired controllers shall be able to be used to control one unit.
 - d. Controller shall support a selection from multiple languages (Spanish, German, Japanese, Chinese, English, Russian, Italian, or French) for display information.
 - e. Controller shall include be a built-in weekly timer with up to 8 pattern settings per day.
 - f. Controller shall consist of an ON/OFF button, Increase/Decrease Set Temperature buttons, a Cool/Auto/Fan/Dry mode selector, a Timer Menu button, a Timer ON/OFF button, Set Time buttons, a Fan Speed selector, a Ventilation button, a Test Run button, and a Check Mode button.
 - g. Controller shall have a built-in temperature sensor.
 - h. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C), and temperature changes shall be by increments of 1 degree F (0.5 degree C).
 - i. Controller shall have the capability of controlling up to a maximum of 16 systems, as a group with the same mode and temperature setpoint for all, at a maximum developed control cable distance of 1,500 feet.
 - j. Basic functions of the controller shall include:
 - 1) ON/OFF for run and stop operation.
 - 2) Operation mode for switching between Cool/Dry/Auto/Fan/Heat.
 - 3) Temperature setpoints:
 - a) Cool/Dry: 67-87 degrees F.
 - b) Heat: 63-83 degrees F.
 - c) Auto: 67-83 degrees F.
 - 4) Fan speed settings.
 - 5) Air flow direction settings.
 - 6) Scheduling.

- 7) Operating conditions and error code display.
- 8) Ventilation control.
- 9) Auto lock out function for setting or releasing of all buttons.

2.6 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10400, Identification Devices.

2.7 SOURCE QUALITY CONTROL

- A. Shop Tests:
 1. Equipment shall be completely manufactured and pre-assembled in accordance with Reference Standards. Perform the following tests and inspections at factory before shipment:
 - a. Tested and inspected for approval as a unit by Underwriters Laboratories Inc., UL Label or equal.
 - b. Factory test equipment to ensure that the entire package has been properly fabricated and assembled, that all the controls function as specified herein and that the package meets the specified performance requirements including manufacturer's data report.
 - c. Fan wheels and shafts shall be statically and dynamically balanced.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
- B. Take field measurements where required prior to installation to ensure proper fitting of Work.

3.2 PREPARATION

- A. Protection of Surrounding Areas/Surfaces:
 1. Openings and penetrations shall be capped to protect the building from outside conditions.
 2. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.

3.3 INSTALLATION

- A. General:

1. Install the equipment in accordance with the Contract Documents and by manufacturer's instructions and recommendations. Obtain written interpretation from Engineer in the event of conflict between manufacturer's instructions and recommendations and the Contract Documents.
2. Install in accordance with Laws and Regulations.
3. Do not modify structures to facilitate installation of equipment, unless approved in writing by Engineer.
4. Installation to conform to requirements of all local and state codes.

3.4 FIELD QUALITY CONTROL

A. Field Tests:

1. After equipment installation is complete, Contractor and a qualified field service representative of unit manufacturer shall perform an operating test and a sound test of each unit and associated controls, in presence of Engineer. Equipment will pass the test when each unit and its controls are demonstrated to function correctly, and sound levels do not exceed maximum limits.
2. Running Tests:
 - a. Field-test each equipment together with its controls and appurtenances. Tests shall demonstrate to Engineer that each part and all parts together function in accordance with the Contract Documents. Provide all necessary testing equipment, labor, and appurtenances.
 - b. Verify that equipment operates at design point as intended, that vibration limits are not excessive and beyond manufacturer's recommendations, and that equipment operates smoothly without excessive noise, temperature rise, or other defects, across entire range of operating curve. Verify that all controls work as intended in both manual and automatic mode. Successfully test-operate each equipment for at least 8 hours.
 - c. If equipment does not comply with the Contract Documents and does not pass the tests, Contractor shall adjust, modify, and retest the equipment as often as necessary until tests are successfully passed.

B. Manufacturer's Services:

1. Provide a qualified, factory-trained service person to perform the following:
 - a. Instruct Contractor in installing equipment.
 - b. After installation, inspect and adjust equipment, verify proper operation, and assist with field testing.
 - c. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
2. Manufacturer's service person shall make visits to the Site as follows:
 - a. First visit shall be for instructing Contractor in proper equipment installation, and assisting in installing equipment. Minimum number of hours on-Site: 4 hours.

- b. Second visit shall be for checking completed installation, start-up of system; and performing field testing. Minimum number of hours on-Site: 4 hours.
 - c. Third visit shall be to instruct operations and maintenance personnel.
 - 1) Furnish services of manufacturer's qualified, factory-trained specialists to instruct operations and maintenance personnel in recommended operation and maintenance of equipment.
 - 2) Training requirements, duration of instruction, and qualifications shall be in accordance with Section 01730, Operation and Maintenance Data.
 - 3) Number of hours on-Site shall be in accordance with Section 01730, Operation and Maintenance Data.
 - d. Technician shall revisit the Site as often as necessary until installation is acceptable.
3. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.5 ADJUSTING

- A. Adjust all controls for proper settings.
- B. While system is operable, balance all equipment to achieve design conditions.

+ + END OF SECTION + +

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SECTION 15990

TESTING, ADJUSTING, AND BALANCING

GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to perform the testing, adjusting, and balancing for all systems described in Article 3.4 below.
- B. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the testing, adjusting, and balancing Work.
- C. Related Sections:
 - 1. Section 01730, Operations and Maintenance Data.
 - 2. Section 10400, Identification Devices.

1.2 REFERENCES

- A. Associated Air Balance Council (AABC).
 - 1. AABC National Standards for Total System Balance.
- B. American National Standards Institute/American Industrial Hygiene Association (ANSI/AIHA).
 - 1. ANSI/AIHA Z9.5 – Laboratory Ventilation.
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
 - 1. ASHRAE Handbook – Fundamentals.
- D. National Environmental Balancing Bureau (NEBB).
 - 1. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
 - 1. SMACNA HVAC Systems – Testing, Adjusting & Balancing Handbook.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Balancer:

- a. Engage an experienced balancer to perform the Work of this Section who has specialized in testing, adjusting, and balancing HVAC and Odor Control systems and similar to that required for this Project.
 - b. Minimum of five years of experience in testing, adjusting, and balancing substantially similar equipment and able to show evidence of at least five installations in satisfactory operation for at least five years.
 - c. Submit name and qualifications to Engineer along with the following information on a minimum of five successful projects:
 - 1) Names and telephone numbers of owners, architects or engineers responsible for projects.
 - 2) Approximate contract cost of the testing, adjusting, and balancing Work.
 - 3) Amount of area tested, adjusted, and balanced.
 - 4) Biographical information on employee proposed to directly supervise the testing, adjusting, and balancing Work.
- B. Regulatory Requirements:
- 1. Associated Air Balance Council (AABC).
 - 2. National Electrical Code (NEC).
 - 3. National Environmental Balancing Bureau (NEBB).
 - 4. National Fire Protection Association (NFPA).
 - 5. Underwriters Laboratories Inc. (UL).
 - 6. Local and State Building Codes and Ordinances.
 - 7. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following:
- 1. Product Data:
 - a. Data sheets with name of devices, manufacturer's name, model number, latest date of calibration, and correction factors for each testing, adjusting, and balancing instruments.
 - b. Other technical data related to specified material and equipment as requested by Engineer.
- B. Informational Submittals: Submit the following:
- 1. Certificates:
 - a. Certification by National Environmental Balancing Bureau (NEBB), Association Air Balance Council (AABC), or equal.
 - 2. Source Quality Control Submittals:
 - a. Specimen copies of report forms for Engineer's review and approval.
 - 1) Forms shall be 8-1/2 by 11-inch paper for loose-leaf binding, with blanks for certification of report and listing all required testing, adjusting, and balancing requirements and ratings.
 - 3. Field Quality Control Submittals:

- a. Written startup and field test reports presenting results of required field testing, adjusting, and balancing.
 - 1) Certified reports shall be in typed format on approved forms imprinted with the company's name.
 - 2) Reports shall include procedure outline used to test, adjust, and balance the systems and the types of instruments used.
 - 3) Minimum three certified copies of testing, adjusting, and balancing reports to the Engineer for review.
 - 4) Reports must be submitted to Engineer and Owner for approval prior to Owner's acceptance for responsibility.
 - 4. Qualifications Statements:
 - a. Balancer, when requested by Engineer.
- C. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data:
 - a. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, and spare parts information.
 - b. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01730, Operations and Maintenance Data.

1.5 SITE CONDITIONS

- A. HVAC Environmental Requirements:
 - 1. Testing, adjusting, and balancing shall be performed when outside ambient conditions are approximate to the local ASHRAE Handbook – Fundamentals design conditions for all heating and cooling functions.

PART 2 - PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Equipment Description:
 - 1. Air Balance Instruments:
 - a. Provide all velometers, anemometers, pitot tubes, differential air pressure gages, manometers, hook gages, static pressure probe units, and all other instruments and accessories as required to perform all air balance tests of equipment, ducts, registers, grilles, etc.
 - b. Flow-measuring hoods (manufactured, not fabricated) shall be acceptable for measurement of ceiling diffuser performance only.
 - 2. System Performance Measuring Instruments:
 - a. Provide insertion thermometers, sling psychrometers, tachometers, revolution counters, clamp-on volt-ammeter recorders, and other

instruments as required to measure all facets of the complete systems performance.

B. Performance Criteria:

1. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards demanded by these organizations.

2.2 ACCESSORIES

A. Balancing Sheaves and Belts:

1. Balancing sheaves and belts shall be provided for all belt driven equipment.
2. Sheaves and belts shall be provided to match construction and duty provided by the equipment manufacturer.
3. Equipment sheaves and belts replaced or not required to achieve balancing shall be submitted to the Owner as spare parts.

2.3 IDENTIFICATION

- A. All equipment and component identification shall be provided in accordance with Section 10400, Identification Devices.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Equipment and components shall be completely installed and in continuous operation, as required, to accomplish the testing, adjusting and balancing Work specified.
- B. Inspect all equipment and components for proper operation prior to testing, adjusting and balancing.
1. Fan Belt Deflection: Not less than 1/4-inch or more than 1/2-inch.
 2. Finned Coils: Plate type fins shall be combed out with a fin comb for the appropriate fin spacing. Helical fins shall be straightened with blunt bladed instrument.
- C. Pre-Startup Inspection:
1. Verify proper equipment mounting and setting.
 2. Verify that control, interlock and power wiring is complete.
 3. Verify alignment of motors and drives.
 4. Verify proper piping connections and accessories.
 5. Verify that lubrication is completed.
- D. First Run Observations:
1. Verify direction of rotation.

2. Verify setting of safety controls.
 3. Monitor heat build-up in bearings.
 4. Check motor loads against nameplate data.
- E. Equipment Check:
1. Verify proper overload heater sizes.
 2. Verify function of safety and operating controls.
 3. Verify proper operation of equipment.
 4. Report on inspection, observation and checking procedures.
- F. Promptly report defects which may affect the Work to Engineer.
- G. Should corrective measures caused by faulty installation require re-testing, adjusting and balancing, such Work shall be at no additional cost to the Owner.

3.2 APPLICATION

- A. General:
1. Test, adjust, and balance all systems, ductwork, piping, etc. and their control systems in accordance with the AABC National Standards for Total System Balance, NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems, SMACNA HVAC Systems – Testing, Adjusting & Balancing Handbook, or in compliance with the standard procedure manual published by the testing, adjusting, and balancing organization affiliated with Contractor. Contractor shall submit one copy of the standard procedure manual to the Engineer for their records.
 2. Contractor shall provide all necessary instruments, tools, ladders, etc. to complete all testing, adjusting, and balancing Work.
 3. Contractor shall assume full responsibility for safe keeping of all instruments, tools, ladders, etc. during the course of the Work.
 4. Contractor shall be solely responsible for the protection and safeguarding of the Work and shall provide every protection against accidents, injury, and damage to persons and property.
 5. Contractor shall keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day's Work.
 6. Contractor shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.
 7. Contractor shall install additional access panels at no extra cost to the Owner, as is required to gain access to equipment concealed above ceilings, behind walls, or any other concealed space.
 8. Systems shall be tested, adjusted, and balanced with clean filters and strainers.
 9. Where equipment is provided with a variable speed controller (VSC) or variable frequency drive (VFD), balance the equipment first with the VSC or VFD and then with balancing dampers (air systems). All systems shall be optimized through the VSC or VFD by balancing with the minimum static pressure needed to meet design flow conditions.

B. Air Systems:

1. Preliminary:
 - a. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals.
2. Central Systems:
 - a. Test rpm for all equipment, including adjusting of each fan, air handling unit, and air conditioning unit to design requirements within the limits of mechanical equipment provided.
 - b. Test and record motor voltages and running amperes including motor nameplate data, and starter heater ratings for each unit as listed above.
 - c. Make pitot tube traverse of main supply, exhaust and return ducts, determine airflow at all fans and units and adjust fans and units to within five percent of design requirements.
 - d. Test and record system static pressure, suction and discharge.
 - e. Test and adjust system for design outside air, (cfm).
 - f. Test and adjust system for design recirculated air, (cfm).
 - g. Test and record heating apparatus entering air temperatures, (dry bulb).
 - h. Test and record cooling apparatus entering air temperatures, (dry bulb and wet bulb).
 - i. Test and record heating apparatus leaving air temperatures, (dry bulb).
 - j. Test and record cooling apparatus leaving air temperatures, (dry bulb and wet bulb).
 - k. Record all fan and air handling unit speeds.
 - l. Record air quantity delivered by each fan and air-handling unit.
3. Distribution:
 - a. Adjust volume dampers, control dampers, splitter dampers, etc., to proper design airflow in main ducts, branch ducts, and zones.
4. Air Terminals:
 - a. Identify each air terminal as to location and determine required flow reading.
 - b. Test and adjust each air terminal to within tolerance of design requirements as listed below.
 - 1) Positive Zones:
 - a) Diffusers and Supply Air Terminals: 0 percent to +10 percent.
 - b) Exhaust and Return Air Terminals: 0 percent to -10 percent.
 - 2) Negative Zones:
 - a) Diffusers and Supply Air Terminals: 0 percent to -10 percent.
 - b) Exhaust and Return Air Terminals: 0 percent to +10 percent.
 - 3) Neutral Zones:
 - a) All Air Terminals: -10 percent to +10 percent.
 - c. Test procedure on air terminals shall include recording comparison of required airflow and observed airflow, adjustment of terminal, and recording of final airflow.
 - d. Adjust flow patterns from air terminal units to minimize drafts to the extent that the design and equipment permits.

5. Verification:
 - a. Prepare summation of readings of observed airflow for each system, compare with required airflow, and verify that duct losses are within specified allowable range.
 - b. Verify design airflow at fans as described above.
 - c. If determined that the air system has not been properly balanced, Contractor shall rebalance and recheck all equipment and components in the presence of the Engineer and as accepted by the Engineer.

3.3 FIELD QUALITY CONTROL

- A. Balancer's Services:
 1. Provide a qualified, factory-trained service person to perform the following:
 - a. After equipment installation, inspect and adjust equipment, verify proper operation, and assist with field testing.
 2. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

3.4 SCHEDULES

- A. Test, adjust, and balance all HVAC equipment

++ END OF SECTION ++

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SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General electrical requirements shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The Contractor shall provide all labor, materials and equipment required to perform the work as specified in the Specifications and as shown on the Contract Drawings. The work shall also include the following:
 - 1. Inserts and other electrical items which shall be installed embedded in concrete, or built into walls, partitions, ceilings or panels.
 - 2. Installation procedures and schedules of all trades shall be reviewed and coordinated with other Subcontractors regarding the installation of electrical items that must be installed.
 - 3. Keep informed of the construction so the electrical work shall be installed within such time periods as will not delay the work of the other Subcontractors.
 - 4. Notify other Subcontractors in advance of the installation of the work included, so they shall have sufficient time for coordination and installation of interrelated items that are included and that must be installed in conjunction with the work included under this Contract.
- C. The existing plant will be maintained in continuous operation during the entire construction period. Work shall be so scheduled and conducted that such work will not impede any treatment process, reduce the quality of the plant effluent or cause odor or other nuisance. In performing the work shown and specified, the Contractor shall plan and schedule his work to meet the plant and collection system operating requirements.
- D. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done at no additional cost and provided that all requirements of these specifications are fulfilled. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements outlined hereinafter. All references to days in this section are to consecutive calendar days, except

where noted. All references to schedule completion dates shall mean the date noted in the latest revision of the CPM schedule.

1.2 RELATED SPECIFICATIONS

- A. Specification 01700 – Maintenance of Plant Operations
- B. Specification 09900 – Painting.
- C. Specification 16292 – Power Distribution System Coordination
- D. Specification 16036 – Testing

1.3 PAYMENT

- A. Payment for general electrical requirements shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. General electrical requirements shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. NEMA, National Electrical Manufacturers Association.
 - 3. UL, Underwriters Laboratories Incorporated.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Point-to-point field wiring diagrams.
 - 2. Qualifications of proposed wiring coordinator who shall prepare the point-to-point field wiring diagrams.
- C. Reports: Demonstration of equipment report shall be submitted.

1.6 QUALITY ASSURANCE

A. General:

1. All equipment and devices provided shall be properly connected and interconnected with other equipment and devices so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Contract Drawings.
2. Similar products shall be by the same manufacturer for uniformity on the Contract.
3. Electrical material and equipment shall be new and shall bear the label of UL, or other nationally recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.
4. Where execution of the work under this Contract requires certain systems and equipment to be modified, the Contractor shall perform the work with due regard to maintenance of operations and construction staging in accordance with the Specifications.
5. The modification work shall be coordinated in advance with the plant superintendent and existing conditions. Contractor shall field determine and make such investigations as required to determine the functionality of each circuit and identify circuit terminations as required for the modifications intended to ensure the proper interface of all components for a complete functional system.
6. The Contractor shall retain the services of a wiring coordinator, to prepare the point-to-point field wiring diagrams. The wiring coordinator shall have experience in the development of the diagrams of the type specified and shall have served in a similar role on a project of similar size and complexity.

B. Area Classifications:

1. Materials and equipment for all areas shall conform to the area electrical and NEC hazardous classifications shown on the Contract Drawings or stated in the specifications.
2. Materials and equipment for all outdoor areas shall conform to corrosive requirements, unless shown otherwise on the Contract Drawings or stated in the Specifications.
3. The locations and requirements shall be in accordance with the following:
 - a. Materials, equipment, and incidentals installed in corrosive areas shall meet NEC and NEMA requirements for corrosive locations. Enclosures installed in corrosive locations shall meet NEMA 4X requirements.
 - b. Materials, equipment, and incidentals installed in hazardous locations shall meet NEC requirements for the Class and Division designated,

- Group D. Enclosures installed in hazardous locations shall be provided with stainless steel hardware and watertight gasketing.
- c. Materials, equipment, and incidentals installed within the dry location of the electrical building shall meet NEC and NEMA 12 requirements.

1.7 GENERAL CONSTRAINTS

- A. General: Under Paragraph 1.09, Sequence of Construction and Operation, herein, the sequence for units which are to be taken out of service for renovation and remedial work is outlined for each area. The operational status of completed or existing units other than the designated units shall not be interrupted by the Contractor. New units may only be used after the specified testing and acceptance of the units.
- B. Accidental Shutdown: In the event of accidental shutdown of plant equipment the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.
- C. Access to Plant Site: An unobstructed traffic route through the plant must be maintained at all times for the plant equipment and personnel.
- D. Access on Internal Roads: Vehicular access to the treatment units and buildings must be maintained at all times.
- E. Personnel Access: Treatment plant personnel must have access to all areas which remain in operation throughout the construction period. The construction work must be phased, and access for plant workers must be maintained during construction.
- F. Power, Light and Communication Systems: Electric power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas which remain in operation. Individual units may be disconnected as required for replacement.
- G. Sump Pumps and Sumps: All existing pumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.
- H. Service Interruptions:
1. When a construction task requires a suspension of normal operations of a plant utility system for a period of less than twenty-four (24) continuous hours, the suspension shall be considered a service interruption.
 2. The contractor shall compile an inventory of the labor and materials required to perform the tasks, an estimate of the time required and a written description of the steps required to complete the task resulting in a

service interruption. The inventory, time estimate and written procedure shall be submitted to the Engineer for review sixty (60) days prior to the start date of the task as defined in the CPM schedule. If the proposed procedure submitted by the Contractor is acceptable, the Engineer shall authorize in writing, the service interruption pending the verification of materials and labor and the final notification specified therein.

3. No service interruption shall be initiated until the list of materials and labor is verified by the Engineer as on site at least one week prior to the proposed start date. After verification of the list of materials and labor, the Contractor shall notify the Engineer of the exact date that he wishes to perform the work in writing two (2) normal working days, excluding Saturdays, Sundays and holidays, prior to the proposed date.
4. When the normal operations of a plant utility system unit are suspended longer than twenty-four (24) hours, then the procedures for a shutdown, specified hereinafter, shall be enforced.

1.8 PRIOR, CURRENT AND FUTURE CONSTRUCTION CONTRACTS

- A. Refer to Specification 01010 - Summary of Work

1.9 SEQUENCE OF CONSTRUCTION AND OPERATION

- A. In order to maintain continuous plant operation during construction, a phased removal, construction and operational sequence will be required.
- B. Refer to Specification 01700 – Maintenance of Plant Operations work phasing and sequencing requirements.

1.10 TEMPORARY FACILITIES

- A. Temporary facilities shall be provided in accordance with the requirements of Division 1, Maintenance of Plant Operations and Section 16020 – Temporary Electrical System.
- B. Temporary facilities shall be any equipment, materials, controls, services and accessories temporarily needed for access to and for protection of all existing structures and equipment, and to maintain an operating system, all in accordance with the provisions of these Specifications.
- C. The size or capacity of the temporary facility shall generally be equal to the size or capacity of the facility replaced, unless otherwise directed by the Engineer.

1.11 INTERIM AND TEMPORARY MATERIAL AND EQUIPMENT

- A. The Contractor shall furnish, install and remove the interim material and equipment in accordance with the Contract Documents.
- B. The Contractor is responsible for the removal from the site of all interim material and equipment and disposal thereof in accordance with the Specifications.
- C. Temporary material and equipment is material and equipment which must be furnished by the Contractor based on his method of construction for maintaining a treatment process for a specific period, or the utility or service systems during the installation or connection of new equipment or material. For specific cases, the location and general routing of temporary equipment and material has been shown for the convenience of the Contractor and to ensure minimal disruption of plant operations during the equipment installation. The Contractor is advised that temporary connection between the existing and new service shall be necessary to comply with the General Constraints specified herein.

1.12 ADDITIONAL PROVISIONS

- A. Shutdowns:
 - 1. Before commencing work on any of the existing equipment which requires a shutdown or suspension of normal operations, the Contractor shall request permission from the Engineer, in writing, at least sixty (60) days in advance of the date he proposes to commence such work. A date in a CPM schedule shall not constitute proper notification. In the request, the Contractor shall explain what construction procedures shall be used during the shutdown.
 - 2. The Contractor is prohibited from shutting down any treatment units or equipment before obtaining written authorization from the Engineer to proceed with such operations; such authorization shall, however, not be construed as a waiver of the requirements for the uninterrupted operation of the plant. A final notification in writing shall be submitted by the Contractor two (2) normal working days excluding Saturdays, Sundays and holidays, in advance of the actual shutdown.

- B. Protection of Underground and Covered Facilities: The location and extent of these facilities are not guaranteed, and the Contractor is cautioned to proceed with care, in the construction of new work in order to prevent damage to any existing structures, piping, or facilities. Protection and support for all underground facilities shall be provided to insure that the service provided for all existing facilities will not be interrupted. Any rerouting of the existing facilities to facilitate construction operation shall be only with written permission of the Engineer and then in the manner and at the time approved by the Engineer. The rerouting shall be made at no additional cost. Contractor shall pay for all damage to existing underground facilities that he causes and compensate the County for any service interruption caused by such damages.
- C. Special Protection of Machinery and Equipment:
1. The Contractor shall take all protective measures to the satisfaction of the Engineer necessary to insure that inclement weather or dust and debris from demolition does not enter any of the mechanical or electrical equipment enclosures. Enclosures shall be provided where necessary to prevent contamination of the air. All protective measures shall be furnished, installed, lighted, ventilated, maintained and removed at the Contractor's own cost. The Contractor shall pay for all damage to machinery and equipment caused by his failure to adequately protect it.
 2. Interior dustproof covers shall be a heavy reinforced polyethylene film curtain, minimum thickness 6 mils, supported by wood framing. All seams and penetrations shall be sealed with duct tape on two sides. Junctions with existing walls, floors and ceilings shall be made with a double fold secured with a backing strip anchored to the existing wall, floor and ceiling.
 3. Exterior weather tight enclosures shall be provided whenever a section of a roof or exterior wall on an existing building is removed or equipment is installed in a new building.
- D. Site Visit: The Contractor, before submitting his proposal, shall visit the site and shall be responsible for having ascertained local conditions, such as location, accessibility and general character of the site, the character and extent of any existing work within or adjacent to the site, and any other work being performed on the site at the time of submitting his proposal. The Contractor shall fully examine all the drawings relating to the work and shall become completely informed as to the extent and character of the work required and prevailing existing condition. No allowances will be made for the Contractor's failure to avail himself of such information.
- E. Existing Cables and Conduits
1. It is anticipated that several branch circuit conduits and/or lights may have to be routed, extended, relocated or temporarily removed and replaced, to permit the installation or removal of equipment by other trades under this Scope of Work. Review all drawings and allow for the rerouting or relocation of wiring systems and devices to remain which must be

relocated or rerouted. This Contractor shall include these costs in his bid price, and accomplish these rework items to suit field requirements and conditions.

2. When working with existing equipment or wiring systems, care shall be taken to avoid damage, and shutdown of process equipment. Prior to working in an area, Contractor shall examine existing conditions and file an inspection report with the Engineer. Any additional defects which result from the Contractor's work, will result in the Contractor being held liable for damage to existing equipment.
3. Where new construction involves connecting to or using existing equipment, the Contractor shall include in his bid price, all cost, work and materials required to adapt, extend or rework the prevailing existing "As Is" condition, to the new work. Should an existing condition prove to be grossly deteriorated or inadequate for modification, such condition shall be reported to the Engineer for a remedy.
4. Where existing empty conduits are to be used for new wiring systems, they shall be assumed to be in poor condition requiring prior "make ready" work before using. A wire brush reamer shall be pulled through prior to wiring and, if necessary, water accumulations shall be pumped or blown out.
5. Contractor shall trace and tag all wires before these are relocated and reconnected from the equipment. Contractor shall coordinate removal of wires with the Field Engineer.
6. The Contractor's attention is directed to the requirement that he shall work on an existing Sewage Treatment Plant which shall remain in operation.
7. As indicated on the plans, certain equipment and/or wiring systems are being taken out of active service permanently and the Contractor shall perform all work required to remove or safely abandon existing systems.
8. Contractor shall perform removals in accordance with Section 16035 - Demolition Electrical and the Contract Drawings. The Contractor shall arrange for the safe de-energization of all electrical equipment.
10. The Contractor shall be responsible for all damage to existing structures, equipment, and facilities caused by his construction operations and must repair all such damage when and as ordered at no additional cost.

- F. Emergency Repair Crews: In case the Contractor's operations disrupt the treatment process or the minimum operating facilities herein before described, at any time, he shall at his own cost immediately make all repairs or replacements and do all work necessary to restore the plant to operation to the satisfaction of the Engineer. Such work shall progress continuously to completion on a 24-hour day, seven work-day week basis. The Contractor shall provide the services of emergency repair crews, available on call 24 hours per day.

PART 2 - PRODUCTS

2.1 POINT-TO-POINT FIELD WIRING DIAGRAMS

- A. The Contractor shall provide point-to-point field wiring diagrams for all equipment, including equipment provided by other Subcontractors.
- B. The diagrams shall be developed for performance of the work and to document terminations. The diagrams shall be prepared based upon approved shop drawings of related Contracts, working drawings and inspections as necessary to complete the diagrams. The diagrams shall include:
 - 1. External wiring for each piece of equipment, panel, instrument and other devices to control stations, lighting panels and motor controllers. The diagrams shall include control, status, signal and power wiring. Power diagrams shall include connections to switchgear, motor control centers, panelboards, panels and field devices.
 - 2. Numbered terminal block identification for each wire termination.
 - 3. Identification of the assigned wire numbers and color coding for all interconnections.
 - 4. Identification of all wiring by the conduit tag in which the wire is installed.
 - 5. Terminal, junction, and pull boxes through which wiring is routed.
 - 6. Identification of equipment with functional name and number to which wiring is to be connected

2.2 SHOP FINISHES

- A. Electrical equipment shall be shop painted in accordance with the requirements of Specification 09900.
- B. Exposed ferrous metal surfaces except aluminum, bronze, brass and stainless steel components shall be cleaned with a commercial blast and primed with one coat of rust inhibitive primer.
- C. Manufactured assemblies such as switchgear, substations, motor control centers, panelboards and motor controllers shall be shop painted in accordance with the requirements of Specification 09900.
- D. Other equipment shall be painted with the manufacturer's best grade finish paint system compatible with the finish coatings specified in Specification 09900.

PART 3 - EXECUTION

3.1 MAINTENANCE OF OPERATIONS

- A. Where execution of the work under this Contract requires certain equipment to be taken out of service, the Contractor shall perform the work with due regard to

maintenance of operations and construction staging in accordance with the Specification Section 01700 Maintenance of Plant Operations.

- B. The Contractor shall schedule the work in advance with the Engineer so as not to affect proper plant operations. When the work is scheduled, the Engineer shall be notified 48 hours prior to proceeding with the work to allow time for the plant superintendent to perform load switching and alternation of equipment.
- C. To the maximum extent possible at the end of the workday, all equipment shall be back in place and ready for its normal service use should a plant emergency arise. In addition, should an emergency condition occur during execution of the work, at the request of the plant engineer, the equipment shall be placed back in service immediately and turned over to plant personnel.
- D. In the event of accidental shutdown of plant equipment the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

3.2 DEMONSTRATION OF EQUIPMENT

- A. The Contractor shall demonstrate, in the presence of the Engineer that all electrical systems and electrically operated equipment operates as specified, designed and as required.
- B. The demonstration of equipment shall include the following:
 - 1. All power circuits shall be operated to verify proper connection to equipment. Mechanical key-interlocks for circuit breakers shall be operated to verify their proper operation. Power shall be removed and reapplied to automatic transfer switches to verify their operation.
 - 2. Emergency power systems shall be activated to verify their automatic start-up, proper operation while running and proper deenergization and cool down upon availability of normal power.
 - 3. All pushbuttons, indicating lights and similar devices shall be operated to verify proper connection and function. All devices, such as pressure and flow switches and similar devices shall be operated to verify that shut-downs and control sequences operate as required.
 - 4. The Contractor, with coordination of the other Subcontractors, shall operate the systems to verify wiring and adjust the controls, as required, to achieve proper operation. This shall include wiring, timing and switching functions.
 - 5. Lighting and Receptacle Systems
 - a. All lighting systems shall be operated to verify proper switching and proper circuit wiring. Emergency lighting systems shall be operated to verify proper switching, circuit wiring and response to loss of primary power.

- b. Receptacle circuit wiring shall be verified to agree with panelboard schedules.
- 6. Protective relaying and breaker protection systems/settings shall be set and operated and detailed in Specification 16292 - Power Distribution System Coordination.
- 7. All instrumentation systems shall be operated to verify that wiring and data transmission is correct.
- 8. The Contractor shall coordinate the demonstration of the electrical systems which are part of other systems (HVAC, plumbing, mechanical, instrumentation) with the other Subcontractors. The Contractor shall operate the systems to verify that the wiring is correct and that all controls operate as required.

3.03 RESTORATION

- A. The Contractor shall field paint after installation marred or scratched surfaces. All scratches, abrasions and other damage to equipment shall be touch-up painted in accordance with the requirements of Specification 09900.

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SECTION 16020

TEMPORARY ELECTRICAL SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall provide all labor, materials, equipment, and incidentals as shown specified and required to furnish and install temporary electrical systems in accordance with the requirements of Specification 16020 - Temporary Electrical System.
- B. The temporary electric systems required involve obtaining two separate electric services from PSEG Long Island and providing distribution and lighting systems associated with each service and a portable rental generator.
- C. The two temporary services, the portable rental generator and the associated distribution and lighting systems required under this Section are interim in nature and shall be available for the entire construction period. The temporary services and systems required include the following:
 - 1. Service point No.1, for Contractor staging area including trailers, small tools, and lighting.
 - 2. Service point No.2, for Temporary distribution and lighting system.
- D. Service point No.2, the portable rental generator and the associated temporary distribution and lighting system shall supply power and light to the existing treatment plant facilities, the temporary bypass pumping system, and the Owner's temporary facilities including plant staff trailer complex and resident engineer trailer. The service point No.2 and associated temporary distribution system shall be complete and shall include all auxiliary equipment necessary to support the continued operation of the treatment plant, the bypass pumping system and the Owner's temporary facilities during construction.
- E. The temporary distribution and lighting system shall also include providing temporary internet service to the plant staff trailer complex as well as providing temporary controls for the treatment plant grit collection system.

1.2 RELATED SPECIFICATIONS

- A. Specification 16035 – Demolition Electrical.
- B. Specification 16036 – Testing.
- C. Specification 16061 – Grounding.

- D. Specification 16071 – Supporting Devices.
- E. Specification 16076 – Labelling and Identification.
- F. Specification 16271 – Dry Type Transformers.
- G. Specification 16300 – Utility Electrical Services.
- H. Specification 16400 – Switchboards.
- I. Specification 16441 – Panelboards.
- J. Specification 16442 – Electric Control Equipment Low Voltage AC Motors and Devices.

1.3 PAYMENT

- A. Payment for the temporary electrical system energy consumed for Service point No.1 shall be the Contractor's responsibility. Payment for the temporary electrical system energy consumed for Service point No.2 shall be the responsibility of Long Beach.
- B. Payment for furnishing, installing, energizing, maintaining, and removing the Service point No.1 and the associated temporary electrical system shall be the Contractor's responsibility.
- C. Payment for furnishing, installing, energizing, maintaining, and removing the Service point No.2 and the associated temporary distribution and lighting system, internet service and the grit collection system controls provided under this Contract shall be the Contractor's responsibility.

1.4 REFERENCES

- A. The temporary electrical work shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. National Electrical Safety Code.
 - 3. Local Codes
 - 4. Local Utility Requirements
 - 5. OSHA Regulations

1.5 SYSTEM DESCRIPTION

- A. The Contractor shall make all necessary arrangements with PSEG Long Island to obtain the temporary service supplies at service point No.1 and No.2 as described by and in accordance with Section 16300 – Utility Electrical Services. Arrangements shall be made with PSEG Long Island immediately after notice to commence work in accordance with the Specification.

- B. Service point No.1 distribution system shall have provisions for meter connections for the Contractor and the Electrical Sub-Contractor and shall comply with the additional requirements specified under Section 01500 – Temporary Facilities and Controls. Connecting lines, service supply and circuits shall be of sufficient capacity to supply the Contractor’s temporary light and power required at the site.
- C. The service point No.1 distribution shall be branched and metered using circuit breakers or fused switches and meters and shall include at a minimum the following circuits:
 - 1. 100 amperes, 240/120 Volt single phase circuit for the Contractor’s field trailer.
 - 2. 100 amperes, 240/120 Volt single phase circuit for the Electrical Sub-Contractor’s field trailer
 - 3. 100 amperes, 240/120 Volt single phase circuit for construction temporary light, power and security.
- D. Should the Contractor or is Sub-Contractor require additional service point No.1 temporary power and light beyond that specified, the Contractor shall arrange with PSEG Long Island for such additional temporary power and light. The Contractor shall bear the costs of all additional material and ancillary equipment necessary.
- E. The service point No.2 shall include obtaining a 480 Volt, 3 Phase, 1200 ampere secondary service from PSEG Long Island. The primary circuit, transformer and requirements associated with service No.2 shall be similar to the permanent service, except the PSEG Long Island transformer shall be pad mounted on a concrete pad.
- F. The service point No.2 shall also include a portable rental engine generator to provide a standby backup power supply for the temporary distribution system in the event the normal PSEG Long Island supply is out of service.
- G. The extent of service point No.2 and the associated temporary distribution system is shown on the Contract Drawings which represent the distribution system equipment and requirements.
- H. Contractor shall also disconnect the existing internet service at the Plant Service Building and re-connect the internet service at the service pole located adjacent to the Plant Service Building and extend to the Treatment plant staff trailer complex and connect each trailer as required for internet service.
- I. Contractor shall provide the grit collection system controls for manual and automatic operation of the treatment plant grit pumps and grit screw conveyor. The extent of the grit collection system controls required is shown on the Contract

Drawings and requirements related to this system are further specified under this section.

1.6 DESIGN REQUIREMENTS

- A. The Contractor is responsible for the design of service point No.1 and the associated temporary systems. The Contractor is also responsible for the design of the raceway and cable routing and installation methods associated with service point No.2 and associated temporary distribution and lighting system. Contractor shall include in the Lump Sum price bid all costs associated with the specified designs.
- B. The Contractor shall provide all systems and circuits in accordance with NFPA 70, the National Electrical Safety Code, local codes, Utility codes, and OSHA requirements. All temporary equipment provided shall be new and of current manufacturer and the installation shall comply with practices associated with a permanent installation.
- C. The service point No.2 temporary distribution and lighting system shall be in accordance with the following design requirements:
 - 1. Each trailer located at the plant staff trailer complex shall have a separate branch.
 - 2. Security lighting circuits shall supply security site lighting for the plant staff trailer complex and parking areas. The lighting system shall be arranged to provide an average lighting intensity of 5 foot candles.
 - 4. All feeders and branch circuit raceway runs shall be properly routed and supported to avoid construction interferences and to not impact plant operations.
 - 5. Equipment shall be properly supported and labelled in accordance with the requirements of Specifications 16071 – Supporting Devices and 16076 – Labelling and Identification.
- D. The service point No.2 temporary distribution and lighting system equipment locations and the distribution diagrammatical requirements are shown on the Contract Drawings. Contractor shall verify the existing conditions and has the option to adjust the temporary equipment locations provided interferences with the construction and plant operations are avoided.
- E. The Contract Drawings also indicate the general locations of the existing treatment plant equipment. Contractor shall become familiar with the existing conditions, the treatment plant equipment, and the interface requirements necessary for the re-supply indicated. Plant equipment locations and the re-supply requirements shall be field verified in advance, exact locations and the re-supply requirements shall be confirmed.

1.7 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer and the utility in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. One Line diagram representing the power distribution for the temporary systems.
 - 2. Site plans indicating the locations of major distribution equipment.
 - 3. Manufacturer's catalog cuts for the products proposed for use.
 - 4. Cable and raceway layout and routing plan drawings.
 - 5. Control schematics and wiring diagrams
 - 6. Security lighting layout with photometric and footcandle printout.

1.8 QUALITY ASSURANCE

- A. Contractor shall provide engineering services for all design work associated with the temporary electrical systems. Retain the services of a Licensed Professional Engineer, registered in the state of New York to perform design calculations, and prepare drawings signed and sealed by the Licensed Engineer.
- B. Contractor shall retain the services of LI Controls Inc who shall provide the programmable smart relay, sequencing program and current switch for the automatic operation associated with the grit collection system. LI controls provided the existing automatic sequencing. The temporary control sequencing shall match the existing operation. Contact Jacque Neville, LI Controls, 631-241-2653.
- C. Contractor shall provide all temporary systems in a manner such that the treatment plant is kept operational. All work shall be executed in accordance with Section 01700 – Maintenance of Plant Operations. Contractor shall also coordinate with plant staff to ensure that the temporary systems do not adversely impact the plant staff ability to maintain operation of the existing treatment plant.
- D. The temporary general lighting systems shall provide lighting for access to and egress from the work and for safe and expeditious construction within designated enclosed areas of the structure or structures.
- E. All temporary electrical system equipment and components shall be of recent manufacture and of proper working order for the intended purpose.
- F. The Contractor shall maintain in proper working order and repair service point No.1, service point No.2 and the associated temporary electrical systems. All

costs for maintenance of the systems shall be in accordance with the Specifications.

- G. The Contractor shall modify, extend, and relocate the temporary electrical system components, as may be required, or as directed by the Engineer, to support construction activities.
- H. The temporary systems shall be tested to the satisfaction of the Engineer to demonstrate that they are capable of safe and functional operation.
- I. The Contractor shall remove each temporary electrical system when directed by the Engineer. All costs for removal of the temporary systems shall be included in the lump sum price bid.

1.9 DELIVERY, STORAGE AND HANDLING

- A. The temporary electrical equipment shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 SERVICE POINT CONNECTIONS

- A. The Contractor shall provide a service entrance and distribution at service point No.1. Service entrance and distribution equipment shall be in accordance with the following:
 - 1. Enclosures shall be rated NEMA 3R.
 - 2. Meter pans associated with service point No.1 shall be suitable for revenue meters.
 - 3. Circuit breakers shall be thermal magnetic type. Circuit breakers shall be equipped with lockable handles.
 - 4. Disconnect switches shall be fused type with current limiting fuses. Disconnect switches shall be equipped with padlocking features.
 - 5. Contractor shall furnish and install all poles, cables, messenger cable, and supports as required for the routing of temporary power.
 - 6. All equipment shall be approved by the Engineer and PSEG Long Island as applicable.
- B. The Contractor shall also provide the following other equipment at service point No.1 and service point No.2:
 - 1. 8-foot-high, steel chain link fence with gate shall enclose the service entrance and distribution center. The fence shall be arranged so to permit a minimum clearance distance of 6 feet between the fence and the equipment.

2. The fence shall include baked enamel, 14 by 10-inch caution signs. The signs shall read, "DANGER - HIGH VOLTAGE - KEEP - OUT". The signs shall be bolted to the fence on each side of the fence and on the main gate.
 3. A 4/0 AWG ground grid consisting of four ground rods, one at each corner, shall be provided. Maximum ground resistance shall be 10 ohms. Grounding shall be in accordance with Article 2.4.
- C. All work associated with each PSEG Long Island service supply shall be in accordance with the requirements specified under Section 16300, Utility Electrical Services.

2.2 SWITCHBOARDS

- A. Provide switchboards for the service point No.2 temporary distribution system as shown on the Contract Drawings. The temporary system switchboards shall be in accordance with the requirements of Specification 16400 – Switchboards, except for the following exceptions:
1. Service switchboard shall be manual non-automatic with individual mounted utility metering compartment and individual mounted main breaker compartment.
 2. Distribution switchboard shall be equipped with group mounted feeder breaker compartments.
 3. All circuit breakers shall be fixed mounted molded case thermal magnetic or solid state trip type as shown on the Contract Drawings.
 4. Remote monitoring and transfer control features are not required.
 5. Switchboards shall be suitable for outdoor installation and provided with weatherproof, non-walk-in NEMA 3R enclosures, slope roof construction.

2.3 PORTABLE RENTAL ENGINE GENERATOR

- A. Provide a portable rental engine generator for the service point No.2 temporary distribution system as shown on the Contract Drawings. The temporary portable engine generator shall be suitable for standby duty to back up the temporary PSEG-LI normal supply during the construction period until the service point No.2 temporary distribution system is no longer needed.
- B. The generator shall be portable trailer mounted suitable for both manual and automatic start-stop operation equipped with the supplier's standard equipment and with the following major features:
1. Generator shall be standby rated at 500 KW, 625 KVA, 0.8 power factor, 480 Volts, 3 phase, 3 wires, solidly grounded.
 2. Engine air emissions shall meet the U.S. EPA Tier 2 Performance Standards for emergency operation.
 3. Sound attenuated protection container with noise attenuation meeting 73 dBA at 23 feet.
 4. UL Listed double wall fuel tank container mounted sized for 72 hours full

load operation. Where gallon capacity required becomes prohibitive for container mounting, a transportable bulk fuel storage tank shall be provided. The storage tank shall be double wall with 110 percent containment meeting UL 142. The storage tank shall be equipped with all piping and auxiliary equipment as required for filling the generator fuel tanks. All fuel piping shall be hard piped and suitably protected from vehicle traffic with barriers.

5. Automatic start-stop from remote auto transfer switch.
- C. Provide all fuel and lubricants required for testing and maintenance of the generator. Contractor shall monitor generator operation and fuel levels and refill fuel tank as required to maintain maximum fuel level.

2.4 AUTOMATIC TRANSFER SWITCH

- A. Provide an automatic transfer switch for the service point No.2 temporary distribution system as shown on the Contract Drawings suitable for switching automatically between the normal utility supply and the standby generator supply.
- B. Transfer switch shall be rated as shown on the Contract Drawings, withstand rating shall be rated 42,000 RMS symmetrical minimum when protected by upstream circuit breaker. Transfer switch shall operate in open transition fashion and shall be equipped with an in-phase monitor function during transfer.
- C. Transfer switch shall also incorporate the manufacture's standard control, monitoring and status features enabling the transfer controls and starting and stopping of the generator.
- D. Enclosure shall be suitable for outdoor installation and provided with a weatherproof NEMA 3R enclosure.
- E. Provide the temporary system automatic transfer switch by Automatic Switch Company, Russelectric, Zenith Controls or equal.

2.5 PANELBOARDS

- A. Provide panelboards for the service point No.2 temporary distribution system as shown on the Contract Drawings. The temporary systems panelboards shall be in accordance with the requirements of Specification 16441 – Panelboards, except for the following exceptions:
 1. Panelboards shall be suitable for outdoor installation and provided with weatherproof NEMA 3R enclosures.

2.6 DRY TYPE TRANSFORMERS

- A. Provide dry type transformers for the service point No.2 temporary distribution system as shown on the Contract Drawings. The temporary system transformers shall be in accordance with the requirements of Specification 16271 – Dry Type Transformers.:

2.7 MAGNETIC MOTOR STARTERS

- A. Provide magnetic motor starters, combination type for the treatment plant east and west grit pumps as shown on the Contract Drawings. The temporary system motor starters shall be in accordance with the requirements of Specification 16442 – Electric Control Equipment Low Voltage AC Motors and Devices, except for the following exceptions:
 - 1. Starters shall be suitable for outdoor installation and provided with weatherproof NEMA 3R enclosures.
 - 2. Starter controls shall be as shown on the Contract Drawings.

2.8 GRIT COLLECTION SYSTEM CONTROLS

- A. Provide grit collection system controls for operation of the treatment plant existing east and west grit pumps and the grit screw conveyor. The controls required shall be as specified and shown on the Contract Drawings.
- B. A relay enclosure, NEMA 3R shall be provided. The relay enclosure shall be equipped with the following devices:
 - 1. Control power transformer with primary and secondary fuses. Fuses shall be Class CC with current ratings as shown on the Contract Drawings and voltage ratings compatible with the circuit voltages.
 - 2. Current switch Eaton type ECSJ series furnished by LI Controls.
 - 3. Programmable smart relay, IDEC type FLIF-H12RCC furnished and programmed by LI Controls.
 - 4. Internal wiring Type MTW or THW stranded copper wire No. 12 AWG for power and No. 16 AWG for control.
 - 5. Terminal blocks for remote wiring.
- C. The relay enclosure shall be adequately sized to house the devices specified. The current switch, the programmable smart relay and the associated programming of the smart relay shall be furnished by LI Controls. LI Controls shall field install within the enclosure the current switch, programmable smart relay, and the internal wiring terminations. LI controls shall also conduct testing to ensure proper system operation.
- D. The smart relay shall be programmed by LI Controls to match the existing smart relay programming to automatically cycle the conveyor and each pump on and off in a repeat cycle fashion.
- E. Modify the existing grit screw conveyor motor starter to the extent shown on the

Contract Drawings. Coordinate with the existing starter in advance and field trace wiring as required to perform the modifications to accomplish the functionality shown.

2.9 RACEWAYS AND WIRING

- A. All conductors shall be 600 Volt, enclosed in raceways as shown on the Drawings or be routed aerially using Type AC, MC or TC cable.
- B. Conductors installed in raceways shall be single conductor type THHN/THWN or equal to be approved by the Engineer. Armored cable, Type AC, metal-clad cable, Type MC or power and control tray cable, Type TC shall also be permitted.
- C. Raceways shall be rigid metallic type.
- D. Aerially routed cables shall be messenger supported from solid wood poles or other recognized means. Messenger shall be high strength galvanized steel.
- E. Poles shall have a class suitable for the installation in accordance with the National Electrical Safety Code and shall be thirty feet length minimum. Poles shall be guyed at angle or corner runs and when eccentrically loaded.

2.10 LIGHTING FIXTURES AND DEVICES

- A. Security lighting lamps shall be 250 Watt high pressure sodium or LED equivalent installed within a pole mounted floodlight type fixture suitable to illuminate the intended area. Fixtures shall be photocell controlled.
- C. Switches, breakers and miscellaneous equipment shall be suitable for the intended purpose, with voltage, current and short circuit interrupting ratings as required for the circuits.

2.11 GROUNDING

- A. The temporary systems shall be grounded in accordance with the requirements of Specification 16061 – Grounding and the Contract Drawings. Provide ground grids and delta grounding arrays, grounding conductors and equipment safety grounds for equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with the manufacturer recommendations and the requirements specified under the various referenced specifications under this

section. Install equipment on suitable concrete pads.

- B. Install connections to existing treatment plant equipment in a staged sequence to minimize impacts to plant operations. Disconnect each existing treatment plant feeder or circuit one at a time and re-connect to the temporary distribution system. The temporary distribution system shall be operational and installed to the maximum extent possible before the disconnection of existing feeders or circuits shall proceed.
- C. Install distribution panels, motor starters and disconnects on rack type support assemblies as required for mounting of equipment. Provide concrete bases for support of vertical support members. Provide concrete pads for mounting of switchboards and other temporary system equipment.
- D. Temporary wiring systems shall be installed without interfering with the construction work or plant operations.
- E. The ground grid cable shall be installed in loop fashion completely around the service point fence. The fence and distribution equipment shall be connected to the grid at a minimum of two locations and with grounding connections provided each side of the entrance gate.
- F. The temporary general lighting system shall be installed progressively in structures as the designated areas are enclosed or as lighting becomes necessary because of partial enclosure. Lamps shall be installed to provide an even distribution of illumination over the work areas.
- G. Receptacles shall be installed in such a manner so as to reach any point in the work areas with an extension cord not to exceed 40 feet in length.
- H. Security lighting shall be installed on poles to illuminate the staging and parking areas.
- I. Aerial conductors shall be installed at a minimum height of 14 feet above finished grade. When conductors cannot be routed at the proper height or where it will interfere with plant operations or construction activities, conductors shall be provided in rigid steel conduit and installed underground.

3.2 MAINTENANCE

- A. The service point No.1 temporary electrical systems and the service point No.2 temporary distribution and lighting system shall be maintained and repaired until it is no longer required.
- B. Lamps, fuses and other equipment shall be repaired and/or replaced, as required.

3.3 TESTING

- A. Test equipment and systems in accordance with the requirements of Specification Sections 16010 – General Electrical Requirements, 16036 - Testing and the various referenced equipment specifications specified under this section.
- B. Retain the services of a factory trained service technician from the portable rental generator manufacturer. The service technician shall be responsible for performing inspecting, and checking, and testing in accordance with the manufacture recommendations. The service technician shall also maintain and test the generator on the recommended periodic basis, six month minimum during the construction period and also be available during initial system operation.
- C. The factory trained service technician shall inspect and check the installation and test the portable generator initially for operation with the plant load in both automatic and manual modes. Operate the plant load for a minimum of 2 hours.
- D. Retain the services of the automatic transfer switch manufacturer to perform inspection and testing of the transfer switch.
- E. Automatic transfer switch inspection and testing shall be performed by the manufacturer's representative, prior to energizing equipment. The inspection and testing shall be in accordance with the recommendations of the manufacturer's representative. The testing shall also include starting and stopping of the generator. Equipment shall not be energized without the permission of the Engineer.
- F. LI Controls shall test the operation of the grit removal system.

3.4 REMOVAL

- A. At the conclusion of the work, when directed by the Engineer, the temporary systems shall be removed from the site in its entirety. The ground surfaces and structures disturbed by the work shall be restored to their original condition. Removals shall be in accordance with the requirements of Specification 16035 – Demolition Electrical.

++ END OF SECTION ++

SECTION 16035

DEMOLITION ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing demolition work. The demolition work shall be performed in accordance with the requirements specified under this Section, the Specifications, and the Contract Drawings.
- B. The Contractor shall remove and dispose of all electrical equipment and items as a result of the demolition Work. Where demolished equipment is so identified, it shall become the property of the County and disposal shall not occur.
- C. The Contractor shall also relocate electrical equipment where specifically identified. The extent of the demolition and relocation work shall be as specified and as shown on the Contract Drawings.

1.2 PAYMENT

- A. Payment for demolition work shall be made as provided for in the Specifications.

1.3 REFERENCES

- A. Demolition work shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. Local Codes and Ordinances

1.4 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Techniques and details proposed to accomplish the demolition work.

1.5 QUALITY ASSURANCE

- A. All demolition and removal work shall be in accordance with the Nassau County Building Code, NFPA 70 National Electrical Code and Section 01700 – Maintenance of Plant Operations.
- B. In performance of the demolition work, the Contractor shall provide protection of adjacent plant areas, existing equipment, and on-going construction. No electrical equipment shall be disposed off-site without the written approval of the County and Engineer.
- C. The Contractor shall execute the work in a careful and safe manner with the least possible disturbance to the public and to the operation of the facility. All work shall be performed with due regard to maintenance of plant operations and construction staging in accordance with the Specifications.
- D. Demolition and removal work shall be executed with care and performed by competent experienced workmen for the various types of demolition and removal work. All patching, replacing, and refinishing of work shall be done by skilled workmen. The work shall be carried out through to completion with due regard to the safety of County employees, workmen on site and the public.
- E. The Contractor shall make such investigations, explorations, and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring, bracing, and shielding requirements so as to prevent any damage to new or existing construction. The Contractor shall be responsible for any damage which may be caused by demolition and removal work to any part or parts of existing structures or equipment designated for reuse or to remain.
- F. All demolished equipment and devices shall become the property of the Contractor and shall be removed from the site, except where identified by the County. All equipment marked by the County to remain shall be carefully removed by the Contractor, so as not to be damaged, cleaned and stored on or adjacent to the site in a protected place or loaded onto trucks provided by the County.
- G. The Contractor shall coordinate the work with other trades to disconnect or remove sources of power to equipment that will be removed or relocated by other trades.

1.6 SITE CONDITIONS

- A. The County assumes no responsibility for the actual condition of structures to be demolished and removed. Conditions existing at the time of inspection for bidding purposes shall be noted by the Contractor and shall be used by him in preparing his bid.
- B. The Contractor shall perform the work with due regard that certain equipment, tanks, and piping contain gases which are potentially hazardous and may be toxic, contain insufficient oxygen for human survival and are combustible in the presence of oxygen. All work regarding hazardous materials shall be performed in accordance with the Specifications.
- C. The existing facility includes a Treatment Plant, Pump Station, Service Building, and the Screen House. Electric supplies for the existing facility consist of a PSEG Long Island electric service transformer and standby generator which supplies the facility main electric distribution. The main electric distribution switchboard, motor control centers and associated equipment are located on the operating floor of the Pump Station.
- D. The Contractor shall perform selective demolition work in a staged sequence. Perform the demolition work with due regard that certain systems and equipment shall remain in operation until such time when the Engineer directs that a given demolition can proceed. In general, the following demolition sequence applies:
 - 1. Demolition work shall not proceed until the temporary service point No.2 and associated distribution becomes available and have been accepted.
 - 2. Demolition of the Service building shall not proceed until the Plant Operators' Trailers are fully functional and accepted.
 - 3. Demolition of the Screen House and Pump Station circuits shall not proceed until the temporary Bypass Pumping Station is fully functional and accepted.
 - 4. Demolition of the PSEG-LI transformer, generator, main distribution switchboard, and motor control centers shall not proceed until the existing treatment plant facilities have been transferred to the temporary distribution and control systems and the existing facilities are fully functional on the temporary systems and have been accepted.
 - 5. Demolition of the temporary distribution system provided under this Contract shall not proceed until the permanent facilities are complete and the pumping of flow to Bay Park is fully functional and accepted.
- E. Contractor shall coordinate in advance with PSEG Long Island regarding the shutdown and removal of the existing PSEG Long Island electric service transformer and supply. Contractor shall also coordinate the shutdown and removal of the PSEG Long Island electric service transformer and supply associated with the temporary service point No.2.

- I. Contractor shall coordinate in advance with the plant operations and field determine and make such investigations as required to determine the source and function of each circuit that shall be disconnected to perform the initial demolition work. All active circuits that are not to be initially demolished shall be retained and remain operational until such time when these circuits can be demolished.

1.7 SCHEDULING

- A. The Contractor shall proceed with the demolition and removal of equipment in a staged sequence designed to maintain the existing facility in operation. The Contractor shall notify the Engineer 48 hours before proceeding and meet with plant personnel to review removals and demolition work. Work shall begin only after approval of the County and Engineer.
- B. Any equipment and appurtenances removed without proper authorization, which are necessary for the operation of the existing facility, shall be replaced to the satisfaction of the Engineer at no cost to the County.
- C. The Contractor shall familiarize himself with the work and coordinate and schedule demolition activities with the other trades for proper sequencing of the work and the removal of equipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. The Contractor shall provide protection and restoration of structures in accordance with the Specifications. Catch platforms, lights, barriers, weather protection, warning signs and other items shall be provided as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.
- B. The Contractor shall provide weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
- C. The Contractor shall provide temporary protection of the existing structure designated to remain where demolition, removal and new work is being done, connections made, materials handled or equipment moved.

- D. The Contractor shall provide dustproof partitions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing equipment affected by the demolition shall be protected. Such enclosures will be required in areas of major demolition work and for protection of existing equipment and personnel. Insulating barriers shall also be provided where necessary for protection.
 - 1. Dust proof partitions shall be constructed of wood studs with plywood on both sides. Partitions shall extend from floor to ceiling with a closure plate at the floor and ceiling and a dust- tight door in each enclosure complete with hardware, attached and keyed.
 - 2. Insulation barriers shall be provided to cover exposed, energized terminals, wires and busses.
 - 3. Adequate ventilation shall be provided for a safe working environment.
- E. The Contractor shall provide adequate fire protection during demolition in accordance with East Rockaway Fire Department requirements.
- F. The Contractor shall not close or obstruct roadways, walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall conduct operations with minimum traffic interference.
- G. The Contractor shall repair any damage to the existing structure or contents by reason of the insufficiency of protection provided.

3.2 REMOVALS

- A. The Contractor shall demolish or relocate electrical equipment as shown on the Contract Drawings. All motors shall be disconnected by the Contractor but removed with the driven equipment by the other trades.
- B. All feeder and branch wiring, conduits and boxes routed exposed shall be removed by the Contractor in their entirety.
- C. All feeder and branch wiring and conduits directly buried in earth, concrete slabs or masonry shall be abandoned in place, except that the wiring ends shall be cut off (or removed) by the Contractor at the conduit mouth. Conduits which exit floor slabs, and walls, shall be cut or hammered down, flush with floor level or wall and filled with epoxy concrete by the Contractor.
- D. Recessed equipment to be demolished shall be abandoned, unless otherwise noted on the Contract Drawings. Demolished recessed panelboards and boxes enclosure fronts and internals shall be completely removed. The enclosure fronts shall be covered with new blank cover plates.

- E. Wherever cable and conduit are to be removed for disposition, the circuit shall be de-energized by the Contractor and adjacent circuits that are to remain in service shall be blanked off and then isolated.
- F. All supports, pedestals and anchors for conduits, lighting fixtures and other equipment shall be removed with the equipment unless otherwise noted on the Contract Drawings. Concrete bases, anchor bolts and other supports shall be removed to approximately one inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas.
- G. The Contractor shall dispose of all demolition equipment, debris and other items, not marked by the County to remain, off the site and in conformance with all applicable codes and regulations.
- H. The Contractor shall perform patching, restoration, finishing and new work in accordance with the Specifications. All openings in structures as a result of the work, shall be patched and exterior openings made watertight. Where alterations occur, or new and old work join, the Contractor shall cut, remove, redrill or refinish the adjacent surfaces to the extent required by the conditions, so to leave the altered work in a condition as existed prior to the start of the work.
- I. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be restored to match the adjacent areas. Wall sleeves and castings shall be plugged or blanked off, all conduit openings in equipment shall be closed.
- J. Where equipment is indicated to be removed, relocated and reused, the equipment shall be operated in the presence of representatives of the Contractor, and the Engineer. Such items shall be removed or relocated with care to prevent unnecessary damage, under the supervision of the trade responsible for reinstallation and protected and stored until required. Material or items damaged during removal shall be replaced with similar new material or items.

3.3 CLEANING AND MAINTENANCE

- A. The Contractor shall maintain the existing electrical power system to operate without interruption. Any interruption of electrical power to the existing facility and equipment shall be with the approval and permission of the County and the Engineer.
- B. The Contractor shall maintain all protection facilities installed in preparation of the demolition work.

- C. The Contractor shall provide on-site dump containers for collection of waste materials, debris, and rubbish.
- D. All existing surfaces shall be cleaned of dirt, grease, loose paint before refinishing.
- E. The Contractor shall clean the site and properties of dust, dirt and debris caused by the demolition and removal work in accordance with the Specifications. Waste materials, debris and rubbish shall be disposed of and the areas shall be returned to conditions prior to start of the work.

+ + END OF SECTION + +

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SECTION 16036

TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The Contractor shall perform all tests as specified in these specifications, and as required.
- B. Individual testing requirements are detailed in the individual equipment specifications.

1.2 RELATED SPECIFICATIONS

- A. Specification 16061 - Grounding
- B. Specification 16121 – Electric Wires and Cables
- C. Specification 16292 - Power Distribution System Coordination

1.3 REFERENCES

- A. NETA - International Electrical Testing Association.
- B. IEEE - Institute of Electrical and Electronics Engineers.
- C. ANSI - American National Standards Institute.

1.4 DESIGN REQUIREMENTS

- A. General
 - 1. The Contractor shall furnish all instruments and qualified personnel for all tests.
 - 2. Written notice of all tests shall be given to the Engineer at least two (2) weeks in advance.
 - 3. Unless waived in writing by the Engineer, all tests shall be made in the presence of a duly authorized representative of the Engineer. When the presence of such representative is so waived, sworn statements, in

- duplicate, of the tests made and the results thereof, shall be furnished to the Engineer by the Contractor.
4. Necessary adjustments and testing shall be made in cooperation with the respective manufacturers and other Subcontractors when necessary.
 5. The Contractor shall make available, the electrical system and personnel when required by other Contractors to test their respective equipment. The Contractor shall coordinate their resources with the other Contractors.
- B. Factory and witness shop testing requirements shall be as detailed in the individual equipment specifications.
- C. Field Testing: All electrical equipment furnished, installed or modified under this Contract shall be field tested by this Contractor as detailed in the individual equipment specifications.
- D. Schedules and Plant Operations
1. When testing requires that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the County's engineer for review and approval one month prior to any work beginning. When testing has been scheduled as above, the plant must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of plant equipment must be coordinated with plant personnel so as not to affect proper plant operations.
 2. At the end of the workday, all equipment shall be back in place and ready for immediate use should a plant emergency arise. In addition, should an emergency condition occur during testing, at the request of the plant engineer, the equipment shall be placed back in service immediately and turned over to plant personnel.
 3. In the event of accidental shutdown of plant equipment the contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.
- E. Independent Testing: In addition to the independent testing for the short circuit and relay coordination studies and protective device settings specified under Section 16292 - Power Distribution System Coordination, the following tests shall also be performed by a qualified testing company using NETA certified technicians.
1. Section 16061 – Grounding
 2. Section 16121 – Electric Wire and Cable, medium voltage cable.
- F. Final Field Testing
1. The Contractor shall complete the installation and testing of the electrical installation at least two (2) months prior to the start-up and testing of all work by other trades. During the period between the completion of

electrical installation and the start-up and testing of the work of other trades, the Contractor shall make all components of the Electrical Work available to the other trades as it is completed for their use in performing Preliminary and Final Field Tests.

2. Before each test commences, the Contractor shall submit a detailed test procedure, and provide manpower and scheduling for the approval of the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of systems by the other trades.

1.5 SUBMITTALS

- A. Submit the following in accordance with Article GC-14 of the General Conditions and Division 1.
- B. Certificate of Compliance
 1. Qualifications of independent testing firm and technicians.
- C. Reports
 1. Proposed testing methods and schedules.
 2. All field test reports.

1.6 QUALITY ASSURANCE AND QUALIFICATIONS

- A. As detailed above, the independent testing firm shall be a qualified firm employing NETA certified technicians.

+ + END OF SECTION + +

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SECTION 16061

GROUNDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing grounding. Grounding shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The grounding work shall be a complete system for the electrical and instrumentation systems, structures and equipment. The work shall include grounding of all electrical equipment, transformer neutrals, equipment enclosures, grounding electrodes, fences and gates.

1.2 RELATED SPECIFICATIONS

- A. Specification 16036 – Testing
- B. Specification 16121 - Electric Wires and Cables
- C. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for grounding shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. Grounding shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. Long Island Power Authority.
 - 3. UL Standard No. 467, Electrical Grounding and Bonding Equipment

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Manufacturer's catalog cuts for the grounding materials proposed for use.
 - 3. Scaled working drawings showing proposed routing and layout of the grounding system.
- C. Field test report shall be submitted.

1.6 QUALITY ASSURANCE

- A. The grounding system maximum resistance shall not exceed 5 ohms under normally dry conditions. All structures and metal equipment containing electrical apparatus shall be connected to ground.
- B. The grounding system shall be field tested. The field testing shall be performed in accordance with the requirements specified under Article 3.1.
- C. Retain the service of an independent testing firm who shall perform field testing of the power distribution system. The testing firm shall have experience in the inspection and testing of the system equipment and shall be a member company of NETA as specified under Section 16036 Testing.

1.7 DELIVERY, STORAGE AND HANDLING

- A. The grounding equipment shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 GROUND CABLE

- A. The ground cable shall be soft drawn bare stranded copper conforming to ASTM B8 and B189. Size shall be as shown on the Contract Drawings.
- B. The insulated cable for equipment grounding shall conform to the requirements of Specification 16121 - Electric Wires and Cables.
- C. Ground cable shall be General Cable Corporation, Okonite Cable Company or equal to be approved by the Engineer.

2.2 GROUND RODS

- A. Ground rods shall be copper-clad steel, 5/8-inch diameter and 10 feet long.
- B. Ground rods shall have a drive point at the lower ends. The upper end of each rod shall be equipped with bronze, clamp type connectors with not less than four bolts.
- C. Ground rods shall be Heary Brothers Lightning Protection Company, Fushi Copperweld, or equal to be approved by the Engineer.

2.3 GROUNDING CONNECTORS

- A. Compression connectors shall be heavy duty copper. Bolted connectors shall be copper alloy castings, designed specifically for the items to be connected, and assembled with Durium or silicone bronze bolts, nuts and washers.
- B. Welded connections shall be by exothermic process utilizing molds, cartridges and hardware designed specifically for the connection to be made.
- C. Bolted or compression grounding connectors shall be Burndy, Thomas and Betts or equal to be approved by the Engineer. Welded grounding connections shall be Cadwell or equal to be approved by the Engineer.

2.4 GROUNDING BUS BARS

- A. Bare, copper bars of rectangular cross section complying with ASTM B187. Grounding bus size shall be as shown on the Contract Drawings with predrilled holes and length as necessary plus provisions for future expansion and secured to wall with insulated stand-off supports.

- B. Bus bar stand-off supports shall be fiberglass reinforced polyester insulators with threaded holes at both ends for bus installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. A complete ground grid system shall be installed as shown on the Contract Drawings.
- B. Ground cable shall be installed at a minimum of 2 feet-6-inches below grade.
- C. Ground rods shall be installed 2 feet below grade, 2 feet from foundation walls and shall extend 10 feet vertically into the earth.
- D. Test points shall be installed at locations and in accordance with the details shown on the Contract Drawings.
- E. Equipment shall be connected in accordance with the details shown on the Contract Drawings. All steel column and underground connections shall be welded except for test points.
- F. Metal casings or supporting frames of electrical equipment, such as transformers, panel boards, control panels, unit substations, and individual motor controllers shall be grounded. The equipment shall be thoroughly grounded to the facility grounding system. All metal conduits leaving all electrical equipment shall be grounded. Grounding type fittings shall be installed on flexible conduits.
- G. An insulated cable for equipment grounding shall be installed with the phase conductors within the conduit for the nominal 120 volt and higher power, lighting and control circuits.

3.2 FIELD TESTING

- A. After installation, the completed ground system shall be field tested for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide field testing. Field testing shall be performed by the testing firm and shall consist of the following:
 - 1. Resistance testing shall be made using a Biddle, Null Balance Earth Tester or Associated Research Vibro-ground, not less than 48 hours after rainfall. Resistance shall be no more than 5 ohms. If resistance is greater than 5

ohms, the Contractor shall continue to drive ground rods up to a maximum of three to reduce the resistance to 5 ohms. Resistance values above 5 ohms after three ground rods have been driven in the same area shall be brought to the Engineer's attention.

2. Grounded cables and metal parts shall be continuity tested. The conduit system shall be ground tested in accordance with the requirements of Specification 16131 - Electric Conduit System.

- B. The Contractor shall provide a Field Test Report, the report shall identify the testing performed and the results obtained.

+ + END OF SECTION + +

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SECTION 16062

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, services, and incidentals shown, specified, and required to furnish and install an Underwriters Laboratories listed Master Label Lightning Protection Systems.
2. Provide a lightning protection system for the elevated metal electrical building. The system shall consist of air terminals, interconnecting conductors, fittings, connectors and auxiliary devices for a complete protection system.

B. Coordination:

1. Review installation procedures included under other Sections and coordinate installation of items to be installed with or before lightning protection system.
2. Review the building features and equipment requirements in advance. Lightning protection layouts are not shown on the Drawings, CONTRACTOR shall provide lightning protection system that satisfies the protection requirements of the building.

C. Related Sections:

1. Section 13122, Metal Building Systems.
2. Section 16061, Grounding.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. LPI 175, Standard of Practice.
2. LPI 176, Standard of Materials.
3. NFPA 70, National Electrical Code.
4. NFPA 780, Standard for the Installation of Lightning Protection Systems.
5. UL 96A, Installation Requirements for Lightning Protection Systems.
6. UL 651, Schedule 40 and 80 PVC Conduit.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Lightning Protection System Subcontractor:

- a. Retain services of lightning protection Subcontractor regularly engaged in providing Master Labeled lightning protection systems.
 2. Subcontractor shall be LPI-certified Master Installer or Inspector.
 3. Subcontractor shall be listed with UL.
- B. Component Supply and Compatibility:
1. Obtain all materials equipment included in this Section regardless of component manufacturer from a single lightning protection system manufacturer.
 2. Lightning protection system manufacturer shall review the metal building features and requirements and prepare all Shop Drawings and other submittals for all components furnished under this Section.
 3. All components shall be specifically constructed for specified service conditions and shall be integrated into the overall system by lightning protection system manufacturer.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Complete scaled drawings showing proposed routing and layout of lightning protection system with installation details. Drawings shall include equipment connection details and downlead details.
 2. Product Data:
 - a. Manufacturer's catalog cuts and technical information.
 - b. Technical specifications.
- B. Informational Submittals: Submit the following:
1. Certificates:
 - a. Certificates of LPI code compliance provided by manufacturer, together with UL Master Label certificate or letter of finding.
 2. Field Quality Control Submittals:
 - a. Master Installer or Inspector's final inspection report following installation.
 3. Qualifications Statements:
 - a. Lightning protection system Subcontractor.

1.6 GUARANTEE

- A. Guarantee:
1. Lightning protection system shall be guaranteed by lightning protection system manufacturer against defective parts and installation for one year from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:

1. The lightning protection system shall consist of a complete cable network on the building roof involving all air terminals, splices, and bonds with cable downloads routed in conduit to ground, and ground rods all connected together in an appropriate manner and certified by LPI to provide a zone of protection to entire building against lightning strikes, in accordance with NFPA 780.
2. Provide complete, certified lightning protection system. Provide bonding connections and miscellaneous items for complete system.

2.2 MANUFACTURERS

A. Manufacturers: Provide products of one of the following:

1. Heary Brothers Lightning Protection Company.
2. Thompson Lightning Protection, Inc.
3. Or equal.

2.3 MATERIALS

A. General:

1. Size materials in accordance with NFPA 780, UL 96A, and LPI 176.
2. Materials and equipment shall be labeled or listed by UL for use in Master Labeled lightning protection systems. Completed system shall conform to NFPA 70, NFPA 780, LPI 175, LPI 176, and UL96A.
3. Materials shall comply in weight, size, and composition for class of structure to be protected in accordance with the following:
 - a. Use Class I materials for systems on structures not exceeding 75 feet in height.
 - b. Use Class II materials for systems on structures exceeding 75 feet above grade.
4. Materials shall be corrosion-resistant, heavy-duty type. Unless otherwise specified, materials shall be Type 316 stainless steel, copper, or high copper-content bronze castings. Bolts, screws, and hardware shall be Type 316 stainless steel.
5. Use aluminum materials in locations where system components are mounted on aluminum surfaces to avoid electrolytic corrosion of dissimilar metals.
6. Provide fittings, mounting bases, couplings, connectors, fasteners, and other system devices required for complete system.

B. Ground Rods: Comply with Section 16061, Grounding.

C. Ground Cables:

1. Ground cables shall be tinned copper, except in connections to aluminum surfaces as required to prevent dissimilar metals reaction.
2. Ground cable stranding, number and size shall be suitable for classification of structure to be protected.
3. Exposed ground cable shall be corrosion resistant.

D. Air Terminals:

1. Air terminals shall be stainless steel 5/8-inch diameter and maximum of 18 inches long based on FAA restrictions at the facility.
2. Air terminals shall include a cast bronze point protector, stainless steel adapter, and copper base.

E. Non-Metallic Conduit and Fittings:

1. Non-metallic conduit shall be Schedule 80 PVC plastic, rated for 90 degrees C, conforming to UL 651.
2. Non-metallic fittings shall be of same material and manufacturer as base conduit. Provide cement for joining fittings to conduit. Fittings shall be by same manufacturer as base conduit.
3. Use non-metallic conduit wherever ground cables are concealed within conduits.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine the conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install main conductors to provide two-way path from each air terminal horizontally or downward to connections with ground terminals.
- B. Install conductors free of excessive splices and sharp bends. Conductor bends shall form an included angle of not less than 90 degrees and shall not have bend radius less than eight inches. Secure conductors to structure at intervals not exceeding three feet.
- C. Space down conductors at intervals averaging not more than 100 feet around perimeter of structure. Provide at least two down conductors for each protected structure.

- D. For structural steel frame construction, down conductors at upper and lower extremities and at intervals not exceeding 200 feet shall be connected to structural steel. Make connections to steel frame with bonding plates having eight square inches of contact, or by exothermic weld connections.
- E. Provide air terminals at intervals not exceeding 20 feet along ridges and around perimeter of flat or gently-sloping roofs. Air terminals shall project a minimum of 10 inches above the area protected.
- F. Protect flat or gently-sloping roofs exceeding 50 feet in width, by providing additional air terminals at intervals not exceeding 50 feet on flat or gently-sloping area. Locate air terminals within two feet of roof edges and outside corners of protected areas. Air terminal spacing exceeding these dimensions will be allowed if the area protected is within a "zone of protection" from lightning strikes.
- G. Provide air terminals for stacks, flues, mechanical equipment, and other objects, having metal thickness less than 3/16-inch and not located within a "zone of protection". Connect objects having metal thickness 3/16-inch or greater to lightning protection system.
- H. Do not connect copper equipment to aluminum surfaces, except using bimetal transition fitting. Lead coating is unacceptable for bimetal transition.
- I. Install roof penetrations using through-roof assemblies with solid bars and appropriate roof flashing. Conductors shall not pass directly through roof.
- J. Grounded metal bodies shall be bonded to the system using bonding connections and fittings. When ground conductors are installed in conduit, conduit shall be non-metallic.
- K. Bond roof mounted metal structure to the roof ground loop or to downlead cables.
- M. Provide ground electrodes for each down conductor dedicated for lightning protection system and bond electrodes to building or structure grounding system. Connect down conductor to ground rod using high-strength, removable ground clamp. Provide bronze ground rod clamp having at least 1.5 inches of contact between rod and conductor, measured parallel to the axis of the rod, at ground test wells.

3.3 FIELD QUALITY CONTROL

- A. Inspection:

1. During installation, lightning protection system shall be inspected by Master Installer or Inspector at several stages during installation in accordance with LPI requirements.
2. Do not conceal system components until inspection has been completed and successfully inspected, and observed by ENGINEER.
3. Upon completion of lightning protection system, arrange for final lightning system inspection and submit final inspection report to ENGINEER. Final lightning system inspection shall be performed by Master Installer or Inspector in accordance with LPI requirements.

END OF SECTION

SECTION 16071
SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing supporting devices. Supporting devices shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The supporting devices shall be a complete system for the equipment. The work shall include providing all required support devices to properly mount and secure all equipment furnished under this Contract.
- C. This section also includes equipment anchorage suitable to meet the specified seismic requirements.

1.2 RELATED SPECIFICATIONS

- A. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for supporting devices shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. Supporting devices shall comply with the latest applicable provisions and recommendations of the following:
 - 1. ASTM A569, Specification for Steel, Carbon, Hot-Rolled Sheet and Strip Commercial Quality.
 - 2. ASTM A570, Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
 - 3. ASTM B633, Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 4. AISI, Standard for Stainless Steel.
 - 5. MFMA-1, Standard Publication for Metal Framing.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Manufacturer's catalog cuts for the supporting devices proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.
 - 2. Scaled working drawings showing dimensions and locations of all items and clearance requirements.
 - 3. Support design details and equipment seismic anchorage details, stamped by a licensed Engineer as required.

1.6 QUALITY ASSURANCE

- A. General:
 - 1. All channels, fittings and hardware used in the supporting system shall be in accordance with MFMA-1, Standard Publication.
 - 2. The design of the support system shall be the responsibility of the Contractor. The Contractor shall provide the proper sized rods, channels, fittings, brackets and appurtenances necessary to adequately support the equipment.
 - 3. The Contractor shall retain the services of a Licensed Engineer, registered in the State of New York, to prepare support details for equipment exceeding 50 pounds in weight. The Engineer shall stamp the support system design details.
- B. Seismic Requirements:
 - 1. Equipment assemblies such as switchboards and panelboards shall be certified to meet seismic requirements in accordance with the requirements specified in the applicable sections of the Specifications.
 - 2. The Contractor shall be provide equipment anchorage details for all equipment certified to meet seismic requirements. The details shall be coordinated with the manufacturer's equipment mounting provisions.
 - 3. The Contractor shall retain the services of a Licensed Engineer, registered in the State of New York, to prepare the seismic anchorage details. The Engineer shall stamp the seismic anchorage and restraint details.

1.7 DELIVERY, STORAGE AND HANDLING

- A. The supporting devices shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Supporting devices shall be by B-Line (Eaton), Kindorf (Thomas & Betts/ ABB Group) or equal to be approved by the Engineer.

2.2 CHANNELS, FITTINGS AND BRACKETS

- A. The Contractor shall provide channels, fittings, brackets and related hardware for mounting and supporting the electrical equipment. Anchor bolts, concrete inserts and related hardware for proper support of equipment shall also be provided. All equipment necessary to meet the seismic requirements specified shall be provided.
- B. Channels shall conform to ASTM A569 or A570. Channels shall have a minimum thickness of 12 gauge. The cross sectional width dimension shall be 1-1/2 inch minimum. The depth shall be as required to satisfy load requirements.
- C. Attachment holes, when required, shall be factory punched on hole centers approximately equal to the cross sectional width and shall be 9/16 inch diameter.
- D. Fittings and brackets shall have 9/16 inch diameter holes on centers identical to the channel or as required to align with the channel holes. Fittings and brackets shall have the same width as the channel and shall be 1/4 inch thick minimum. Fittings and brackets shall mate properly with the channel.
- E. All channels, fittings, brackets and related hardware shall be steel and have an electro-plated zinc finish according to ASTM B633.
- F. In corrosive areas, channels, fittings, brackets and related hardware shall be type 316 stainless steel or PVC coated.

2.3 CONDUIT HANGERS, SUPPORTS AND INSERTS

- A. The Contractor shall provide channels, rods, straps, anchors and related hardware for support of the exposed electric conduit system.

- B. The Contractor shall also provide anchor bolts, concrete inserts and related hardware for proper support of equipment. All equipment necessary to meet the seismic requirements specified shall be provided.
- C. Conduit hangers, supports and inserts shall be in accordance with Specification 16131 - Electric Conduit System.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All supporting devices shall be installed level, parallel and perpendicular to building walls and floors, such that the support system is installed in a neat and professional manner.
- B. All holes in hung ceilings for support rods and other equipment shall be made adjacent to bars where possible, to facilitate removal of ceiling panels.
- C. The channels, fittings and brackets shall be rigidly bolted together and braced to make a substantial supporting framework support system.
- D. Where switchboards and other electrical equipment is being installed on concrete pads, the Contractor shall furnish leveling channels. The Contractor shall install the leveling channel in the concrete pads. Seismic certified equipment shall be anchored in accordance with the seismic anchorage details.
- E. All equipment fastenings to steel columns, beams and trusses shall be by beam clamps. In lieu of beam clamps, equipment may be welded to steel structures, subject to Engineer approval.
- F. No holes shall be drilled in any steel columns, beams and trusses.
- G. Hanger rod supports shall be installed such that threaded rod is parallel and perpendicular to building walls and floors.

+ + END OF SECTION + +

SECTION 16076

LABELING AND IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing labeling and identification. Labeling and identification shall be provided in accordance with the requirements specified under this section, the Specifications, and the Contract Drawings.
- B. The labeling and identification shall be provided for the identification of equipment. The work shall include providing all signs and labels, equipment nameplates, markers and tags for all equipment furnished under this Contract.
- C. All equipment nameplates shall have both the equipment name and tag identification number.
- F. All pull boxes, junction boxes, terminal boxes, etc. shall be tagged with its own unique system related tag number.
- G. All conduits shall be tagged with its own unique system related tag number. The conduit systems include the extent shown on the Contract Drawings and may include but are not limited to, power, lighting, telephone, instrumentation, control, fire alarm, low voltage power, security, CCTV, and Fiber Optic Network.
- H. In addition to tagging and labeling the pull box exterior, the pull box interior shall also be tagged and labeled. All conduit bushings on the pull box interior shall be tagged and labeled.

1.2 RELATED SPECIFICATIONS

- A. Specification 16121 - Electric Wires and Cables

B. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for labeling and identification shall be made as provided for in Division 1 of the Specifications.

1.4 REFERENCES

- A. Labeling and identification shall comply with the latest applicable provisions and recommendations of the following:
1. NFPA 70, National Electrical Code.
 2. OSHA, Occupational Safety and Health Act.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 2. Submit signs, nameplates and other labeling and identification devices proposed for use with specifications and other data required to demonstrate compliance with the specified requirements.

1.6 QUALITY ASSURANCE

- A. All labeling and identification signs and nameplates shall be provided in accordance with the NFPA 70 and OSHA.

1.7 DELIVERY, STORAGE AND HANDLING

- A. The labeling and identification devices shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 SIGNS AND WARNING LABELS

- A. Provide signs and warning labels as described by and in accordance with NFPA 70, 70 E and industry standards.

- B. High voltage signs shall be provided for equipment operating over 600 volts. High voltage signs shall be fiberglass reinforced polyester, rigid acrylic or aluminum plate 1/16-inch thick.
 - 1. Finish shall be industry standard of red, white and black graphics. Signs shall be 10 inches by 14 inches with the following exceptions:
 - a. Use 7-inch by 10-inch signs where this is the largest size that can be applied.
 - b. Use 14-inch by 20-inch signs where needed for adequate vision.
 - 2. High voltage signs shall read; "DANGER - HIGH VOLTAGE KEEP OUT".
 - 3. High voltage sign mounting screws shall be 3/16 inch diameter, round head, stainless steel, self-tapping type.
- C. Low voltage signs shall be provided for equipment operating below 600 volts.
 - 1. Low voltage safety signs shall be pressure-sensitive vinyl complying with 40 CFR 1910.145, five inches by 3.5 inches in size.
 - 2. Low voltage signs shall read; "DANGER – 480 VOLTS KEEP OUT".
 - 3. Low voltage sign mounting screws shall be 3/16-inch diameter, round head, stainless steel, self-tapping type.
- D. Arc flash warning labels shall be provided based on and for the equipment included in the power distribution system coordination.
 - 1. Warning labels shall be adhesive-backed polyester.
 - 2. Warning labels shall read, "Warning – Arc Flash and Shock Hazard. Labels shall also include the additional information as described by and in accordance with NYPA-70E.

2.2 EQUIPMENT NAMEPLATES

- A. Equipment nameplates shall be provided in addition to the manufacturer's nameplate, to identify the equipment number and the item's function and the equipment to which it serves.
- B. Equipment nameplates shall be provided in accordance with the requirements specified under Article 2.2.
- C. Equipment nameplates shall be laminated plastic with black letters on a white background. Nameplates for equipment identification shall have 1/2-inch high letter engravings. Nameplates for pilot device identification shall have 1/4-inch high letter engravings.
- D. Nameplates for distribution equipment shall have the following information:
 - 1. Equipment name and number.
 - 2. Voltage.
 - 3. Phases and number of wires.

- E. Pull boxes, junction boxes and control stations shall have a nameplate identifying the equipment name and number.
- F. All feeders and branch circuit devices shall have nameplates identifying the served equipment name and number. Where execution of the work under this Contract requires certain feeders and branch circuit devices to be modified, the Contractor shall provide new nameplates reflecting the modifications. The nameplates shall identify the served equipment name and number.
- G. All control and indicating devices shall have individual nameplates identifying device function.
- H. Nameplate mounting screws shall be 3/16 inch diameter, round-head, stainless steel self-tapping type. Adhesives shall not be used.

2.3 CONDUIT MARKERS AND TAGS

- A. Conduit markers and tags shall be provided for the identification of the electric conduit system.
- B. Conduit markers and tags shall be in accordance with Specification 16131 - Electric Conduit System.

2.4 CABLE AND WIRE MARKERS

- A. Cable and wire markers shall be provided for the identification of the electric wire and cable.
- B. Cable and wire markers shall be fiberglass based. Teflon coated stainless steel line/wire shall be used to attach the markers to the cables.
- C. Cable and wire markers shall be in accordance with Specification 16121 - Electric Wires and Cables.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All signs, nameplates and tags shall be installed neatly, properly and as recommended by the manufacturers.
- B. Signs and nameplates shall be mounted with screws. Where mounting of signs or nameplates with screws is impractical, the Contractor shall alert the Engineer.

- C. High voltage signs shall be installed on equipment operating at over 600 volts. High voltage signs shall also be installed on sides of fences or walls which enclose outdoor equipment operating at over 600 volts.
- D. Control, signal and status wire and cable shall be identified by a unique number. The numbering system shall reflect the actual identification used in the work and shall be documented on the point-to-point wiring diagrams.

+ + END OF SECTION + +

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SECTION 16121

ELECTRIC WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing electric wires and cables. Electric wires and cables shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The electric wires and cables to be provided shall include all accessories.
- C. The following index of this Specification is presented for convenience.

<u>Article</u>	<u>Title</u>	<u>Page</u>
		16121-
PART 1	GENERAL	
1.1	Section Includes.....	1
1.2	Payment	2
1.3	References	2
1.4	Submittals	2
1.5	Quality Assurance	4
1.6	Delivery, Storage and Handling	5
PART 2	PRODUCTS	
2.1	300 Volt Insulated Cable	5
2.2	600 Volt Insulated Wire and Cable	5
2.3	Medium Voltage Insulated Wire and Cable	7
2.4	600 Volt and Below Wire and Cable Accessories.....	8
2.5	Medium Voltage Wire and Cable Accessories	9
2.6	Shop Tests	10
2.7	Data Highway Cable	11
PART 3	EXECUTION	
3.1	General	12
3.2	Installation of Wiring	12
3.3	Conductor Identification	13
3.4	600 Volt and Below Wire and Cable Field Testing	14
3.5	Medium Voltage Wire and Cable Field Testing.....	14

- D. The cables and wires proposed for all instrumentation cables and wires shall be approved by the Contractor before Engineer approval can be given. The Contractor shall submit the approvals from the Contractor along with the cable and wire shop drawings for Engineer approval. The cable and wires shall include those used for all equipment and devices specified in Division 13.

1.2 PAYMENT

- A. Payment for electric wires and cables shall be made as provided for in Division 1 of the Specifications.

1.3 REFERENCES

- A. Electric wires and cables shall comply with the latest applicable provisions and recommendations of the following:
1. NFPA 70, National Electrical Code.
 2. National Electrical Safety Code.
 3. ASTM B5, High Conductivity Tough-Pitch Copper Refinery Shapes.
 4. ASTM B8, Concentric-Lay-Stranded Copper Conductors, Hard, Medium-hard or Soft.
 5. ASTM B33, Tin Coated Conductors.
 6. ASTM D69, Test Methods for Friction Tape
 7. ICEA S-66-524 Cross-linked-thermosetting - polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical energy.
 8. ICEA S-68-516, Ethylene-Propylene-Rubber-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.
 9. ICEA S-94-649, Concentric Neutral Cables Rated 5 through 46 KV.
 10. UL Standard No. 44, Wires and Cables, Rubber-Insulated.
 11. UL Standard No. 83, Wires and Cables, Thermoplastic-Insulated.
 12. UL Standard 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors.
 13. UL 1072, Medium Voltage Power Cables.
 14. AEIC CS6-87, Ethylene-Propylene-Rubber-Insulated Shielded Power Cable.
 15. NETA, International Electrical Testing Association.
 16. IEEE 48, Test Procedures and Requirements for High Voltage Alternating-Current Cable Terminations.

1.4 SUBMITTALS

Long Beach WPCP Consolidation
Pump Station Conversion

16121-2

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
1. Prior to equipment submission, a list of proposed manufacturers shall be submitted with the products they produce proposed for the contract.
 2. Manufacturer's Literature, specifications and engineering data for the electric wires and cables and accessories.
 3. For medium voltage wires and cables the following information shall be submitted:
 - a. Manufacturer and type of cable.
 - b. Minimum insulation resistance in megohms per 1,000 ft. At 15.5 degrees C.
 - c. Material, number and size of strands composing each conductor.
 - d. Conductor insulation in thickness inches or 64th of an inch with material and voltage rating.
 - e. Sheath thickness in inches or 64th of an inch.
 - f. Average outside diameter of bare conductor.
 - g. Average outside diameter of finished cable and jacket material.
 - h. Weight per 1,000 ft. of finished cable.
 - i. Material and thickness in inches or 64th of an inch of each shield system.
 - j. Minimum bending radius, in inches.
 - k. Minimum pulling temperatures at which cable may be pulled without damage.
 - l. Maximum pulling tensions which may be applied to the cable without damage.
 - m. Literature identifying the methods and materials which Contractor proposes to use to make splices and terminations. Submittal shall consist of manufacturer's literature evidencing compatibility of the conductor insulation, shield and jacket of the cable with the splicing or terminating materials and methods which Contractor proposes to use.
 - n. Manufacturer's recommended pulling lubricants.
 - o. Qualifications of splicing and termination personnel.
 4. Description of shop and field testing methods, procedures and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 45 days in advance prior to conformation of witness testing dates and actual testing.
 5. Qualifications of proposed testing firm to perform acceptance testing shall be submitted. Submit firm experience records at least 45 days in advance

to actual testing, five recent references with phone numbers shall be submitted.

C. Reports:

1. Shop and field test reports shall be submitted.
2. Acceptance testing report shall be submitted.
3. Medium voltage cable testing report shall be submitted to PSEG Long Island.

D. MATERIAL SAFETY DATA SHEETS

1. Material Safety and Data Sheets (MSDS) shall be submitted for all cables and wires supplied. MSDS shall be submitted with the equipment shop drawings.

1.5 QUALITY ASSURANCE

A. General:

1. All cables and wires shall be made by an approved manufacturer, and in their construction shall be employed the most improved commercial materials and processes of manufacture.
2. Only electrical wiring manufactured under high standards of production and meeting the approval of the Engineer shall be used. Friction tape shall be in accordance with ASTM Des. D69.
3. All medium voltage cable shall be in accordance with PSEG Long Island cable specification. Medium voltage cable splicing and terminations shall be done by experienced cable splicers who have worked with similar cable for a period of at least 10 years, using materials and procedures recommended by the cable manufacturer. All splicing and terminations of medium voltage cable shall be in accordance with the instructions of the cable manufacturer.
4. The wire and cable manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.
5. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology and the NETA acceptance testing specification.
6. A three-foot medium voltage cable sample as be provided for inspection as required by PSEG Long Island customer representative.

B. Field Tests:

1. Electric wires and cables shall be field tested. Field testing for 600 volt and below wires and cables shall be in accordance with the requirements specified under Article 3.04.
2. The Contractor shall retain the services of an independent testing firm who shall perform acceptance testing on the medium voltage wire and cable installation. The testing firm shall have experience in the inspection and testing of cables of the type specified and shall be a member company of NETA. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer. The testing shall be performed in accordance with the requirements specified under Article 3.5.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Electric wires and cables shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

PART 2 - PRODUCTS

2.1 300 VOLT INSULATED CABLE

- A. 300 volt insulated cable shall be used for all communication and fire alarm circuits to the extent indicated on the Contract Drawings. The size and quantity of 300 volt insulated cable shall be as indicated on the Contract Drawings.
- B. Communication and Fire Alarm Cable shall be in accordance with the following:
 1. Conductors shall be stranded, tinned coated copper, No. 18 AWG minimum size for fire alarm cable and No. 24 AWG for communication cable. Insulation shall be polyethylene. Where specifically shown on the Contract Drawings or stated in the Specifications, communication system conductors shall be twisted shielded cable.
 2. The cable shall include an outer jacket. Jacketing shall be neoprene, chlorosulfonated polyethylene (hypalon), chlorinated polyethylene or flame retardant 105 degree C or polyvinyl chloride.
 3. Fire Alarm Cable shall be UL listed, made of Teflon and approved by the East Rockaway Building Department, Material and Equipment Acceptance Division.
 4. Communication and Fire Alarm Cable shall be by General Cable Corporation, Belden Company with Beldfoil shielding or equal to be approved by the Engineer.

2.2 600 VOLT INSULATED WIRE AND CABLE

Long Beach WPCP Consolidation

Pump Station Conversion

16121-5

- A. 600 volt insulated wire and cable shall be used for all 600 volt and below power, lighting, control, and alarm circuits. 600 volt wire and cable shall also be used for all instrumentation and security circuits to the extent indicated on the Contract Drawings.
- B. The size and quantity of 600 volt insulated wire and cable shall be as indicated on the Contract Drawing. The conductor jacket shall be in accordance with color identification requirements specified under Article 3.03.
- C. 600 Volt single conductor wire and cable for installation in conduit shall be in accordance with the following:
 - 1. Conductors shall be stranded, copper, single conductor cable conforming to ASTM B8, No. 12 AWG minimum size.
 - 2. Insulation shall be flame-retardant EPR (FREP), moisture and heat resistant thermoset rated 90 degrees C in dry locations and 90 degrees C in wet locations and listed by UL as type XHHW-2 or RHW-2.
 - 3. XHHW-2 shall be used for all indoor circuits and RHW-2 for all underground and outdoor circuits.
 - 4. 600 volt insulated wire and cable for installation in conduit shall be by Okonite Company, General Cable Corporation or equal to be approved by the Engineer.
- D. Variable Frequency Drive Power Cables:
 - 1. 600 Volts, 3/Conductor, VFD Power Cable, 90 Degrees Celsius Wet or Dry locations, 2,000 Volts, Copper stranded conductors with cross-linked Polyethylene insulation, Three symmetrically placed copper ground conductors and 5 mil copper tape shield. Approved for direct burial, free air or raceways.
 - 2. Variable frequency drive cables shall be by General Cable, Southwire, Belden or equal approved by the Engineer.
- E. When identified on the Contract Drawings 600 Volt multiple conductor cable shall be used for control and alarm circuits in the quantities indicated. 600 Volt multiple conductor control cable for installation in conduit shall be in accordance with the following:
 - 1. Conductors shall be stranded, tinned coated copper conforming to ASTM B8 and B33, No. 12 AWG minimum size.
 - 2. Insulation shall be moisture and flame resistant cross-linked polyethylene rated 90 degrees C in wet and dry locations and listed by UL as type XHHW-2.
 - 3. Cable conductors shall be assembled together with flame and moisture resistant filters and tape to make round.

4. Cable shall include an overall protective jacket of polyethylene compound, 45 mils minimum thickness.
 5. 600 Volt multiple conductor control cable shall be Okonite Company, General Cable Corporation or equal to be approved by the Engineer.
- F. 600 Volts instrumentation cable shall be in accordance with the following:
1. Conductors shall be stranded, tinned coated copper, No. 16 AWG minimum size. All conductors shall be polyethylene insulated and twisted in pairs with an aluminum-mylar shield overlapped.
 2. Cables shall be single pair shielded type or multiple pair shielded type as shown on the Contract Drawings. Multiple pair cables shall also include an overall shield in addition to the individual shields on each pair.
 3. The cable shall include an outer jacket. Jacketing shall be neoprene, chlorosulfonated polyethylene (hypalon), chlorinated polyethylene or flame retardant 105 degree C polyvinyl chloride.
 4. Instrumentation cable shall be by Okonite Company, General Cable Corporation, Belden Company or equal to be approved by the Engineer.

2.3 MEDIUM VOLTAGE INSULATED WIRE AND CABLE

- A. Medium voltage cable insulation shall be suitable for normal installation, indoors or outdoors, in conduit, in air, and intermittent or continuous submersion in water. Cable shall bear UL label "MV 90" at a minimum and comply with or exceed ICEA S-68-516 and AEIC CS6-87. Medium voltage cable shall be in accordance with the requirements of PSEG Long Island cable specification.
- B. Medium voltage cable identification shall meet the requirements of ICEA S-94-649. Cable shall have identification markings along the entire length as described by and in accordance with PSEG Long Island cable specification.
- C. Medium voltage cable shall be in accordance with the following:
1. Conductors shall be two conductor number 2 AWG copper concentric or compressed round stranded with copper concentric neutrals with ten number 14 AWG neutral strands.
 2. The cable insulation system shall include two separate shield layers and the primary insulation.
 - a. Conductor Shield: The conductor shield shall consist of an extruded inner layer of non-conducting energy suppression or semiconducting material. Shield minimum thickness shall be 12 mils.

- b. Primary insulation: The primary insulation shall be a high quality ozone resistant ethylene-propylene rubber based compound. Minimum thickness shall be 220 mils.
- c. Insulation Shield: The insulation shield shall be an outer layer extruded over the insulation of UV stabilized weather resistant layer of black semi-conducting material consisting with a minimum thickness of 30 mils.
- 3. Jacket: the cable shall have a black linear low density polyethylene jacket extruded to fill over the concentric neutrals. The minimum thickness of the jacket shall be 50 mils.
- 4. Medium voltage insulated wire and cable shall be by General Cable Corporation, Okonite Company, Kerite Company, or equal to be approved by the Engineer.

2.4 600 VOLT AND BELOW WIRE AND CABLE ACCESSORIES

- A. Cable connectors shall be provided for terminating 600 volt and lower voltage wire and cable. Connectors for wire and cable up to 600 volt shall be solder less type and properly sized to fit fastening device and wire size. Connectors shall be in accordance with the following:
 - 1. For wire sizes up to and including No. 6 AWG, compression type with UL 486A listing shall be used. All cable terminations for conductors No. 10 AWG and smaller shall be terminated using UL listed ring tongue type, nylon insulated connectors, at each terminal board.
 - 2. For wire sizes No. 4 AWG and above, either compression type or bolted type with tin-plated contact faces shall be used.
 - 3. For wire sizes No. 250 kcmil and larger, connectors with at least 2 cable clamping elements or compression indents and provision for at least 2 bolts for joining to apparatus terminal shall be used.
 - 4. Compression connectors shall be Power-Connect, ring tongue shall be Series 83 as manufactured by Ideal Industries. Connectors shall also be by Thomas and Betts, Burndy or equal approved by the Engineer.
- B. Cable splicing for 600 volt and below wire and cable shall be performed when terminals are not provided. Splicing shall be in accordance with the following:
 - 1. For wire sizes No. 8 AWG and larger, splices shall be made up with compression type copper splice fittings with UL 486A listing. Splices shall be taped and covered with materials recommended by the cable manufacturers, to provide insulation equal to that on the conductors.
 - 2. For wire sizes No. 10 AWG and smaller, splices shall be made up with pre-insulated spring connectors. Connectors shall be flame retardant with UL listing.

3. Splices shall be submersible rated for underwater use at all underground locations and all above grade indoor and outdoor locations below elevation 21.40 feet. Underwater splices shall be rated for 10,000 psig. The splices shall be precision precast polyurethane compression dams, waterblock solder pins and an amber polyurethane overmold to prevent all water from entering the cable and keeping seawater outside the cable from passing through the splice to the electrical connection. Underwater splices shall be UL listed. All underwater splices shall be manufactured by PMI Industries or approved equal.
 4. Compression splices shall be by Ideal Industries, Thomas and Betts, Burndy, or equal to be approved by the Engineer. Waterproof compression splices shall be thermo-shrink as manufactured by Ideal Industries. Waterproof compression splices shall also be by Thomas and Betts, Burndy, Buchanan or equal approved by the Engineer.
 5. Spring connector splices shall be Twister type and Twister DB type for waterproof, as manufactured by Ideal Industries. Spring connectors shall also be by Thomas and Betts, Burndy, or equal approved by the Engineer.
- C. Cable markers shall be provided for the identification of 600 volt and below wire and cable. Markers for 600 volt and below wire and cable shall be in accordance with the following:
1. Markers shall be vinyl type, moisture, heat and abrasion resistant with adhesive back. Cable identification shall be clearly marked.
 2. Markers shall be by Ideal Industries, Thomas and Betts or equal to be approved by the Engineer.
- D. Pulling compound shall be provided to facilitate wire pulling. Pulling compound shall be in accordance with the following:
1. Pulling compound shall be waxed based, with a .17 average coefficient of friction and a temperature range of 30 to 190 degrees F. The compound shall be compatible with all cable types.
 2. Pulling compound shall be Ideal Industries, Greenlee or equal to be approved by the Engineer.

2.5 MEDIUM VOLTAGE WIRE AND CABLE ACCESSORIES

- A. Cable connectors shall be provided for connecting medium voltage wire and cable. Connectors shall be in accordance with the following:
1. Connectors shall be copper, tin-plated, long barrel compression type, UL listed. Suitable for voltage applications up to 35KV. Connectors shall be Power-Connect type as manufactured by Ideal or equal approved by the Engineer.

2. For sizes 250MCM and larger connectors shall be two-hole mount type with provisions for two bolts for joining to apparatus terminal.
 3. Connectors shall be by Ideal Industries, Thomas and Betts, Burndy or equal to be approved by the Engineer.
- B. Cable terminators shall be provided for terminating medium voltage wire and cable. Terminations shall be in accordance with the following:
1. Cable terminations shall meet Class 1 requirements and be design-proof tested per IEEE 48.
 2. Terminations shall be of the molded elastomer, wet-process porcelain or heat-shrinkable types with grounding provisions for the cable shielding.
 3. Terminations shall be Elastimold, G&W Electric Company, Raychem Corporation or equal to be approved by the Engineer.
- C. Cable splices shall be provided for splicing medium voltage wire and cable, splicing shall be in accordance with the following:
1. For dry locations:
 - a. Cable splices shall be made using standard splice kits which reinstate the cable's insulation and jacket and continue the metallic shielding through the entire cable joint.
 - b. Splices shall be of the premolded splice, conventional tape or heat-shrinkable type.
 - c. Splices shall be Elastimold, G&W Electric Company, Raychem Corporation or equal to be approved by the Engineer.
 2. For wet locations: Splices shall be submersible rated for underwater use. Underwater splices shall be rated for 10,000 psig. The splices shall be precision precast polyurethane compression dams, waterblock solder pins and an amber polyurethane overmold to prevent all water from entering the cable and keeping seawater outside the cable from passing through the splice to the electrical connection. Underwater splices shall be UL listed. All underwater splices shall be manufactured by PMI Industries or approved equal.
- D. Pulling compound shall be provided to facilitate wire pulling. Pulling compound shall be in accordance with the requirements specified under Paragraph 2.4 D.

2.6 SHOP TESTS

- A. Certified Shop Tests:
1. Shop testing shall be performed on the wire and cable at the manufacturer's plant prior to shipment. Shop test shall be in accordance with the latest revisions of ICEA and UL and shall demonstrate that the wire and cable tested conforms to the requirements specified.

2. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.
3. All low voltage wire and cable shall be shop tested in accordance with the requirements of Underwriters' Laboratories.
4. All medium voltage wires and cables shall be shop tested in accordance with the following:
 - a. Conductors shall meet the electrical resistance requirements of ICEA-S-68-516, Part 2.5.
 - b. Insulation Resistance test shall be performed in accordance with the requirements of ICEA S-68-516, Part 6.28. Each cable shall have an insulation resistance not less than that corresponding to the insulation resistance constant of 20,000 megohms - 1000 ft. at 15.6 degrees C.
 - c. A high voltage AC and DC test shall be performed in accordance with the requirements of ICEA S-68-516, Part 6.27. The AC and DC test voltages shall be in accordance with Section B of AEIC CS6.
 - d. Shield resistance shall be measured and recorded from end to end on the completed cable.
 - e. Each reel of completed shielded power cable shall be partial discharge tested in accordance with Section E and F of AEIC CS6.

2.7 DATA HIGHWAY CABLE

- A. Data highway cable shall be utilized for systems and circuits where shown on the Contract Drawings.
- B. All data highway cable provided under this Contract shall be furnished by a single manufacturer.
- C. The data highway cable shall have the following specifications:
 1. Category 6, ethernet plenum cable.
 2. 4 Pair - AWG 24 solid copper conductors.
 3. FEP insulation with PVC overall jacket.
 4. Meets ANSI/TIA/EIA-568-A performance specifications.
 5. Characteristic impedance: 100+/-15 ohms.
 6. DC resistance: 7 ohms (maximum).
 7. DC resistance unbalance: 2.5% (maximum).
 8. Mutual capacitance: 5.6 nF/100 meters (maximum).
 9. Pair-to-pair capacitance unbalance: 100 pF/100 meters (maximum).
 10. Manufactured to UL444 and flame tested to UL910.
 11. UL rated Type CMP and MMP.

- D. Cable shall be equal to Southwire Cyber Technologies, “Cyber LAN Category 6 plenum.”

PART 3 - EXECUTION

3.1 GENERAL

- A. All cables and wires shall be installed within the raceways as shown on the Contract Drawings. They shall be carefully handled so as to avoid twists or kinks in the conductors or damage to the insulation.
- B. The Contractor shall ensure that the manufacturer’s recommended cable bending radii and pulling are not exceeded and that the number of conductors permitted in a conduit are in accordance with the latest applicable section of NFPA 70 National Electrical Code.
- C. No splices shall be permitted between terminals except at approved junction or terminal boxes. Boxes shall be provided as shown on the Contract Drawings or as required by Code for the pull lengths. No more than two terminations shall be made at each terminal point. Cable and wire runs shall be looped through pull boxes without cutting and splicing where possible. All splices below grade, in manholes, hand holes and wet locations shall be water proofed.
- D. No splicing of instrument wiring shall be permitted. Instrument wiring shall be extended by use of field termination boxes employing labeled terminal strips. Shield continuity shall be maintained. Ultimate shield termination (ground) shall be at one end only.

3.2 INSTALLATION OF WIRING

- A. Cables shall be installed complete with proper terminations at both ends. For each motor circuit, Contractor shall ensure proper phase sequence and motor rotation.
- B. Wire and cable contained within a single conduit shall be pulled simultaneously using insulating pulling compounds containing no mineral oil.
- C. Pulling tension on medium voltage cables shall be continuously monitored using a calibrated Dynamometer type device, having a calibration label within six months of its use.

- D. Cables shall be installed with maximum slack at all terminal points, boxes, handholes and manholes.
- E. Medium voltage cables located within manholes, handholes and boxes shall be wrapped with fireproofing tape for their entire length on an individual cable basis. Tape shall be 30 mills thick of self-extinguishing material which will not support combustion. Tape shall not deteriorate when subjected to water, salt, sewage or fungus and shall be secured with glass cloth tape. Medium voltage cables shall be fireproofed in accordance with the cable manufacturer's recommendations and then covered with tape extending at least one inch into any duct.

3.3 CONDUCTOR IDENTIFICATION

- A. Each wire shall be labeled at each termination point and all splice locations. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification stamped on terminal boards when provided or the cable so it is visible around the cable's circumference.
- B. Each wire shall be identified in junction boxes, cabinets, and terminal boxes. Where no termination is made, use a plastic-coated, self-adhesive, wire marker. Where termination is made, use a plastic, pre-printed sleeve wire marker. Paper, self-adhesive wire markers shall not be used.
- C. In manholes and handholes, each power wire shall be identified by a laminated plastic tag located so that it can be seen from center of manhole without moving adjoining wires. Bundle and mark control wires as listed in conduit and cable schedule.
- D. Multi-conductor control cables shall be color coded in accordance with ICEA S-61-402, Method 1, Table K.
- E. The following identification scheme shall be used for all 600 volt and below power circuits:

<u>System Voltage</u>	<u>Neutral</u>	<u>Phase A</u>	<u>Phase B</u>	<u>Phase C</u>	<u>Ground</u>
208/120V	White	Black	Red	Light Blue	Green
240/120V	White- Gray Strip	Black- Blue Strip	Red- Blue Strip	None	Green
480/277V	Gray	Brown	Orange	Yellow	Green

Long Beach WPCP Consolidation
Pump Station Conversion

16121-13

- F. Medium voltage cables greater than 2000 volts shall be color coded by a bright yellow colored tape band. Conductor identification shall be marked by a single wrap for Phase A, a double band for Phase B and three bands for Phase C.

3.4 600 VOLT AND BELOW WIRE AND CABLE FIELD TESTING

- A. After installation, all 600 volt and below wire and cable shall be field tested. The field tests shall be performed by the Contractor who shall furnish all testing equipment. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide a report identifying the tests performed and the results obtained.
- B. Each electrical circuit shall be tested after permanent cables are in place to demonstrate that the circuit and equipment are connected properly and will perform satisfactorily and that they are free from improper grounds and short circuits. The tests shall consist of the following:
 - 1. 600 volt wire and cable mechanical connections shall be individually tested after installation and before they are put in service with a calibrated torque wrench. Values shall be in accordance with manufacturer's recommendations.
 - 2. 600 volt and below wire and cables shall be individually tested for insulation resistance between phase and from each phase to ground. Test after cables are installed and before they are put in service with a Megger for one minute at a voltage rating recommended by the cable manufacturer or in accordance with NEMA and ICEA standards.
 - 3. The insulation resistance for any given conductor shall not be less than the value recommended by the cable manufacturer or in accordance with NEMA and ICEA standards. Any cable not meeting the recommended value or which fails when tested under full load conditions shall be replaced with a new cable for the full length.
 - 4. Shielded instrumentation cable shields shall be tested with an ohmmeter for continuity along the full length of the cable and for shield continuity to ground.
 - 5. Connect Shielded instrumentation cables shall be connected to a calibrated 4-20 milliamp DC signal transmitter and receiver. Test at 4, 12, and 20 milliamp transmitter settings.

3.5 MEDIUM VOLTAGE WIRE AND CABLE FIELD TESTING

- A. The Contractor shall provide acceptance testing of the medium voltage wire and cable. The acceptance testing shall be witnessed by the Engineer and certified by the Contractor.
- B. Each medium voltage wire and cable circuit shall be acceptance tested on an individual per phase basis, all testing and inspection shall be performed by the testing firm.
- C. Perform visual and mechanical inspections and testing for each medium voltage cable circuit. Perform the following inspections for each individual cable to verify installation and to confirm cables and terminations comply with PSEG Long Island requirements.
- D. Electrical tests shall be performed for each power cable. Perform the following tests for each individual cable. Test each cable with respect to ground and adjacent cables.
 - 1. Insulation resistance tests using a 5,000-volt megohmmeter for 15kV cables. Evaluate ohmic values by comparison with cables of same length and type and investigate values less than 50 megohms.
 - 2. Neutral and shield continuity tests using ohmmeter method on each section of cable. Investigate values in excess of 10 ohms per 1,000 feet of cable.
 - 3. High potential tests. The following procedures shall be adhered to before performing dc over potential tests:
 - a. All equipment transformers, switches, motors, circuit breakers, surge arrestors, etc. shall be disconnected from cable circuit to prevent test interruptions due to flashovers or trip outs resulting from excessive leakage current.
 - b. Adequate clearance shall be established between the circuit test ends and any grounded object and to other equipment not under test.
 - c. Circuit conductors not under test shall be grounded including all cables shields and nearby equipment.
 - d. Insulation surfaces shall be cleaned.
 - e. Cable ends shall be keep dry.
 - 2. High-potential shall be applied slowly in 8 to 10 equal steps to 80 percent of the NETA test value or manufacturer's shop production test value, whichever is smaller. Record the leakage current at each test voltage and plot the curve on graph paper.
 - 3. The test shall be stopped, if the leakage current increases excessively or a "knee" appears in the curve before reaching maximum test voltage.
 - 4. Upon reaching the specified maximum test voltage, the voltage shall be maintained for 15 minutes, record the leakage current at 30 seconds and one minute and at one-minute intervals thereafter. Plot leakage current versus time on the same graph as the step voltage curve.

5. Conductor test potential shall be reduced to zero and measure residual voltage at discrete intervals.
 6. Grounds shall be applied to drain all insulation stored charge. Conductors shall be connected to ground through a suitable discharge resistor for one minute and then subsequently grounded directly.
 7. New cable failing the test shall be replaced and retested.
 8. The test curves shall be signed by the tester and initialed by the Engineer.
- E. All tests and values for wire and cable shall be in accordance with the manufacturer's recommendations and NETA, ATS Acceptance Testing Specification.
- F. The Contractor shall provide an acceptance testing report. The report shall be in accordance with NETA, ATS Acceptance Testing Specification.

+ + END OF SECTION + +

SECTION 16131

ELECTRIC CONDUIT SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing conduit system. The conduit system shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The conduit system required shall be provided with all rigid and flexible conduits, boxes, fittings, supports, hangers and inserts and other conduit accessories as required for the installation of the electric wire and cable.
- C. The following index of this Specification is presented for convenience.

<u>Article</u>	<u>Title</u>	<u>Page</u>
		16131-
PART 1	GENERAL	
1.1	Section Includes.....	1
1.2	Related Specifications	2
1.3	Payment	2
1.4	References	2
1.5	Submittals	3
1.6	Delivery, Storage and Handling	3
PART 2	PRODUCTS	
2.1	Rigid Steel Conduit	3
2.2	Hangers, Supports and Inserts	4
2.3	Flexible Metallic Conduit.....	5
2.4	Outlet Boxes and Fittings	5
2.5	Conduit Accessories	6
2.6	Terminal, Junction and Pull Boxes.....	9

<u>Article</u>	<u>Title</u>	<u>Page</u>
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16131-

PART 3 EXECUTION

3.1	General	11
3.2	Installation of Raceways.....	12
3.3	Conduit Connections to Equipment.....	15
3.4	Installation of Boxes and Fittings.....	16
3.5	Installation within Hazardous Areas	17
3.6	Field Tests	17

- D. All PVC coated conduit installed shall be the same uniform gray color. No other color variations will be accepted. All RGS conduit shall be painted to match the same uniform gray color of the PVC coated conduit delivered to the site.
- E. Every conduit shall be tagged to define its system served to the extent applicable: power, process/mechanical, instrumentation, telephone, fire alarm, communications and lighting.
- F. Where conduit enters and exits pull boxes, junction boxes, terminal boxes, etc. the labels for conduit tags shall be placed on the interior of the box on the conduit bushings.

1.2 RELATED SPECIFICATIONS

- A. Specification 09900 - Painting.
- B. Specification 16071 – Supporting Devices.

1.3 PAYMENT

- A. Payment for Electric Conduit System shall be made as provided in Division 1 of the Specifications.

1.4 REFERENCES

- A. Electric conduit system shall comply with the latest applicable provisions and recommendations of the following:
 1. NFPA 70, National Electrical Code.
 2. IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 3. UL Standard No. 6, Rigid Metal Electrical Conduit.
 4. UL Standard No. 50, Electrical Cabinets and Boxes.
 5. UL Standard No. 360, Liquid-Tight Flexible Steel Conduit.
 6. UL Standard No. 514A, Metallic Outlet Boxes.

7. UL Standard No. 514B, Fittings for Conduit and Outlet Boxes.
8. UL Standard No. 886, Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.
9. ANSI C80.1, Specification for Zinc Coated Rigid Steel Conduit.
10. ANSI C80.4, Specification for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.
11. NEMA Standard No. RN-1, PVC Externally Coated Galvanized Rigid Steel Conduit.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 2. Manufacturer's catalog cuts for the conduit, boxes, fittings and supports proposed for use.
 3. Construction details of conduit racks and other conduit support systems with seismic restraint details and calculations signed by a licensed Engineer.
 4. Scaled working drawings showing proposed routing of all conduits, inclusive of conduits embedded in structural concrete and conduits directly buried in earth. Drawings shall show locations of pull and junction boxes and all penetrations in walls and floor slabs.
- C. Field test report shall be submitted.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Electric conduit system shall be delivered, stored and handled in accordance with the Specifications, the manufacturer's instructions and the following:
 1. Conduit shall be delivered to the work in standard bundles having each length suitably marked with the manufacturer's name or trademark and bearing the label of the Underwriters' Laboratories, Incorporated, inspection service.

PART 2 - PRODUCTS

2.1 RIGID STEEL CONDUIT

- A. The Contractor shall provide rigid steel conduit for conduits runs within the Electric Building and for runs embedded in the structural slabs and walls. All

steel conduits shall comply with the requirements of ANSI C80.1, and the Underwriters' Laboratories, Incorporated, Standard for No. 6.

- B. Both the inside and outside surfaces of the rigid steel conduit shall be protected against corrosion by a coating of zinc applied by the hot-dip galvanizing process.
- C. Rigid steel conduits, elbows and couplings shall be rigid, heavy wall, mild steel, hot dip galvanized. Conduits, elbows and couplings shall have a smooth interior with tapered threads and carefully reamed ends. Conduit size shall be 3/4-inch minimum and shall conform to UL-6.
- D. PVC coated rigid steel conduits shall be provided for all exposed conduit runs at outdoor locations and at the valve pit. PVC coated conduits shall be factory applied and shall include a smooth 2 mil thick urethane interior coating and 40 mil thick polyvinyl chloride exterior coating. The exterior PVC coating color shall be gray. The threads of conduits that have been cut to size shall have the same PVC coating applied in the field. PVC coated conduit shall conform to NEMA Standard RN-1.
- E. PVC coated conduit elbows and couplings shall include a PVC coating that matches the conduit.
- F. Rigid steel conduit shall be by Allied Tube and Conduit Corporation, Wheatland Tube Company or approved equal. PVC coated rigid steel conduit shall be by Perma-Cote Industries, OCAL Incorporated, Robroy Industries or equal to be approved by the Engineer.

2.2 HANGERS, SUPPORTS AND INSERTS

- A. The Contractor shall provide hangers, supports and inserts for support of the electric conduit system. The supports shall securely attach the electric conduit system to the channel and structure.
- B. All drilled in type concrete inserts shall be expansion shields or anchors conforming to Specification 05051 – Anchor Systems In corrosive locations, concrete inserts shall be 316 stainless steel.
- C. Hangers and supports shall be in accordance with the requirements of Specification 15518 - Hangers and Supports except beam clamps, hanger rods and hardware shall be steel with electro-plated zinc finish. This shall also include bolts, nuts and washers. In corrosive locations, hangers and support hardware shall be type 316 stainless steel or factory applied 40 mil thick PVC coated.
- D. Hangers, Supports and Inserts shall be by B-Line, Kindorf or equal to be approved by the Engineer.

2.3 FLEXIBLE METALLIC CONDUIT

- A. The Contractor shall provide flexible metallic conduit where required to permit movement of connected devices and where it is impracticable to complete runs with rigid conduit.
- B. Liquid-tight flexible metallic conduit shall be used for all indoor non-hazardous areas.
- C. Liquid-tight flexible metallic conduit shall be used for all outdoor non-hazardous areas.
- D. For hazardous areas flexible conduit shall include a brass inner core with a bronze outer braid and protective neoprene plastic coating. End fittings shall be steel, brass or bronze.
- E. Flexible conduit shall be by Anaconda American Brass Company, Electric-Flex Company or approved equal. Hazardous area flexible conduit shall be by Crouse Hinds Company, Appleton Electric Company or equal to be approved by the Engineer.

2.4 OUTLET BOXES AND FITTINGS

- A. The Contractor shall provide outlet boxes and fittings for rigid and flexible conduit. The outlet boxes and fittings required for the work which constitutes a part of the conduit system, shall be of approved types.
- B. For outdoor, wet and corrosive areas, conduit fittings and outlet bodies shall be cast gray iron alloy, cast malleable iron bodies and covers. All units shall be gasketed, watertight, and threaded with five full threads and shall have rust-proofing in accordance with the requirements of Article 2.6. Fittings and bodies installed on PVC coated conduits shall also include interior and exterior coatings equivalent to the conduit.
- C. Threaded cast ferrous metal, hub type outlet boxes shall be used throughout, except in the interior walls of superstructures and in roof slabs protected by built-up roofing where pressed steel boxes shall be installed. Cast iron or alloy outlet boxes of the proper size and depths for the application, complete with watertight gaskets and covers secured by brass screws, shall be furnished and installed as indicated on the Contract Drawings or as required by the conduit run. Outlet boxes, furnished and installed for the installation of lighting fixtures, switches and receptacles in a future contract, shall be furnished with watertight gaskets and blank covers.

- D. For non-hazardous, indoor dry dusty areas pressed steel boxes of the proper size and depths for the application shall be provided. Boxes shall be rated NEMA 12, not less than No. 14 U.S. Standard Gauge (0.078 inch). The conduit openings shall be provided with oil-resistant gaskets. Conduits shall be fastened to these boxes with locknuts and bushings, and all unused outlets or holes shall be left sealed.
- E. All outlet boxes intended for fixtures shall be provided with approved fixture studs.
- F. For concealed conduit runs in outside walls and all exposed conduit work, connections to boxes and fittings shall be made through threaded holes, unless otherwise approved by the Engineer. For concealed conduit work in non-hazardous areas in other than outside walls, connections between conduit and boxes may be made with drilled holes, using locknuts and bushings. Where necessary unions may be used. Unions in hazardous locations shall be Crouse Hinds type UNF, UNL, UNY conduit fittings or equal to be approved by the Engineer. Unions in non-hazardous areas shall be Universal or Erickson conduit couplings or equal to be approved by the Engineer.
- G. All boxes installed for concealed conduit, shall be provided with extension rings or plaster rings and covers as required. For non-hazardous, dry indoor areas stainless 302/304, satin beveled steel cover and device plates for surface mounted boxes shall be used. For corrosive locations, galvanized ferrous and galvanized cast ferrous metal cover and device plates with neoprene gaskets shall be used.
- H. Outlet boxes and fittings installed on PVC coated conduit shall also include interior and exterior coatings equivalent to the conduit.
- I. For receptacle, switch, fixture, and other device outlet boxes recessed in walls, or exposed within hung ceiling spaces, in non-hazardous, indoor, dry areas above grade, standard galvanized pressed steel outlet boxes with partially pre-punched conduit connection cutouts, of the proper size and depth for the application, shall be provided. Conduits shall be fastened to these boxes with locknuts and bushings. Similar pressed steel boxes with blank covers may be used for junction and pull boxes in conduit runs where pressed steel device boxes are permitted.

2.5 CONDUIT ACCESSORIES

- A. The Contractor shall provide conduit accessories for use with the conduit system. The conduit accessories shall be of approved types.
- B. Expansion and Deflection Fittings:
 - 1. Expansion and deflection fittings shall be made up of non-corrodible parts and shall provide for ample longitudinal and lateral movement. A suitable

bond shall provide a low resistance, continuous longitudinal path for ground currents.

2. Expansion and deflection fittings shall be watertight cast iron, malleable iron or hot dipped galvanized. Fittings shall be corrosion-resistant, UL listed and compatible with the conduit system.
3. Provide expansion fittings where expansion and contraction only are required. Expansion fittings shall provide expansion /contraction with eight-inch total movement.
4. Provide expansion /deflection fittings where both expansion and deflection in a single fitting is required. Expansion/deflection fittings shall be in accordance with the following:
 - a. Axial expansion or contraction up to 3/4-inch.
 - b. Angular misalignment up to 30 degrees.
 - c. Parallel misalignment up to 3/4-inch.
5. Expansion and deflection fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.

C. Sealing Fittings:

1. Sealing fittings shall be cast gray iron alloy or cast malleable iron or copper free aluminum with zinc electroplate and lacquer or enamel finish.
2. Sealing fittings shall have an ample opening with threaded closure for access to conduit hub for making dam. Sealing fiber and compound shall be suitable for use with the fitting and shall be the products of the fitting manufacturer.
3. For corrosive locations, seal fittings shall include interior and exterior coatings equivalent to the PVC conduit coating specified under Article 2.1.
4. Sealing fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.

D. Drain Fittings:

1. Drain fittings shall be a combination device designed to provide ventilation to minimize condensation and drains accumulated condensate.
2. The combination drain/breather fitting shall be 3/8 inch male thread size with stainless steel body.
3. Drain fittings shall be by Crouse Hinds, Appleton Electric or equal to be approved by the Engineer.

E. Conduit Hubs:

1. Conduit hubs shall be threaded, insulated throat type with bonding screw locknut.
2. The conduit hub and locknut shall be malleable iron or zinc and shall include a 90 degree C insulating surface and a sealing ring for a water tight and dust tight connection.
3. Conduit hubs shall be by 0-Z Gedney, Thomas and Betts or equal to be approved by Engineer.

F. Conduit Bushings:

1. Conduit bushings shall be insulated, grounding type with lay-in-lug connection. Two locknuts shall be provided for each bushing.
2. The conduit bushing and locknuts shall be steel, malleable iron or zinc. The bushing shall include a 90 degree C insulating surface.
3. Conduit bushings and locknuts shall be by O-Z Gedney, Thomas and Betts or equal to be approved by the Engineer.

G. Duct and Conduit Sealing:

1. Seal underground spare ducts with duct seal. Duct seal shall be a soft, fibrous non-hardening sealing compound for sealing between cables and conduits.
2. Duct seal shall be by O-Z Gedney, Ideal Industries or equal to be approved by the Engineer.
3. Seal all conduit entries where the submersible pump and grinder vendor cables are terminated using a re-enterable foam duct sealant suitable for providing a watertight, gas tight seal and NEC rated as a raceway seal.
4. Re-enterable foam duct sealant shall be type FST by Polywater or equal approved by the Engineer.

H. Thruwall Seals and Bushings:

1. Thruwall seals and bushings shall be in accordance with the following:
 - a. For conduits passing through existing exterior block walls or passing through existing exterior subsurface walls, existing exterior concrete walls, floor slabs and roof slabs for use in core bit-drilled holes sealing bushings shall be used. Sealing bushings shall be Type CSMI at the inside of the structure and Type CSMC at the outside of the structure, within the same core drilled hole. Sealing bushings shall be manufactured by O-Z/Gedney or equal to be approved by the Engineer.
 - b. For conduits passing through existing interior concrete walls or floors and existing interior block walls sealing bushings shall also be used. Sealing bushings shall be CSMC or CSMI type as manufactured by O-Z/Gedney or equal to be approved by the Engineer.
 - c. For conduits passing through fire rated floors and walls fire stop fittings shall be used. Fire stop fittings shall be CFS and/or CFSI type as manufactured by O-Z/ Gedney or equal to be approved by the Engineer.

J. Conduit Tags:

1. Conduit tags shall be Setmark snap around conduit markers which shall be secured to the conduit with annealed brass wire.
2. Conduit tags shall be clearly stamped with the conduit number in conformity with the Contract Drawings or as directed by the Engineer.
3. Conduit tags shall be by Seton Nameplate Corporation or equal to be approved by the Engineer.

K. Conduit Markers:

1. Conduit identification markers shall be self-sticking color-coded tape. Identification tape shall be two inches wide and colored in accordance with the color banding specified under this section.
2. Conduit markers shall be by Thomas and Betts or equal to be approved by the Engineer.

2.6 TERMINAL, JUNCTION AND PULL BOXES

- A. The Contractor shall provide terminal, junction and pull boxes as shown on the Contract Drawings and where otherwise required, or as directed by the Engineer. The Contractor is responsible for the sizing of all boxes as described by and in accordance with NFPA 70.
- B. Boxes located indoor in dry, dusty areas shall be NEMA Type 12, constructed of welded and galvanized sheet steel. Boxes 24 inches and less shall be 14 USS standard gauge metal. 12 USS standard gauge metal on boxes greater than 24 inches, except 10 USS standard gauge shall be used for boxes with any dimension of 36 inches or more.
- C. Boxes located in other areas shall conform to the following area classifications:
 1. For wet locations boxes shall be watertight NEMA Type 4. Boxes shall be constructed of galvanized cast iron and shall include gasketed, bolt on covers, with tapped holes in bosses or hubs for conduit entrance. Boxes shall be provided with cast mounting lugs for installation in concrete.
 2. For hazardous locations boxes shall be explosion proof NEMA Type 7 for indoor locations and NEMA Type 8 for outdoor locations. Boxes shall be constructed of cast iron and shall include threaded connections and ground joint surfaces.
 3. For corrosive locations boxes shall be corrosion resistant, NEMA Type 4X. Boxes shall be constructed of 316 stainless steel material with sealed seams.
 4. Boxes used for termination of the submersible pump and grinder vendor cables shall be rated NEMA Type 8 and boxes use for the grinder vendor cables shall also be submersible.
 5. Contractor's attention is directed to the fact that the specified submersible equipment manufacturers differ in terms of the submersible cable quantities and sizes required. Contractor shall coordinate with the equipment actually selected and the submersible cable requirements and adjust the installation as required to suit the equipment provided.
- D. Pull and junction boxes shall be provided with covers held in place by brass screws. Terminal boxes shall be provided with terminal block supports and approved hinged covers fitted tightly against a gasket and secured by lug bolts and wing nuts. Hinges, lug bolts, wing nuts and other fittings shall be made of an approved, non-ferrous, non-corrodible metal. All boxes shall be provided with rabbeted gaskets or flange gaskets securely held in place.

- E. Tapping for threaded connections to outlet boxes, junction boxes, pull boxes and conduit fittings in non-explosion proof construction shall conform to the following:
1. All threads shall be tapered.
 2. If threads for connection of conduit are tapped all the way through a hole in an enclosure, or if an equivalent construction is employed, there shall be not less than 3-1/2 threads in the metal and the construction of the enclosure shall be such that a suitable conduit bushing can be properly attached.
 3. If threads for connections of conduit are not all the way through a hole in a box wall, conduit hub or the like, there shall be not less than five full threads in the metal and there shall be a smooth, well rounded inlet hole for the conductors, which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing and which shall have an internal diameter approximately the same as that of the corresponding trade size of rigid conduit. The threaded hole shall be provided with a conduit end stop.
 4. Tapping for threaded connections for explosion proof construction shall conform to the requirements of the National Electrical Code for construction in Class I, Division 1, hazardous locations.
- F. Cast iron or cast ferrous alloy outlet boxes, junction boxes, pull boxes, conduit fittings and conduit accessories such as box covers shall be rust-proofed by zinc coating applied by the "hot-dip" process or shall be given a rust protective coating applied by either of the following methods:
1. Method A:
 - a. Castings shall be given a mechanical and chemical cleaning.
 - b. Castings shall be given a phosphoric acid type dip.
 - c. Then a coating of zinc chromate primer shall be applied, and finally
 - d. A coating of baked enamel finish shall be applied over the outside and inside surfaces of the castings.
 2. Method B:
 - a. Castings shall be given a mechanical and chemical cleaning.
 - b. Then a coating of cadmium shall be deposited electrolytic ally.
 - c. Then a coating of zinc shall be applied by electroplating.
 - d. Then a vinyl resin base aluminum lacquer shall be applied.
- G. Stamped steel outlet boxes, junction boxes and box covers shall be rust-proofed by a zinc coating applied by an electro-galvanizing or sherardizing process. Fabricated sheet steel boxes shall be formed from galvanized sheet steel. Welded joints shall be touched up with aluminum lacquer and boxes and covers shall be given a shop priming coat of zinc chromate rust inhibiting paint.
- H. Terminal blocks shall be used within terminal boxes for termination of the submersible vendor cables. Terminal boxes shall include power and control terminal blocks rated 480 Volts. Coordinate with the submersible cables actually furnished and provide amperes ratings and terminal quantities that are suitable for the total number and sizes of the cables provided.

PART 3 - EXECUTION

3.1 GENERAL

- A. All conduits shall be installed in accordance with the requirements specified under this section and in conformity with the sizes stated in the Specifications or shown on the Contract Drawings. They shall be installed complete with all accessories, fittings, and boxes, in an approved and workmanlike manner so as to provide proper raceways for electrical conductors.
- B. The Contractor's attention is called to the fact that conduit runs where indicated on the Contract Drawings are shown diagrammatically for the purpose of outlining the general method of routing the conduits to avoid interference. Where conduit runs are not shown, it shall be the responsibility of the Contractor to establish the runs required based upon the various systems shown on the Contract Drawings and the field conditions.
- C. Conduit runs shown routed down vertically at the Generator and Electric Building elevated platforms shall be embedded in the structural concrete walls to provide protection from potential storm water damage. Conduit runs are also shown embedded in the structural concrete slabs at the Grinder Chamber, EQ Tanks, Pump Station and Valve Pit. Conduits embedded in the structural concrete walls and slabs shall be accordance with embedded criteria specified under this Section under item 3.2.
- D. Should any structural difficulties prevent the setting of cabinets, boxes, conduits, etc., at points shown on the plans, deviations therefrom as determined by the Engineer will be permitted and shall be made without additional cost.
- E. All exposed steel conduits, fittings, boxes, straps, racks and hangers shall be painted in conformity with Specifications 09900 - Painting. PVC coated conduit systems shall not be painted. Paint shall match the gray color of the PVC coated conduits.
- F. Conduits shall be tagged using conduit tags. Conduit tags shall be installed where conduits terminate in equipment and enclosures.
- G. Coordinate conduit penetrations through structural concrete slabs and walls at the elevated platforms with the structural openings and sealing. At the existing structures, unless specifically noted otherwise on the Contract Drawings the existing walls and floors shall be core drilled and sealed using thru-wall type seals and conduit sealing bushings.

- H. Exposed conduits shall be color banded using conduit markers. Markers shall also include operating voltage when over 600 volts. Conduit markers shall be installed 360 degrees, double wrap around conduit exterior. Conduit markers shall be installed where conduits enter equipment, boxes, within each room, at wall penetrations and 50 feet on centers in each area. When exposed conduits are to be painted, markers shall be installed after the conduits are painted. Color banding shall be in accordance with the following:
1. 120/208 volt AC: Gray.
 2. 277/480 volt or 480 volt AC: Sand.
 3. 2400 volt or 4160 volt AC: Silver.
 4. 13800 volt AC: Brown.
 5. Fire Detection and Alarm: Red.
 6. Telephone: Blue.
 7. Intercommunication: Yellow.
 8. Security System: Rust.
 9. Low Voltage Switching, Instrumentation and Controls System: Black.

3.2 INSTALLATION OF RACEWAYS

- A. The Contractor shall install all exposed raceways parallel or at right angles to walls and ceiling beams. Changes in directions shall be made with bends, elbows and pull boxes. All parallel runs shall be spaced uniformly throughout and secured in place with hangers and fasteners.
- B. Conduits, where exposed, shall in all cases be substantially supported in an approved manner, but they shall not be fastened to or come in contact with any other pipes, ducts or other work of a similar nature. In all exposed work, approved channel or angle iron hangers, racks, one-hole straps or a combination thereof shall be provided to support the conduits. Where conduits are supported with one-hole straps, spacers shall be used to provide 1/4-inch minimum clearance between the conduits and walls or ceilings.
- C. Hanger rods for trapeze type hangers shall not be less than 5/8 inch diameter. Conduit supports shall be located at intervals not exceeding 8 feet. Conduits shall be securely fastened to each support with U-bolts, straps or clamps. All hanger types (trapeze and others) shall be furnished and installed in accordance with Specification 15518, Hangers and Supports. All items that are hung and supported shall be submitted as a separate shop drawing complete with licensed structural engineer P.E. seal.
- D. All concealed conduits shall be placed in walls, floors, ceilings or slabs at the proper time in accordance with the progress of the structural work. The Contractor shall cooperate in every respect in meeting schedules and shall not delay the structural work unnecessarily.

- E. Conduits embedded in concrete shall be blocked and braced in place by use of adequate conduit separators to prevent displacement during the pouring of concrete. The Contractor will be held responsible for proper position of conduits and shall rearrange any conduit that may be displaced while concrete is poured, without additional cost.
- F. Where conduit runs are to be concealed and the Contractor fails to place such conduit in sufficient time to be included in the structures and the structures are completed without such conduit, the Contractor shall install such runs either concealed or exposed as directed by the Engineer, with no extra payment for additional work or for more conduit than the original lengths.
- G. Embedded conduit shall be run in structural concrete in the center of slabs and walls and above water stops. Conduit connections shall be made watertight.
 - 1. Conduits shall be run embedded in structural concrete where shown and at the Contractor discretion only if the concrete thickness, conduit size and spacing complies with the requirements specified under this item.
 - 2. Contractor is responsible to confirm that concrete thickness, conduit size and spacing is sufficient for embedding the quantity of conduits intended in advance of actual installation.
 - 3. Before concrete is installed, arrange for observation of conduits by Engineer, make location measurements to document on record drawings.
 - 4. Run embedded conduits in structural concrete in center of slabs and walls and above water stops. Conduit connections shall be made watertight.
 - 5. Unless specifically shown otherwise on the Contract Drawings or stated in the Specifications, embedded conduits shall be in accordance with the following criteria:
 - a. Conduits shall not be larger in outside diameter than $\frac{1}{3}$ the overall thickness of the slab or wall in which they are embedded.
 - b. For concrete at foundation slabs, the conduit shall not be larger in outside diameter than $\frac{1}{3}$ the overall thickness of the slab minus one inch.
 - 6. Conduit spacing shall be as follows:
 - a. Two adjacent conduits shall be separated by center to center distance of three times outer diameter of larger conduit.
 - b. For multiple conduit layer assemblies, conduits shall be separated vertically three times outer diameter of larger conduit center to center.
 - c. When conduits cross at a given point, the conduits may be in direct contact and the angle of cross shall be 45 degrees or greater. Conduits may also cross within the vertical spacing of a multi-conduit layer assembly.
 - d. When conduits cross a structural expansion joint, two adjacent conduits shall be separated by center to center distance of three times outer diameter of conduit fitting of the larger conduit.

- e. Embedded conduit shall be located between the layers of reinforcement and a minimum of 2-1/2 inches clear from parallel reinforcing bars and a minimum of two inches from other reinforcement.
- H. A run of conduit between outlet and outlet, between fitting and fitting or between outlet and fitting shall not contain more than the equivalent of three-quarter bends, including those bends located immediately at the outlet or fitting. The equivalent number of 90° bends in a single conduit run are limited to the following:

1. Runs in excess of 300 feet	0
2. Runs of 300 feet to 201 feet	1
3. Runs of 200 feet to 101 feet	2
4. Runs of 100 feet and less	3

Factory bent elbows or field bent elbows with approved tools may be used. Heating of conduit to facilitate bending is prohibited.

- I. Factory-made conduit bends or elbows shall be used wherever possible in making necessary changes in direction. Field bends shall be carefully made so as to prevent conduit damage or reduction in the internal areas. The radius shall not be less than six times the nominal diameters for the conduit with carefully matched bends on parallel runs so as to present a neat appearance.
- J. All conduits, where cut, shall be carefully reamed to remove burrs. No running threads will be permitted. All screw joints shall be watertight. Conduits shall be fitted in an approved manner to all devices and boxes. The ends of all conduits shall be equipped with suitable approved conduit fittings. The ends of all empty conduits shall stub up six inches above the slab and shall be capped.
- K. All conduits shall be carefully cleaned before and after installation and all inside surfaces shall be free from all imperfections likely to injure the cable. Conduits shall be cleaned in accordance with the following:
 - 1. After erection of complete conduit runs, conduits shall be snaked with a suitable swap to which shall be attached an approved tube cleaner equipped with an approved cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit.
 - 2. All conduits through which the mandrel will not pass shall be removed and replaced by the Contractor at his own expense. After snaking, the ends of the dead-ended conduits shall be protected with standard malleable iron caps to prevent the entrance of water or other foreign matter.
 - 3. Conduit ends shall be protected after cleaning with caps to prevent entrance of water, concrete, debris or other foreign substance.
- L. As far as practicable, conduits shall be pitched to drain to outlet boxes or otherwise so installed as to avoid trapping moisture. Trapped conduits in concealed construction shall be provided with outlet boxes for drainage. Where

necessary drainage in outlet boxes or where dips are unavoidable in exposed conduits, a drain fitting shall be installed at the low point.

- M. Install thru-wall type seals and conduit sealing bushings for all conduits passing through existing concrete slabs, floors, walls or block walls. Where two or more conduits penetrate at a single location maintain six inch minimum between the core drill hole openings, outer edge to outer edge.
- N. Conduit runs shall be installed so as to avoid flues, heat sources, steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water, steam pipes or heat sources.
- O. Where conduit enter or leave equipment located within electrical and control rooms the conduit shall be sealed and packed with duct seal compound.
- P. A 250 pound tested polyethylene pull tape shall be provided in all empty conduits, with a minimum 8 inch of slack, double backed into the conduit. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings designed for this purpose at each end. Discs shall not be removed until it is necessary to clean the conduit.
- Q. All conduit that is cut on the job shall be cut square and taper reamed to remove burrs before installation. Where steel conduit is cut and threaded on the site, it shall be coated before and after making connections.

3.3 CONDUIT CONNECTIONS TO EQUIPMENT

- A. At each motor, limit switch, solenoid valve, electrical control device or other electrically controlled or operated equipment, the Contractor shall install a complete conduit connection between the conduit system and the terminal box of the motor or the conduit connection point of the equipment.
- B. Conduits installed in the conduit system shall be terminated in such locations as to permit direct connections to motors, devices or equipment.
- C. Connections shall be made with rigid conduit if equipment is fixed and not subject to adjustment, mechanical movement or vibration. Rigid connections shall be provided with union fittings to permit removal of equipment without cutting, breaking or burning conduit.
- D. Motors, transformers and equipment subject to adjustment, mechanical movement or vibration shall be connected with flexible metallic conduit.

- E. Equipment subject to vibration and devices such as solenoid valves, small limit switches, etc., shall be connected with flexible metallic conduit arranged to prevent strain and distortion.
- F. Flexible conduit connections shall be watertight unless the area of installation requires explosion-proof construction.

3.4 INSTALLATION OF BOXES AND FITTINGS

- A. All concealed outlet boxes shall be set in such a manner that they will be plumb and flush with the finished surface.
- B. Boxes shall be installed rigidly and securely to the structure. Independent supports shall be provided where no walls or other structural surface exists.
- C. Expansion and expansion/deflection fittings shall be installed where conduits cross structural expansion joints and at locations shown on the Contract Drawings. Fittings shall be installed on each conduit and incorporated into the expansion joints of structures, at right angles to the joint, to insure their proper functioning and preservation.
- D. Expansion fittings shall be installed on exposed conduit runs exceeding 200 feet. Unless specifically shown otherwise on the Contract Drawings or stated in the Specifications, when crossing structural expansion joints larger than one inch, an expansion fitting shall also be installed together with an expansion/deflection fitting. The fittings shall be installed on each conduit run in accordance with manufacture's recommendations to provide the additional movement necessary.
- E. All conduit connections in wet and corrosive locations shall be made up watertight and shall terminate at enclosures with an approved conduit hubs.
- F. All conduit connections in dry and dusty locations shall terminate at enclosures with bushings and lock nuts. Terminations shall include one bushing and two lock nuts at each location. Lock nuts shall be installed one inside and one lock nut outside the enclosure. All conduit shall be bonded to the safety ground.
- G. At pull and junction boxes having any box dimension in excess of 18 inches, jumper type grounding bushings shall be installed on conduit ends and jumper wires shall be installed to bond all conduits and to bond conduits to boxes.
- H. All insulated grounding bushings shall be bonded together and to the structure of the enclosure by a continuous, copper bonding wire.
- I. Removable, flame-retardant, insulating cable supports shall be provided in all boxes with any dimension exceeding 3 feet.

- J. Scratched PVC boxes damaged as a result of installation shall be touched up by field applying PVC. All touch up work shall be in strict conformance with manufacturer's recommendations.

3.5 INSTALLATION WITHIN HAZARDOUS AREAS

- A. Explosion-proof boxes and fittings shall be of a type approved by the Engineer. Boxes and fittings shall be of cast iron with finish as specified hereinbefore or of an aluminum alloy specially developed for use in hazardous areas.
- B. Explosion-proof boxes shall be suitable for the installation of explosion-proof switches, receptacles, lighting fixtures or other devices as indicated. All conduit connections to such boxes shall be made with threaded fittings. Bushings and locknut connections shall not be used.
- C. Conduits terminating at explosion-proof boxes, enclosing circuit opening equipment, shall be sealed at the entrance to the box with an approved compound-filled sealing fitting to prevent passage of explosive or combustible gases through the conduit. Where construction prevents the use of sealing fittings, the ends of the conduits shall be properly sealed with sealing compound.
- D. Sealing fittings shall be installed to seal each conduit leading from or entering into hazardous locations. Exposed conduits passing through hazardous locations shall be sealed at point of exit and entrance.
- E. The installation of explosion-proof boxes, fittings and all conduits in connection therewith shall conform to the requirements of the National Electrical Code for Class I, Division 1 Group D hazardous location unless specifically noted otherwise.

3.6 FIELD TESTS

- A. After installation, the electric conduit system shall be field tested. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:
 - 1. Each conduit shall be tested by pulling through a cylindrical mandrel as specified under paragraph 3.2 K. Maintain a record of all conduits testing clear.
 - 2. Conduit systems shall be ground tested in the presence of the Engineer, who will inspect all enclosures, pull and junction boxes for bonding to the safety green conductor pulled with the nominal 120 volt and higher power and control circuits, and for bonding of the conduit grounding bushing to this safety ground.
 - 3. The separation of above safety grounding system from the instrumentation signal grounding shall be verified.

- B. The Contractor shall provide a Field Test Report. The Report shall identify the testing performed and the results obtained.

+ + END OF SECTION + +

SECTION 16133

UNDERGROUND DUCTS - DUCTS IN CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing underground ducts. Underground ducts shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. Underground ducts shall be concrete encased. The Contractor shall provide reinforced concrete encasement for the duct system.
- C. The Contractor shall perform all excavations and backfilling, as required, unless specifically shown otherwise on the Contract Drawings or stated in the Specifications.

1.2 RELATED SPECIFICATIONS

- A. Specification 02200 – Earthwork
- C. Specification 03300 - Cast-in-Place Concrete
- D. Specification 05120 - Structural Steel
- E. Specification 16061 - Grounding
- F. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for all work for underground ducts shall be made as provided under Division 1 of the Specifications.

1.4 REFERENCES

- A. Underground ducts shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. National Electrical Safety Code.
 - 3. UL No. 651, Schedule 40 and 80 PVC conduit.
 - 4. NEMA TC2, Electrical Plastic Tubing, Conduit and Fittings.
 - 5. UL No. 1684, Reinforced Thermosetting Resin conduit.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Manufacturer's Literature with manufacturer's name, designation and catalog number for all products proposed for the underground duct system.
 - 3. Scaled Working Drawings showing the routing of the duct banks and the location of manholes, handholes and the principal outline of buildings and structures. Reference duct banks dimensionally from fixed objects or structures. Include profiles of duct banks showing crossings with piping and other underground systems.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Underground ducts shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

PART 2 - PRODUCTS

2.1 RIGID STEEL CONDUIT

- A. Steel conduit shall be used for all conduit systems throughout the underground system, except where the use of non-metallic conduit is specified. Steel conduit for ducts shall be in accordance with the requirements of Specification 16131 - Electric Conduit System, except PVC coating of conduit is not required.

2.2 NON-METALLIC CONDUIT AND FITTINGS

- A. Non-metallic conduit shall be used for the entire length of run of the permanent 480 Volt secondary service from the PSE&G Long Island transformer to the metering compartment located at the main switchboard. Non-metallic conduit for these ducts shall be PVC plastic or fiberglass-reinforced epoxy.
 - 1. PVC plastic conduit shall be Schedule 40, NEMA type EPC-40-PVC, rated 90 degrees C, conforming to UL No. 651.
 - 2. Reinforced thermosetting resin conduit and fittings shall conform to UL No. 1684. Both conduit and fittings shall consist of 68 percent glass content encapsulated in an epoxy matrix.
- B. All non-metallic fittings, elbows, bodies, terminations, expansions and fasteners shall be the same material and manufacturer as the conduit.
- C. PVC conduit shall be by Carlon, Amoco or approved equal. Fiberglass-reinforced epoxy conduit shall be by FRE conduit, A.O. Smith or approved equal.

2.3 CONDUIT SPACERS

- A. Conduit spacers shall be nonmetallic, interlocking type to maintain spacing between conduits. Spacers shall be suitable for all types of conduit in multiple sizes.

2.4 WARNING RIBBON

- A. Warning ribbon shall be a three inch wide, four mil polyethylene or polyvinyl chloride tape. The tape shall be permanently imprinted in red color, "CAUTION BURIED ELECTRIC LINE BELOW."
- B. Warning tape shall be by Seton, Ideal Industries or approved equal.

2.5 DUCT SEAL

- A. Duct seal for conduits shall be in accordance with the requirements of Specification 16131 - Electric Conduit System.

2.6 REINFORCED CONCRETE

- A. Concrete for envelope shall be Class 40 concrete in accordance with the requirements of Specification 03300 - Cast-in-Place Concrete. Steel reinforcement shall be in accordance with the requirements of Specification 05120 - Structural Steel.

2.7 EXPANSION AND DEFLECTION FITTINGS

- A. Where specifically shown on the Contract Drawings, expansion and deflection fittings shall be provided at the structural joints of the underground duct system.
- B. Expansion and deflection fittings shall be in accordance with Specification 16131 - Electric Conduit System.

2.8 CONDUIT BUSHINGS

- A. Conduit bushings shall be provided for the termination of rigid steel conduits at each manhole.
- B. Conduit bushings shall be in accordance with Specification 16131 - Electric Conduit System.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The duct system shall be installed to avoid interferences with structures, piping and other underground systems. Terminate ducts with insulated grounding bushings at manholes and handholes. Conduit ducts shall be sized, arranged and installed in a reinforced concrete envelope as shown on the Contract Drawings.
- B. Trenches for duct banks shall be in accordance with the requirements of Specification 02200 - Earthwork. Duct bank trenches shall have the bottom tamped firm and even, and suitably braced side forms shall be employed in forming the envelope.
- C. Duct banks shall follow straight lines as far as possible. Where deviation from a straight line becomes necessary, offsets shall be made using 5 degree angle coupling or make bend with sweeps. The sweep radius shall be 36 inch for 90 and 45 degree bends and 30 inch for 30 degree bends. Where directed by the Engineer, bends shall be made up with standard factory bends or other approved curved sections.
- D. Duct bank installations and penetrations through foundation walls shall be made watertight.
- E. Duct banks shall be assembled using non-magnetic saddles, spacers and separators. Separators shall be positioned to provide 3-inch minimum concrete separation between the outer surfaces of the ducts.

- F. Concrete covering shall be provided on both sides, top and bottom of the concrete envelopes around conduits. Concrete covering shall be in accordance with the detail shown on the Contract Drawings. Top of concrete encasement shall not be less than thirty inches below finish grade. Add red dye to concrete used for envelopes or trowel a coloring on the concrete for easy identification during subsequent excavation.
- G. Before pouring concrete, written approval shall be obtained from the inspecting engineer.
- H. Ducts shall be firmly fixed in place during pouring of concrete. Concrete shall be carefully spaded and vibrated to insure filling of all spaces between ducts.
- I. Transitions shall be made from rigid steel conduit to PVC coated rigid steel where conduits exit duct banks and enter structures or turn upward for continuation above grade.
- J. Ducts entering manholes and hand holes shall be terminated using suitable end bells. Rigid steel ducts shall be terminated using insulated grounding bushings.
- K. Backfilling for duct banks shall be in accordance with the requirements of Specification 02200 - Earthwork. Backfilling shall be permitted when directed by the engineer to proceed. Backfilling shall not be with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material or other materials which can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.
- L. Duct runs shall be sloped for drainage toward manholes and away from buildings with a slope of approximately 3 inches per 100 feet.
- M. A ground cable shall be installed in each duct bank envelope where shown on the Contract Drawings. Cable shall be in accordance with the requirements of Specification 16061 - Grounding. The ground shall be made electrically continuous throughout the entire duct bank system. Ground cable shall be connected to the building, station ground grid, equipment ground buses and to each conduit grounding bushing of the underground duct system. The ground cable shall be terminated at the last manhole or handhole for outlying structures.
- N. After installation each conduit in each duct bank shall be cleaned and cleared of obstructions and foreign matter by rodding and by the passage of cleaning brushes or cutting mandrels. After cleaning, the clearance of each conduit shall be checked by passing a 12 inch long mandrel, of diameter 1/2 inch less than the nominal duct diameter, through the entire length of duct run. Ducts which do not permit passage of the mandrel shall be cleared, cut out and replaced or sealed and replaced by additional construction. The duct bank conduit cleaning shall be

included in the electric conduit system field test report specified in Specification 16131 - Electric Conduit System.

- O. A warning ribbon shall be installed approximately 12 inches below finished grade over all underground duct banks carrying cables of 480 volts and higher.
- P. All ducts entering buildings and structures shall be sealed. All empty spare ducts shall be sealed and plugged.
- Q. An expansion and deflection fitting shall be installed on each conduit at each of the structural expansion joints when shown on the Contract Drawings. Joints shall be located as defined by the criteria noted on the Contract Drawings.

+ + END OF SECTION + +

SECTION 16134
ELECTRIC MANHOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing electric manholes. This section also includes requirements for providing electric handholes. Electric manholes and handholes shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The Contractor shall perform all excavations, complete all forms, and do backfilling and tamping, as required, unless specifically shown otherwise on the Contract Drawings or stated in the Specifications.

1.2 RELATED SPECIFICATIONS

- A. Specification 02200 - Earthwork
- B. Specification 02500 – Surface Restoration
- C. Specification 03300 – Cast-In-Place Concrete
- D. Specification 03420 – Designed Precast Concrete Vaults
- D. Specification 05120 - Structural Steel
- E. Specification 05561 - Metal Castings
- F. Specification 16061 – Grounding

1.3 PAYMENT

- A. Payment for electric manholes and handholes shall be made as provided for in the General Conditions and as specified under Division 1 of the Specifications.

1.04 REFERENCES

- A. Electric manholes and handholes shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. National Electrical Safety Code.

1.05 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Manufacturer's technical information for manholes, handholes and accessories proposed for use.
 - 3. Drawings showing interior and exterior dimensions and details of openings, jointing, inserts and reinforcing.
- C. Structural Design Calculations:
 - 1. Structural design calculations sealed by a P.E. registered in the State of New York. Design calculations for manholes shall include confirmation structures adequately resist flotation when they are totally empty and subjected to groundwater full height of structure.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Electric manholes and handholes shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manholes and handholes shall be provided to the extent shown on the Contract Drawings. Manholes and handholes shall be cast-in-place type or pre-cast type of reinforced concrete. The Contract Drawings show cast-in-place type construction. Contractor has the option to use pre-cast type construction, where used adjust requirements accordingly.
- B. Concrete for manholes and handholes shall be Class 40 concrete in accordance with the requirements of Specification 03300 – Cast-In-Place Concrete and Specification 03420 – Designed Precast Concrete Vaults. Manholes and handholes shall be constructed to withstand ground water pressure when completely submerged by rising water table.
- D. Steel reinforcement shall be as shown on the details on the Contract Drawings and shall be in accordance with the requirements of Specification 05120 - Structural Steel.

- E. Manholes and handholes shall have dimensions as shown on the Contract Drawings and shall be provided with all duct entrances sized and located to suit duct banks.
- F. Concrete floor shall be sloped towards the drain sump at the center of each manhole and handhole.
- G. All manhole and handhole hardware shall be hot dipped galvanized steel.
- H. Minimum structural design loading for manholes shall be as indicated in ASTM C857, unless otherwise noted herein. Manholes subjected to vehicular traffic shall be designed for H-20 traffic loading. Other manholes shall be designed for a vertical live load of 300 psf.
- I. Walls of manholes shall be designed for a minimum vertical surcharge of 100 psf.
- J. Manholes shall be designed to resist flotation when totally empty and subjected to groundwater full height of the manhole.

2.2 FRAMES AND COVERS

- A. Each manhole and handhole shall be provided with a cast-iron watertight manhole frame with inside and outside covers.
- B. All frames and covers shall be in accordance with the requirements of Specification 05561 - Metal Castings. Frames and covers shall be annealed, high quality, gray cast iron, free from blowholes, sandholes, scabs, fins, scales, and other defects. They shall be uniform in form and dimensions and shall be as approved by the Engineer.
- C. The frames shall be so set that the completed installation will provide a proper alignment of the outside covers with the roadways or other surrounding areas. Manhole and handhole covers shall fit the frame without undue play.
- D. The following words shall be cast in the top of all manhole and hand hole covers, as appropriate.
 - 1. "ELECTRIC POWER, LOW VOLTAGE"
 - 2. "ELECTRIC POWER, MEDIUM VOLTAGE"
 - 3. "COMMUNICATIONS / INSTRUMENTATION"

The words "ELECTRIC", TELEPHONE", "COMMUNICATION" and "FIRE ALARM" shall be cast in the top of all power, telephone, communication and fire alarm manhole and hand hole covers respectively.

2.3 CABLE SUPPORTS

- A. Manholes shall be furnished with cable racks, cable hooks and insulators to effectively support all cables indicated for present and future installation. Cable racks shall be made from steel channel with ample strength to support cables. Racks shall be firmly anchored to walls. Cable hooks shall be made from malleable iron. Racks and hooks shall have hot-dipped galvanized finish. Insulators shall be made of high-grade dry-process porcelain with smooth glazed surfaces and shall fit hooks in such manner as to prevent wobbling and insure minimum movement.

2.4 PULLING IRONS

- A. Galvanized steel pulling irons shall be provided for each manhole and handhole. Pulling irons shall be cast in the wall opposite to the centerline of each incoming duct bank and 12 inches below centerline of bottom line of ducts.

2.5 GROUNDING

- A. Each manhole shall be provided with a grounding system. The grounding system shall consists of grounding rod and cable in accordance with the details shown on the Contract Drawings.
- B. Ground rod and cable shall be in accordance with the requirements of Specification 16061 - Grounding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Manholes and handholes shall be installed where shown on the Contract Drawings. Except where handholes are directly supported by utility supports, place each manhole and handhole on a 12-inch select fill base and make level.
- B. Manhole and handhole excavation shall be in accordance with the requirements of Specification 02200 Earthwork. Backfilling for manholes and handholes shall be in accordance with the requirements of Specification 02200 Earthwork.
- C. Manhole and handhole installation shall be completed so that structure is watertight. Two coats of bituminous waterproofing material shall be applied to exterior surface of each manhole and handhole. A waterproof gasket shall be provided all around removable precast manhole cap.
- D. Cable racks shall be installed within each manhole for the support of cables. Cable racks shall be in accordance with the following:

1. Attach racks with 3-inch by 3/8-inch diameter "tamp-in" studs mounted in 1-inch holes drilled into walls of manholes in the absence of inserts. Apply PVC coating to all racks.
 2. Provide cable hooks to support each cable on each rack along the cable run within the manholes. Apply PVC coating to all hooks.
 3. Individually support each cable at each hook on porcelain insulators. Provide sufficient slack for each cable.
 4. In the manhole securely tie each cable in place at each insulator block to prevent excessive movement of insulators, cables, or fireproof tape. Tie cables with non-metallic 3/4-inch strapping tape as manufactured by 3M or tie down with nylon straps.
 5. Install the pump shielded control cables to maintain separation from other cables. Provide dedicated shielded control cable racks that are separate from the racks for the other cables.
- E. A grounding system shall be installed for each manhole. All exposed metal, manhole frame and cover, accessories and the concrete reinforcing rods shall be bonded with No. 4 AWG minimum bare copper wire and connected to the duct bank ground in accordance with the details shown on the Contract Drawings.
- F. Concrete curb shall be provided for manholes when required to adjust manhole cover to proper grade. Curb shall be constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the curb shall be such as is necessary to bring the manhole frame to the proper grade.
- G. For cast in place type manholes and handholes, pulling irons shall be set and other built-in items shall be in place before placing concrete.

+ + END OF SECTION + +

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SECTION 16231

ENGINE GENERATOR

PART 1 GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. Provide all labor, materials, equipment, and incidentals as shown specified and required to furnish and install a standby power generator system with appurtenances for complete and operational system.
 - 2. The following generator is included in this Section:
 - a. A single outdoor diesel engine generator housed in a walk-in sound attenuated enclosure shall supply an emergency-standby power source for the pump station.
 - b. The generator shall be rated 1000 KW, 1250 KVA, 0.8 power factor, 480 volts, 3 phase, 3 wires, solidly grounded.
 - c. The generator shall be located on an elevated structural platform as shown on the Drawings.
- B. Coordination:
 - 1. Review installation procedures under other Sections and coordinate installation of items that must be installed with or before engine generator Work.
 - 2. Notify other trades in advance of installing engine generator set to provide sufficient time for installing related items included that must be installed with or before engine generator Work.
- C. Related Sections:
 - 1. Section 05051, Anchor Systems.
 - 2. Section 05511, Pre-Engineered Aluminum Stairs.
 - 3. Section 05522, Aluminum Handrails and Railings.
 - 4. Section 16036, Testing.

1.2 REFERENCES

- A. Standards referenced in this section are:
 - 1. International Standards Organization (ISO), ISO 8528, Reciprocating Internal Combustion Engine Driven Alternating Current Generator Sets.
 - 2. ISO 9001, Quality Management Systems – Requirements.
 - 3. NEMA MG-1, Motors and Generators.
 - 4. NFPA 30, Flammable and Combustible Liquids Code.
 - 5. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - 6. NFPA 70E, Electrical Safety in the Workplace.
 - 7. NFPA 110, Standard for Emergency and Standby Power Systems.

8. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
9. UL 508, Safety Standard for Industrial Control Equipment
10. UL 508A, Industrial Control Panels Power Distribution and Control.
11. UL 2200, Standard for Safety Stationary Engine Generator Assemblies (rated 600 volts or less)

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

- a. Shall have minimum of five years of experience of producing substantially similar equipment to that specified and shall document at least five installations in satisfactory operation for at least five years.
- b. Shall possess valid ISO 9001 certification.
- c. Supplier shall have complete parts and service facilities, factory-trained service staff available for 24-hour emergency service and be authorized to administer the warranty for all components of engine generator systems.

B. Component Supply and Compatibility:

1. Obtain all equipment included in this Section regardless of component manufacturer from a single generator set manufacturer. Materials, equipment, and parts shall be new, of current production of a firm that manufactures the generator set as a matched system. Manufacturer shall have full responsibility for engine generator performance. Generator set manufacturer shall prepare or approve all Shop Drawings and other submittals for all components furnished under this Section.
2. Engine generator shall be factory assembled and factory tested. Verify in the factory that system is free from electrical and mechanical defects and conforms to the Contract Documents.

C. Regulatory Requirements: Comply with applicable provisions of authorities having jurisdiction, including the following:

1. Code of Federal Regulations (CFR), Title 40, Part 89, Control of Emissions from New and In-Use Nonroad Compression Ignition Engines, Subpart D Emission Test Equipment Provisions
2. Comply with the State of New York, local and federal codes and regulations for standby diesel generators.
3. Local Ordinances: Systems shall conform to Nassau County Laws and Regulations relative to noise control, emissions and fuel.
4. Local and State Building Codes: Installations shall conform to applicable codes including requirements of local fire marshals.
5. Permits: Obtain and pay for required permits, fees, and inspections by authorities having jurisdiction

1.4 SUBMITTALS

- A. All files associated with shop drawings and product data shall be submitted as Adobe PDF with searchable function. This allows reviewer to search the document for keywords.

- B. Action Submittals: Submit the following:
1. Shop Drawings:
 - a. Installation drawings specific to the Project.
 - b. Bill of material for all equipment and spare parts.
 - c. Electrical wiring and interconnection diagrams with all terminals for external connections identified.
 - d. Control panel data shall include:
 - 1) Description of control features.
 - 2) Operator panel control switches and functions.
 - 3) Alarm and status displays.
 - 4) Provisions for remote start signal and remote status and alarm.
 - 5) Compliance with UL 508 and 508A.
 - e. Enclosure data shall include the following:
 - 1) Plan and elevation drawings showing overall dimensions, interior equipment arrangement, and working spaces.
 - 2) Construction details and hardware specifications.
 - 3) Exhaust piping and silencer mounting arrangement.
 - 4) Sound attenuation provisions and decibel levels.
 - f. Fuel storage system data shall include:
 - 1) Fuel tank construction and arrangement.
 - 2) Storage capacity and hours of operation at rated load and 3/4 load.
 - 3) Alarm devices.
 - 4) Construction details including secondary containment provisions for fuel tank.
 - 5) Piping arrangements and details.
 - 6) Compliance with UL 142 and local codes.
 - g. Provide the following relative to installation:
 - 1) Vibration isolators and anchor bolt requirements.
 - 2) Seismic restraint requirements.
 - 3) Provisions for fuel piping, electrical conduits, and other external connection requirements.
 2. Product Data:
 - a. Manufacturer's literature, specifications, engineering data sheets, and standard drawings, necessary to fully describe the engine generator sets and appurtenances and substantiate compliance with the Contract Documents. Information shall be annotated to clearly indicate ratings, features, and options specific to the Project.
 - b. Generator data shall include:
 - 1) Listed to UL 2200.
 - 2) Heat rejection to room
 - 3) Combustion air requirements.
 - 4) Factory painting specifications.
 - c. Engine data shall include:
 - 1) Fuel flow at rated load.
 - 2) Fuel consumption at 1/4, 1/2, 3/4, and full load.
 - 3) Engine Type: Naturally aspirated or turbocharged and after-cooled.
 - 4) Maximum exhaust backpressure.

- 5) Silencer attenuation rating.
- 6) Jacket water heater system.
- 7) Gaseous emissions data measurements for hydrocarbons, carbon monoxide, particulate matter, and NOx conforming to 40 CFR 89, Subpart D.
- d. Alternator data shall include:
 - 1) Winding insulation class and temperature rise in accordance with NEMA MG-1-1.65
 - 2) Standby and continuous KW/KVA ratings.
 - 3) Motor starting KVA at 90 percent sustained voltage.
 - 4) Surge KW capacity.
 - 5) Machine reactances and time constants.
- e. Starting system data shall include:
 - 1) Battery system.
 - 2) Battery charger.
 - 3) Cycle cranking configuration.
- f. Submit emissions data measurements for hydrocarbons (HC), carbon monoxide (CO), particulate matter (PM) and oxides of nitrogen (NOx) conforming to USEPA test procedures. Include USEPA not-to-exceed requirements for each pollutant.
3. Testing Procedures:
 - a. Source Quality Control Testing Procedures: Provide factory testing procedures and dates at least thirty days prior to testing.
 - b. Site Quality Control Testing Procedures: Testing procedures, provided at least thirty days prior to scheduled start of testing.
- C. Informational Submittals: Submit the following:
 1. Manufacturer's Instructions:
 - a. Manufacturer's unloading, rigging, installing, testing, and startup instructions. Information shall be specific to and indicate options for the Project
 2. Source Quality Control Submittals:
 - a. Provide factory testing results within seven days of completing factory test.
 3. Site Quality Control Submittals:
 - a. Services to be performed by Supplier's representative, provided at least thirty days prior to start of Site testing.
 - b. Report on results of testing at the Site, provided within seven days of completion of testing.
 4. Manufacturer Reports: Reports of visits to Site by Supplier's representative, including purpose of visit, problems encountered, and resolutions.
 5. Qualifications Statements:
 - a. Manufacturer: When requested by ENGINEER, submit data documenting compliance with qualifications requirements of the Contract Documents.
- D. Closeout Submittals:
 1. Operation and Maintenance Manuals: Provide in accordance with Section 01730, Operation and Maintenance Data. Include the following information:

- a. Operating Instructions: Instructions for starting, stopping, protection of circuits, automatic controls, battery charging and safety considerations. Methods for adjusting speed, output voltage, and control timers.
 - b. Performance Parameters: Provide nominal values and acceptable limits for output voltage, frequency, load, engine temperature, and oil pressure Include circuit drawings with component identifications for reference .
 - c. Maintenance Instructions: Procedures for daily, weekly, monthly, and annual basis, or on an hours-run basis. Include guidance for selecting fuel oil, lubricating oil, use of water treatment additives, and anti-freeze.
2. Warranty Documentation.

- E. Maintenance Materials:
- 1. Provide the following spare parts for each generator set:
 - a. Two sets of primary and secondary fuel filters.
 - b. One set of air filters.
 - c. Two control circuit fuses of each size used.
 - d. Two sets of lube oil filters.
 - e. One set of fan belts.

1.5 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. Obligations of CONTRACTOR under the Contract Documents shall not be limited by provisions of the specified special warranty.
- B. Special Warranty:
 - 1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct or, at option of OWNER remove or replace materials or equipment specified in this Section found to be defective during a period of five years after date of Substantial Completion or 3,000 hours of operation.
 - 2. Products supplied under this Section shall be covered by a single warranty for the coverage period. Warranty shall provide for free replacement or repair of parts for five years or 3,000 hours of operation, and free labor for the first two years.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Cover all generator air and exhaust openings with vapor inhibiting and water repellent material.
 - 2. Deliver anchorage devices that are to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.
 - 3. Inspect equipment for shipping damage or loose parts upon delivery. Check for evidence of water that may have entered equipment during transit.

4. Notify ENGINEER of loss or damage to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.
- B. Handle equipment in accordance with manufacturer's instructions. Furnish at least one copy of instructions with equipment at time of shipment.
- C. Storage:
 1. Store equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
 2. Store materials for easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms or other supports. Protect equipment from corrosion and deterioration.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Quantity and ratings of the systems shall be as indicated in Paragraph 1.1.A.2 of this Section.
- B. Generator shall be emergency emissions rated Tier 2 for operation and duration of normal utility outages as defined by ISO 8528 for limited time operation. Generators shall be standby rated capable of operating for up to 500 hours per year, of which maximum of 300 hours is continuous running, and no overload is allowed.
- C. Generator assemblies shall be UL 2200-listed, control panels shall be UL 508-listed and above-ground fuel tanks shall be UL 142-listed.
- D. Generators shall be rated for the specified KW, without overload, at the following Site conditions:
 1. Maximum Ambient Temperature: 40 degrees C.
 2. Altitude: 2000 feet above mean sea level.
- E. Frequency regulation shall be isochronous under varying loads from no load to 100 percent rated load. Frequency variation for constant load from no load to rated load shall not exceed plus or minus 0.25 percent.
- F. Voltage cyclic variations in RMS voltage shall not exceed plus or minus 0.5 percent of rated speed for constant loads from no load to rated load.
- G. The generator shall be able to start and operate two variable frequency drive operated peak flow Sewage Pumps, plus the miscellaneous pump station loads quantities and sizes as indicated on the Drawings with a maximum voltage dip of 15 percent and a maximum frequency dip of 3 percent in each of the following two steps.
 1. Step 1, 1.1 Miscellaneous pump station loads, quantities and sizes as indicated on the Drawings. 1.2, first 400 Horsepower Sewage Pump.

2. Step 2, 2.1, second 400 Horsepower Sewage Pump.
- H. The generator and enclosure housing shall be suitable for the wind speed and wind pressure as indicated on the code compliance criteria indicated on the Drawings.

2.2 MANUFACTURERS

- A. Provide generator systems of one of the following:
1. Caterpillar
 2. Cummins/ONAN
 3. Or equal.

2.3 ENGINE

- A. Engine Type: Four-cycle compression ignition, water cooled diesel 1800 RPM. Two-cycle engines are not acceptable.
- B. Engine Construction:
1. Steel-backed bearings.
 2. Crank Case: Reinforced cast iron.
 3. Crank Shaft: Forged alloy steel with hardened journals, finished and dynamically balanced.
 4. Cylinder Head: Cast iron.
 5. Pistons: Aluminum alloy with chrome faced rings.
 6. Replaceable cylinder liners and valve seat inserts for engines rated over 200 horsepower.
 7. Single-block construction. Bolted, multiple blocks are not acceptable.
- C. Cooling System:
1. Radiator: Engine-mounted with engine-driven blower fan capable of cooling the engine under full load conditions in an ambient temperature of 104 degrees F without de-rating.
 2. Thermostatic valve in jacket water outlet between radiator and engine to maintain proper jacket water temperature. Engine-driven pump to circulate water through cooling system.
 3. Coolant: Fill system with 50 percent solution of ethylene glycol with additives as recommended by engine manufacturer.
 4. Coolant water temperature gauge.
 5. High engine temperature shutdown.
 6. Loss of coolant shutdown.
 7. Fan guard.
 8. Radiator face duct connection.
 9. Engine coolant heaters, thermostatically controlled, capable of keeping jacket water at temperature not less than 90 degrees F in compliance with NFPA 110. Coolant heaters shall operate at 208 volts, single phase. House contactor for controlling heater in NEMA 4X stainless steel enclosure mounted on unit.
 10. Extend radiator drain hose to shutoff valve located on the exterior of the generator enclosure.

11. Provide shutoff valves so that the engine coolant heater can be removed without draining the engine coolant.
- D. Lubrication System: Positive displacement, mechanical, full pressure lube pump, full flow and bypass lubrication filters with replaceable spin-on canister elements, oil drain line with valves and dipstick oil level indicator.
- E. Fuel System: Suitable for operation on No. 2 diesel fuel oil. System to include primary and secondary fuel filters, fuel/water separator, fuel priming pump, flexible fuel lines and fuel pressure gauge.
- F. Governor: Woodward 2301E load sharing and speed control system complete with software. Electronic system to provide automatic isochronous frequency regulation. System dynamic capabilities to be controlled as function of engine temperature for fast stable operation at varying engine operating conditions. System to actively control fuel rate and excitation. Fuel rate to be regulated as function of starting, accelerating to start, disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- G. Fuel Oil Sub-Base Tank
 1. Construction: Heavy-gage steel primary storage tank sub-base mounted with welded steel secondary containment sized to contain 110 percent of primary tank capacity. Rust inhibitor coating inside and prime- and finish-coated outside, color to match generator set exterior paint.
 2. Storage sub-base tank capacity in gallons shall be sufficient for 72 hours of run time at the generator full KW rating.
 3. Comply with the following:
 - a. UL142-listed and labeled.
 - b. NFPA 30, NFPA 37, and NFPA 110.
 - c. Nassau County Requirements.
 4. Fittings: NPT for fuel supply and return; two-inch diameter NPT for normal vent, manual fill and level alarms; NPT for emergency vents, level gauges, basin drain, and leak detection alarm.
 5. Critical high, high, and low fuel level switches and leak detector switch shall be monitored by the fuel overfill alarm panel specified under this section.
 6. Direct read fuel gauge and fuel gauge with 240-30 ohm sender wired to generator control panel.
 7. Mushroom-type cap and screen for normal vent openings and pressure relief-type caps for emergency vent openings.
 8. Through hole stub up areas size and quantities as required for conduit entries.
 9. Manufacturers: Provide sub-base tank of one of the following:
 - a. Pryco, Inc.
 - b. Tramont Corp.
 - c. Or equal.
- H. Air Supply/Exhaust Systems:
 1. Heavy duty air cleaner with service indicator.
 2. Flexible stainless steel exhaust connector.

3. Hospital grade silencer with condensate drain ports.
 4. Schedule 40 stainless steel piping. Insulate indoor piping to limit surface temperature to 50 degrees C.
- I. Air Emissions:
 1. Comply with United States Environmental Protection Agency (USEPA) standards for non-road engines and with state and local requirements.
 2. Submit emissions data measurements for hydrocarbons (HC), carbon monoxide (CO), particulate matter (PM) and oxides of nitrogen (NOx) conforming to USEPA test procedures. Include USEPA not-to-exceed requirements for each pollutant.
 - J. Starting System: DC system complete with engine mounted batteries, locally mounted charger and connecting cables between batteries and engine and between charger and batteries.
 1. Batteries: Lead-acid or calcium/lead antimony, engine cranking type, rated in accordance with engine manufacturer's requirements for minimum of three 15-second cranking cycles at firing speeds without recharging, and to accommodate DC power requirements of control panel and other accessories requiring DC power.
 2. Battery racks, cables, connectors, and disconnect switch.
 3. Engine-mounted battery charging alternator and solid-state voltage regulator.
 4. Battery Charger:
 - a. UL-listed, voltage regulated and equipped with float, taper and equalize charge settings.
 - b. Automatic charge rate compensation based on ambient temperature at the batteries.
 - c. Analog DC ammeter and voltmeter; 12-hour equalize timer; AC and DC fuses.
 - d. Loss of AC power, low battery voltage and high battery voltage alarm lights and contacts for remote annunciation; power on light.

2.4 ALTERNATOR

- A. Construction: Synchronous generator, four-pole, 2/3 pitch, revolving field, self ventilated, drip-proof construction, single bearing, dynamically balanced rotor with amortisseur windings to minimize voltage deviations and heating effects under unbalanced load conditions. Rotor directly connected to engine flywheel housing to ensure permanent alignment. Rotor connected to engine flywheel via flexible coupling to ensure permanent alignment.
- B. Winding Insulation Systems: Class H in accordance with NEMA MG-1. Temperature rise not to exceed 130 degrees C over 40 degrees C ambient at rated load. Epoxy coating for fungus resistance and abrasion protection.
- C. Excitation System: Brushless construction. Excitation support system, permanent magnet type, to sustain 300 percent rated current for up to 10 seconds under short circuit conditions. Provide surge suppressors to protect against voltage spikes.

- D. Voltage Regulator: Automatic solid-state system to maintain generator output voltage within plus or minus 0.5 percent from no load to full load. Control voltage buildup, provide volts per Hertz regulation, protect from over-excitation, limit voltage overshoot on startup, and be environmentally sealed. The regulator shall be 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated output to the alternator field. It shall be immune to mis-operation due to voltage waveform distortion. The voltage regulator shall include current monitoring capability to provide regulated current output on any fault condition.
- E. Provide anti-condensation heater to maintain temperature approximately five degrees Fahrenheit above ambient when generator is idle.

2.5 DUCT MOUNTED LOAD BANK

- A. General:
 - 1. The load bank shall be radiator duct mounted, UL 508A listed designed as a supplemental load to the generator and sized at 50 percent of the generator KW rating.
 - 2. The load bank enclosure shall be constructed of heavy gauge aluminized steel per ASTM A463 and be suitable for mounting on the generator radiator exhaust duct which shall provide cooling for the load bank when in operation.
 - 3. The load bank enclosure shall house all controls and fuses.
 - 4. The load bank shall be provided factory wired with all power and control wiring and raceways as required for proper operation and as required for the requirements specified.
- B. Resistive Load Elements:
 - 1. Load elements shall be helically wound chromium alloy sized for continuous duty. Elements shall be supported across the entire length within the air stream by segmented ceramic insulators on stainless steel rods.
 - 2. The overall tolerance of the load bank shall be 0 to 5 percent, sized to deliver the full rated KW without reliance upon the tolerance and to minimize change in resistance due to temperature.
- C. Protective Devices:
 - 1. An over-temperature switch shall be provided to sense the load bank exhaust. When the switch senses an over-temperature condition, the switch will signal the controls to shut down the load bank.
 - 2. The load bank elements shall be equipped with three phase fusing. Fuses shall be current limiting type with a continuous current suitable for the KW rating of the elements and a short circuit interrupting rating of 200 KA.
- D. Control Panel:
 - 1. The control panel shall be load bank unit mounted. The panel shall include an integral control power transformer with primary and secondary fusing to supply 120 Volt to the load bank controls.
 - 2. The panel shall be equipped with the following switches and visual indicators:
 - a. Power On-Off switch.

- b. Master Hand-Off-Auto switch.
 - c. Load step On-Off switches for application of individual load elements when the master switch is in hand position.
 - d. Power on indicator.
 - e. Overtemperature indicator.
3. A load step controller shall be provided to automatically maintain a minimum load on the generator. The load controller shall be equipped with time delayed circuits for control of the amount of resistive load to be added. The controller shall activate whenever the master switch is in the auto position and a generator run contact closes. When activated the controller will automatically add or subtract the resistive load elements in steps in response the total load on the generator.
 4. A current transformer shall be provided to signal the load step controller the magnitude of load on the generator. The current transformer shall be mounted in the generator main circuit breaker enclosure.

2.6 GENERATOR CONTROL PANEL

- A. The generator controls shall be in accordance with NFPA 110, Level 1, and control panel shall conform to the following:
 1. Install control panel on vibration isolators or isolated from engine and alternator.
 2. Engine generator controller shall be microprocessor based and provide automatic starting, monitoring, protection, and control functions for the unit. The control system shall be designed and manufactured by the generator set manufacturer.
 3. Controls shall be UL 508-listed and microprocessor-based with programmable adjustments. Control power from starting battery system.
 4. Controller shall include the following minimum protective functions to self- protect the generator:
 - a. Voltage phase sequence, 47.
 - b. Under/overvoltage, 27/59
 - c. Over/under frequency, 81O/U.
 - d. Overcurrent, 50/51.
 5. Controller shall include the following monitoring, control and protective functions:
 - a. Emergency stop pushbutton with provisions for accepting the remote stops specified.
 - b. Generator Monitoring: KW, KVA, KVAR, power factor, current and voltage metering.
 - c. Engine Monitoring: Coolant temperature, oil pressure, engine speed, battery voltage, critical high, high, and low fuel, and fuel leak alarms. Run time and fuel level readouts.
 - d. Control: Run, auto, stop control, speed and voltage adjust, remote start-stop and cycle cranking.
 - e. Engine Protection: High coolant temperature, alarm and shutdown, low coolant temperature and level alarm, high engine oil temperature, alarm and shutdown, overspeed, over-crank and high, low and weak battery voltage.
 6. Provide output dry contacts for remote monitoring and control for the following:
 - b. Generator running
 - c. Generator common warning alarm.

- d. Generator common shutdown alarm.
- e. Switch not in auto.
- f. Low tank fuel (warning alarm).
- g. Liquid leak in containment areas, including tank, double walled piping, and other fuel supply components (warning alarm).
- 7. Reset Control: There shall be no manual or remote restarts. Alarm lamps shall remain in alarm state until manual reset is accomplished even if alarm condition has been corrected.
- 8. Provide control panel anti-condensation space heater.

2.7 FUEL OVERFILL ALARM PANEL

- A. Provide a NEMA 4X fuel overfill alarm panel for mounting at grade remote from the generator enclosure as shown on the Drawings.
- B. The panel shall be suitable for operation at 24 VDC from the generator batteries and shall activate whenever the level monitoring devices sense the following conditions:
 - 1. Critical High Fuel Level.
 - 2. High Fuel Level.
 - 3. Low Fuel Level.
 - 4. Rupture Basin.
- C. The panel shall include the following:
 - 1. Level and rupture basin lights, one for each of the specified conditions sensed.
 - 2. Alarm relays with form C dry contacts, one for each of the specified conditions sensed for remote indication at the generator control panel.
 - 3. Alarm horn.
 - 4. Horn silence pushbutton and latching relay.
 - 5. Control fuse, diode and terminals for remote wiring.
 - 6. Device nameplates.

2.8 CIRCUIT BREAKERS

- A. General: Provide main, exciter and load bank circuit breakers, sized for protecting the engine- generator and the load bank.
- B. Type: UL-listed, molded case breakers, thermal magnetic type for exciter and load bank. Main breaker shall include an electronic RMS type trip unit. Trip unit shall be adjustable and shall include long-time, short-time and instantaneous phase and ground protection.
- C. Provide NEMA 1 enclosed units and mount on engine generator. Main breaker enclosure shall be equipped with the load bank current transformer for automatic operation of the load bank elements.

2.9 ENCLOSURE

- A. Provide each engine-generator with a custom designed and built outdoor weatherproof walk-in type sound-attenuated enclosure. The enclosure shall be sound-attenuated to

reduce noise level to 77 dBA at a point twenty-three feet from engine-generator in free air environment, while operating at full load.

- B. The enclosure design shall be in accordance with the provisions of the 2015 International Building Code. The enclosure shall be built for proper access to all components and shall include engine maintenance doors with platforms and handrails. Working space shall comply with NFPA 70, 70E, OSHA, and Laws and Regulations. Lube and fuel oil and coolant drains shall be extended to exterior of enclosure and terminated with drain valves, capped with pipe nipples on flanged connections.
- C. Enclosure construction shall be pre-painted aluminum stressed skid consisting of the following:
 - 1. Roof: One-piece peaked roof sheet, no less than 0.040-inch thick, 3003 aluminum alloy with extruded aluminum recessed side and end rails and I-beams, 6061-T6 alloy.
 - 2. Side and End Walls: Panels, no less than 0.050-inch thick, 5052 H-34 aluminum sheet fastened with rivets spaced three inches on center, with extruded aluminum post sections on 2.0-foot centers.
 - 3. Floor and Under-frame: Two 6-inch wide flange I-beam longitudinal skids with 10-gage minimum steel cross members on 12-inch centers. Cross members to be overlaid with 3/4-inch tongue and groove exterior fir plywood subfloor surfaced with 1/8-thick diamond plate steel.
 - 4. Doors and Frames: Aluminum frames, stainless steel hardware and key lockable doors fully gasketed to form weather-tight seal. Provide two single personnel doors and two engine maintenance double doors one on each side of the enclosure.
 - 5. Insulation and Sound Absorption: Two inch matted fiberglass thermal insulating and sound absorption material in ceiling, walls and intake plenum covered with perforated aluminum.
 - 6. Bird Screen: Intake and discharge plenum openings covered with bird screen protection.
 - 7. Platforms, Handrails and Stairs: Provide fixed mounted anodized aluminum platforms, steps and removal handrails on each side of the enclosure as shown on the Drawings. Steps and handrails shall conform to Section 05511, Pre-Engineering Aluminum Stairs and Section 05522, Aluminum Handrails and Railings.
 - 8. Provide louvers sized as required for sufficient engine combustion and radiator cooling. Intake louver shall include a motorized damper and the discharge louver shall include a gravity blow open damper. The louvers shall be of aluminum construction riveted into steel frame forming rigid, water-resistant assembly.
- D. The enclosure shall be completely wired with the following equipment:
 - 1. 480 Volt disconnect and 30 KVA transformer, 120/208 Volt, three Phase, supplied from a 480 Volt, three phase remote source.
 - 2. 208 Volt, three phase jacket water heater and contactor control.
 - 3. 120/208-volt, three-phase load center panelboard with circuit breakers for all 120/208 Volt generator and enclosure power requirements including lighting, convenience receptacle, battery charger, day tank, generator jacket and space heater and ventilation fan.

4. The panelboard shall also include an additional five 20 ampere single pole circuit breakers, three breakers shall be spare. Two breakers shall be used for remote located receptacles, one circuit for the grinder chamber receptacle and the second for the pump station receptacles.
5. Interior vapor-tight LED type lighting fixtures with snap switch at entrance door.
6. Exterior weatherproof wall pack LED type lighting fixture one over each personnel door. Exterior light fixtures shall include an integral motion sensor.
7. Battery-powered dual head emergency lighting fixtures positioned to light engine starting controls.
8. Interior duplex receptacles.
9. Heaters thermostatically control for enclosure heating.
10. Ventilation fans to operate when temperature exceeds 40 degrees C.
11. Exterior emergency stop station. The emergency stop station shall be housed in a NEMA 4X control station mounted adjacent to the access door on the exterior of the enclosure. The station shall be factory wired to the local control panel.

2.10 ACCESSORIES

- A. Engine Generator Mounting:
 1. Vibration Isolators: Steel springs in combination with rubber pads.
 2. Vibration Isolation: Provide flexible connections between engine-generator set and fuel lines, exhaust system, electrical conduits, and other externally connected support systems.
 3. Anchor Bolts: Type 316 stainless steel, conforming to Section 05051, Anchor Systems.
 4. Template shall be furnished by manufacturer for setting anchorages devices, pipe sleeves, and nuts for mounting spring-type isolators to concrete foundation. Provide bolts and nuts for bolting isolators to channel frame base of engine-generator set.

2.11 FINISHING

- A. Engine generator ferrous metal surfaces shall be prime-coated for corrosion protection and finish-painted in accordance with manufacturer's standard painting system.
- B. Color of finish paint to be selected by ENGINEER from manufacturer's standard colors.

2.12 SOURCE QUALITY CONTROL

- A. Factory Tests
 1. Following assembly, perform at the factory standard production tests to verify proper operation and performance.
 2. Factory tests shall be in accordance with the manufacturers standard test procedures and shall include at a minimum the following:
 - b. High potential insulation resistance test for electrical circuits.
 - c. Load bank cold resistance verification.
 - d. Functional testing and verification of systems.
 - e. Generator two-hour load test at full rated KW and rated power factor.

Long Beach WPCP Consolidation
Pump Station Conversion

16231-14

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine the conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install engine generator system in accordance with the Contract Documents, approved Shop Drawings, and manufacturer's recommendations.
- B. Make all connections to generator with flexible conduits

3.3 SITE QUALITY CONTROL

- A. Site Testing: Test engine-generator set in accordance with Section 16036 and NFPA 110. Provide all materials and equipment, including portable load banks, fuel, lubricants and material required for Site testing. Completely fill fuel tank at conclusion of testing.
- B. Manufacturer's Services: Provide qualified, factory-trained serviceman to perform the following:
 - 1. Supervise unloading and installation of equipment.
 - 2. Instruct CONTRACTOR in the installation of equipment.
 - 3. Inspect and adjust equipment after installation and ensure that equipment operates properly.
 - 4. Instruct OWNER's personnel in operating and maintaining the equipment.
- C. Service representative of manufacturer qualified factory trained specialists shall make a minimum of four separate 8 hour site visits for the following:
 - 1. First visit shall be for unloading supervision and instruction of CONTRACTOR in installing equipment.
 - 2. Second visit shall be for assistance in installation of equipment and to perform inspection, checking and adjustments.
 - 3. Third visit shall be for performing testing and start-up of system.
 - 4. Fourth visit shall be to instruct operations and maintenance personnel.
 - 5. Representative shall revisit the Site as often as necessary until installation is acceptable.
 - 6. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Lump Sum Price bid.

++ END OF SECTION ++

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SECTION 16271

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing dry type transformers. Dry type transformers shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.

1.2 RELATED SPECIFICATIONS

- A. Specification 16076 - Labeling and Identification

1.3 PAYMENT

- A. Payment for dry type transformers shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. Dry type transformers shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. ANSI C89.1, Specialty Transformers.
 - 3. ANSI C89.2, Dry-Type Transformers for General Applications.
 - 4. UL Standard No. 1561, Dry-Type General Purpose and Power Transformers.
 - 6. NEMA ST-20, Sound Levels.
 - 7. DOE 2016, Efficiency Standard.

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Manufacturer's catalog cuts for the transformers proposed for use.
 - 2. Dimensional drawings showing transformer details with diagrammatic nameplate.
 - 3. Description of shop and field testing methods, procedures and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be

submitted at least 45 days in advance prior to conformation of witness testing dates and actual testing.

- C. Shop test and field test reports shall be submitted.
- D. Operations and Maintenance Manuals shall be submitted in accordance with the Specifications.

1.6 QUALITY ASSURANCE

- A. General:
 - 1. All transformers shall conform to the applicable NEMA, ANSI, DOE and UL Standards and shall be built by one approved manufacturer who shall use only best commercial materials and processes of manufacture. Transformer enclosures shall have ample room for primary and secondary wiring connections.
 - 2. All transformers shall be UL listed and certified to ANSI/NEMA sound levels.
 - 3. The transformer manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.
 - 4. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology.
- B. Field testing of the transformers shall be performed in accordance with the requirements specified under Article 3.02.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Dry type transformers shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Dry type transformers shall be manufactured by Cutler-Hammer, General Electric Company, Square D or approved equal.

2.2 DRY TYPE TRANSFORMERS

- A. Transformers shall be of the dry, commercially quiet, low temperature rise type consisting of two copper windings per phase. Transformers shall be energy efficient type complying with DOE Efficiency standard. Transformers shall be

suitable for indoor or outdoor installation in accordance with the locations shown on the Contract Drawings.

- B. Transformers shall have KVA rating, primary voltage and connection, secondary voltage and connection and number of phases as shown on the Contract Drawings.
- C. Transformer insulation shall be rated 220 degrees C, 80 degrees C rise.
- D. Transformers shall be equipped with six 2-1/2 percent fully rated taps, two above and four below the rated voltage tap on the primary winding. The arrangement, assembly, and laminations of the core shall be such as to facilitate repair to the windings. The design, shape, and arrangement of windings shall allow free flow of air for insulation and cooling.

2.3 SHOP TESTS

- A. Shop tests shall be performed at the transformer's manufacturer's plant prior to shipment. Shop tests shall demonstrate that the equipment tested conforms to the requirements specified.
- B. Each transformer shall be given a routine test in accordance with the latest requirements of UL, ANSI and NEMA standards.
- C. The Contractor shall provide a shop test report. The report shall identify the tests performed and the results obtained.
- D. Transformer shop tests shall be performed consisting of the following:
 - 1. Applied potential shall be performed.
 - 2. Induced potential shall be performed.
 - 3. No load losses shall be performed.
 - 4. Voltage ratio shall be performed.
 - 5. Polarity shall be performed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Transformers shall be installed on walls or floors. Floor mounted transformers shall be installed on one inch of Korfund sound absorber material on raised concrete base at locations shown on the Contract Drawings. Sufficient access and working space shall be provided for ready and safe operation and maintenance.

- B. The transformer leads shall be provided with solderless, clamp type cable connectors. Conduit runs shall be arranged for easy removal of the transformers.
- C. Transformer nameplates shall be Install for identification of equipment. Nameplates shall be provided in accordance with the requirements of Specification 16076 - Labeling and Identification.

3.2 FIELD TESTS

- A. Insulation resistance tests shall be performed on the transformers after installation. The tests shall be witnessed by the Engineer and certified by the Contractor. The tests shall be performed by the Contractor who shall furnish all testing equipment.
- B. The Contractor shall provide a field test report. The report shall identify the tests performed and the results obtained.

+ + END OF SECTION + +

SECTION 16282

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

- A. Scope:
 - 1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install surge protective devices (SPD).
 - 2. SPDs furnished under this Section shall be ANSI/UL 1449 Type 2 integrating both surge suppression and high-frequency noise filtering suitable for use on low-voltage distribution systems.

1.2 REFERENCES

- A. Standards referenced in this Section are:
 - 1. ANSI/UL 1449, Surge Protective Devices.
 - 2. IEEE C62.41, Recommended Practice on Surge Voltages in Low-voltage AC Power Circuits.
 - 3. IEEE C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits.
 - 4. UL 1283, Electromagnetic Interference Filters.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Shall have at least five years experience manufacturing and servicing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.
- B. Component Supply and Compatibility:
 - 1. Obtain all products included in this Section regardless of component manufacturer from a single SPD manufacturer.
 - 2. SPD manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
 - 3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by SPD manufacturer.
- C. Regulatory Requirements: Comply with the following:
 - 1. NEC 110.9, Requirements for Electrical Installations, Interrupting Rating.
 - 2. NEC 240.21, Overcurrent Protection, Location in Circuit.

1.4 SUBMITTALS

- A. All files associated with shop drawings and product data shall be submitted as Adobe PDF with searchable function. This allows reviewer to search the document for keywords.
- B. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Electrical and mechanical drawings for each type of unit, showing electrical ratings, dimensions, mounting provisions, connection details, and layout diagrams.
 - b. Components list and nameplate schedule.
 - c. Summary sheets with schedules of equipment.
 - 2. Product Data:
 - a. Manufacturer's technical information, including catalog information.
 - b. Manufacturer's technical specifications with assembly and component ratings.
- C. Informational Submittals: Submit the following:
 - 1. Certifications:
 - a. Certification that SPD devices comply with standards referenced in this Section.
 - 2. Source Quality Control Submittals:
 - a. Report of results of testing and inspections performed at manufacturer's shop.
 - 3. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
 - 4. Qualifications Statements:
 - a. Manufacture, when requested by ENGINEER.
- D. Closeout Submittals: Submit the Following
 - 1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01730, Operation and Maintenance Data.
 - b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.
 - 2. Warranty Documentation: Submit example warranty at time of shipment of the equipment. Include final warranty accepted by ENGINEER in the operations and maintenance manual for the equipment.

1.5 DELIVERY, STORAGE, AND HANDLING.

- A. Delivery:
 - 1. Upon delivery, check for evidence of water that may have entered equipment during transit.
- B. Storage:
 - 1. Store SPD equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
 - 2. Protect equipment from corrosion and deterioration.

1.6 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. The obligations of CONTRACTOR under the Contract Documents shall not be limited in any way by the provisions of the specified special warranty.
- B. Special Warranty on Materials and Equipment:
 - 1. Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials or equipment specified in this Section found to be defective during a period of five years after the date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
 - 1. General Electric.
 - 2. Schneider Electric/Square-D Company.
 - 3. Eaton/Cutler-Hammer.
 - 4. Or equal.

2.2 EQUIPMENT

- A. General:
 - 1. SPD shall be modular, high-energy, parallel design with fast-acting transient voltage suppression using metal oxide varistors. Equipment shall provide noise attenuation with electromagnetic interference filter.
 - 2. SPD shall comply with requirements of the following:
 - a. ANSI/UL 1449.
 - b. UL 1283.
 - c. IEEE C62.41 and IEEE C62.45.
 - 3. SPD shall be suitable for operation under the following environmental conditions:
 - a. Relative Humidity: Zero to 95 percent, non-condensing.
 - b. Frequency: 47 to 63 Hertz.
 - c. Temperature: Zero to 149 degrees F.
 - 4. SPD operating voltage and IEEE C62.41 and IEEE C62.45 Category A, B, and C application environments shall be suitable for the associated SPD location(s) shown or indicated on the Drawings.
 - 5. SPD shall be suitable for internal mounting. The SPD shall be factory-mounted and integrated into switchboard specified under Section 16400.
- B. SPD shall include a surge suppression path for each mode as required for the system configuration shown on the Drawings. Each mode shall be individually fused and

equipped with thermal cutouts. SPD short-circuit rating shall be 200 kA. Protection modes shall include, to the extent applicable, the following:

1. Line-to-line.
 2. Line-to-neutral.
 3. Line-to-ground.
 4. Neutral-to-ground.
- C. SPD shall include electromagnetic interference/radio frequency interference (EMI/RFI) noise rejection filter with attenuation up to 30 dB from 10 kHz to 100 MHz.
- D. SPDs and components in the operating path shall have maximum continuous operating voltage greater than 115 percent of nominal system operating voltage.
- E. ANSI/UL 1449 minimum withstand rating shall be 20 kA per pole, and ANSI/UL 1449 voltage protection rating for SPD shall not exceed the following:

Modes	208Y/120	480Y/277
L-N,L-G, N-G	800	1200
L-L	1200	2000

- F. SPD surge capacity based upon IEEE C62.41 location category shall, as a minimum, be the following:

Category	Application	Per Phase	Per Mode
C	Service entrance	240 kA	120 kA
B	High exposure locations (distribution equipment)	160 kA	80 kA
A	Branch locations	120 kA	60 kA

2.3 ACCESSORIES

- A. Provide SPD equipped with the following accessories:
1. Surge counter with display for indicating the number of surges detected.
 2. LED indicators for monitoring device status.
 3. Audible alarm and silence switch for indicating an inoperative condition.
 4. Dry contacts, "Form C", for remote annunciation of unit status.
 5. Indicators, counter, alarm, and silence switch shall be visible and accessible from front of the SPD. When SPD is integral to distribution equipment, indicators, counter, alarm, and silence switch shall be visible and accessible from front of the equipment in which the SPD is installed.

2.4 SOURCE QUALITY CONTROL

- A. Perform manufacturer's standard factory tests on equipment. Tests shall be in accordance with IEEE C62.45 and ANSI/UL 1449.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install SPD at locations shown on the Drawings in accordance with equipment manufacturer's recommendations, Laws, and Regulations, and the Contract Documents.
- B. Conductor length between suppressor and connection point shall be as short and as straight as possible.

++ END OF SECTION ++

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SECTION 16292

POWER DISTRIBUTION SYSTEM COORDINATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing power system studies and distribution system field testing. Power system studies and field testing shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. Two separate and distinct power system studies are required. Each power system study shall include a short circuit study, a protective device evaluation study, arc flash study, and a protective device coordination study for a completely coordinated power distribution system.
- C. The first power system study shall be provided for the temporary electrical distribution system that will be utilized to supply the existing treatment plant and associated facilities, as well as the temporary bypass pumping station. Completion of the first power system study shall occur in advance of placing the temporary distribution system into operation.
- D. The second power system study shall be provided for the permanent electrical distribution system that will be utilized to supply the permanent facilities.

1.2 RELATED SPECIFICATIONS

- A. Specification 16036 - Testing
- B. Specification 16076 – Labeling and Identification.

1.3 REFERENCES

- A. The power distribution system coordination shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. NFPA 70E, Electrical Safety in the Workplace.
 - 3. IEEE 141, Recommended Practice for Electric Power Distribution Industrial Plants.
 - 4. IEEE 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

5. IEEE 399, Recommended Practice for Industrial and Commercial Power System Analysis.
6. IEEE 1584, Guide for Performing Arc-Flash Hazard Calculations.

1.4 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article 4 - Contractor's Working Drawings, Design and Shop Drawings; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 1. Calculations and results of the power system studies shall be submitted. The results of each study shall be submitted in a report format including the specified information. Each report shall be stamped and signed by the Licensed Engineer.
 2. Work sequence for the field testing shall be submitted. The sequence shall indicate the schedule of work, time frame and downtime for the equipment. The work sequence shall be submitted at least 45 days in advance prior to conformation of the field testing dates.
 3. Qualifications of proposed testing firm to perform field testing shall be submitted. Submit firm experience records at least 45 days in advance to actual testing, five recent references with phone numbers shall be submitted.
- C. Reports: Field test report shall be submitted.

1.5 QUALITY ASSURANCE

- A. General:
 1. The power system studies shall be performed in accordance with the latest applicable provisions and recommendations of the following:
 - a. NFPA 70 and 70E.
 - b. IEEE 141, 242, 399 and 1584.
 2. The Contractor shall retain the services of a Professional Engineer, licensed in the State of New York, to perform the power system studies. The Licensed Engineer shall be from an independent consulting firm or the equipment manufacturer. The Engineer responsibilities during execution of the studies specified shall include but are not necessarily limited to:
 - a. Coordinate with and obtain utility fault data and protective device information.
 - b. Obtain and review equipment shop drawings and other information as required.
 3. The Contractor shall coordinate with the Engineer performing the studies and assist him in the collection of all information necessary to complete the studies specified.

4. Perform studies in advance of each system being placed into operation.
5. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology and the NETA maintenance testing specification.

B. Field Testing:

1. The power distribution systems shall be field tested. The field testing shall be performed in accordance with the requirements specified under Article 3.1.
2. Retain the service of an independent testing firm who shall perform field testing of the power distribution system. The testing firm shall have experience in the inspection and testing of the system equipment and shall be a member company of NETA as specified under Section 16036 Testing. Provide proof of membership or demonstrate that the standards and experience required for membership are possessed, all to the satisfaction of the Engineer.

PART 2 - PRODUCTS

2.1 POWER SYSTEM STUDIES

A. General:

1. The Contractor shall provide a current and complete short-circuit study, protective device evaluation, arc flash study, and a protective device coordination study for each electrical distribution system.
2. The studies shall include the utility and generator supplies and all portions of the low voltage electrical distribution system from the normal and alternate sources of power through the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.
3. Problem areas or equipment inadequacies shall be promptly brought to the Engineer's attention.
4. The following operating modes shall be included for the permanent electrical distribution system:
 - a. Utility operation: System operating on the utility supply under maximum conditions.
 - b. Generator operation: System operating on the generator supply under maximum conditions.
 - c. Maximum conditions include two 400 Horsepower peak flow pumps, two grinders and the facility miscellaneous loads in operation. The peak flow pumps operate from variable frequency drives without bypass capability.
5. The temporary electrical distribution system shall include two operating modes, one utility and one generator similar to the permanent electrical distribution system. Maximum conditions shall include a single lump motor load of 250 horsepower located at the main distribution switchboard.

B. Short Circuit Study:

1. The short circuit study shall be performed with the aid of a computer program.
2. The study input data shall include the utility company's short circuit, single and three phase contributions, with the X/R ratio, the resistance and reactance components of each branch impedance, motor and generator contributions, base quantities selected, and all other applicable circuit parameters.
3. Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboards, and other significant locations through the system.
4. The short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, including motor back EMF current contributions shall be listed with its respective X/R ratio.

C. Protective Device Evaluation Study:

1. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters, busways, switches, and fuses by tabulating and comparing the short-circuit ratings of these devices with the available fault currents.
2. Appropriate multiplying factors based upon system X/R ratios and protective device rating standards shall be applied.

D. Protective Device Coordination Study:

1. A protective device coordination study shall be performed to select or to check the selections of the power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and setting to the extent required for the distribution system shown on the Contract Drawings.
2. The overcurrent device settings computed in the coordination study shall provide complete 100 percent selectivity. The system shall be selectively coordinated such that only the device nearest a fault will operate to remove the faulted circuit. System selectivity shall be based on both the magnitude and the duration of a fault current.
3. The coordination study shall include all voltage classes of equipment starting at the utility's incoming line protective device down to and including each of the medium and low voltage equipment. The phase and ground overcurrent and ground fault protection shall be included, as well as settings for all other adjustable protective devices.
4. The time-current characteristics of the installed protective devices shall be plotted on the appropriate log-log paper. Reasonable coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a complete system basis. Sufficient curves shall be used to clearly indicate selective

coordination achieved to the utility main breaker, power distribution feeder breakers, and the overcurrent devices at each major load center.

5. There shall be a maximum of five protective devices per plot. Each plot shall be appropriately titled. Plots shall include the following information as required for the circuits shown:
 - a. Representative one-line diagram, legends and types of protective devices selected.
 - b. Power company's relays or fuse characteristics.
 - c. Significant motor starting characteristics.
 - d. Parameters of transformers, ANSI magnetizing inrush and withstand curves.
 - e. Operating bands of low voltage circuit breaker trip curves, and fuse curves.
 - f. Relay taps, time dial and instantaneous trip settings.
 - g. Cable damage curves.
 - h. Symmetrical and asymmetrical fault currents.
6. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. A tabulation of the recommended power fuse selection shall be provided for all fuses in the system.

E. Arc Flash Study

1. An arc flash study shall be performed to identify the parameters of the zone of protection and label equipment in accordance with the requirements specified.
2. Perform the arc flash study for the system operating modes specified. For each operating modes evaluate the arc flash first with the motors on line and then again with the motor off line.
3. Arc Flash study report shall contain the following information:
 - a. Bus name
 - b. Protective device name
 - c. Bus kV
 - d. Bus bolted fault level (kA)
 - e. Bus arcing fault level (kA)
 - f. Protective device bolted fault level (kA)
 - g. Protective device arcing fault level (kA)
 - h. Trip/Delay time (sec)
 - i. Breaker opening time (sec)
 - j. Ground
 - k. Equipment type
 - l. Gap (mm)
 - m. Arc flash boundary (mm)
 - n. Working distance (mm)
 - o. Incident energy (j/cm^2)
 - p. PPE Level

- q. Proposed label.
 - r. Cable length from trip device
 - s. Incident energy at low marginal
 - t. Incident energy at high marginal
- 3. Contractor shall furnish and install all Arc flash study labels and affix to the all equipment as described by and in accordance with NFPA 70, 70E and Section 16076 – Labeling and Identification.

2.2 STUDY REPORTS

- A. The results of each power system study shall be summarized in a final typewritten report. Two separate reports are required, the first report shall be designated Power System Study for the Temporary Distribution System. The second report shall be designated Power System Study for the Permanent Distribution System. Each report shall include the following information arranged in Sections:
 - 1. Description, purpose, basis, written scope, and a single-line diagram of the power distribution system which is included within the scope of the study.
 - 2. Tabulations of circuit breaker, fuses, and other equipment ratings versus calculated short-circuit duties, and commentary regarding same.
 - 3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
 - 4. Fault current tabulation including a definition of terms and a guide for interpretation.
 - 5. Tabulation of appropriate tap settings for relay seal-in units.
- B. Each power system study shall include a separate section addressing arc flash analysis. In addition to protection and calculation procedures, and coordination review and analysis results, report shall include protective device evaluation for each high-incident energy case to determine if adjustments can improve system performance relative to arc flash hazard level.

PART 3 - EXECUTION

3.1 FIELD TESTING

- A. The Contractor shall provide field testing of the permanent electrical distribution system, as well as the temporary electrical distribution system specified under this Section. The testing for the temporary electrical distribution system specified under this section shall be limited to the equipment provided under this Contract.
- B. All field testing shall be performed by the testing firm, after the completion and approval of the power system studies. The field testing shall be witnessed by the Engineer and certified by the Contractor.

- C. The testing firm shall adjust, set, calibrate and test all protective devices. All protective devices and meters in the low voltage equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturer's recommendations, the coordination study and best industry practice.
- D. Proper operation of all equipment associated with the device under test and its compartment, shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
- E. All solid-state trip devices shall be checked and tested for setting and operation. Circuit breakers associated with the trip devices shall be tested for trip and close function with their protective device. Provide primary current injection testing for each draw-out circuit breaker and secondary current injection for fixed mounted breakers with a solid-state trip device. Test the pickup and timing for each protective function, long, short, instantaneous and ground fault.
- F. All tests shall be in accordance with the manufacturer's recommendations and NETA, ATS Acceptance Testing Specification.
- G. The Contractor shall provide a field test report. The report shall be in accordance with NETA, ATS Acceptance Testing Specification.

3.2 MAINTENANCE OF OPERATIONS

- A. When the field tests specified require that certain pieces of equipment be taken out of service, the Contractor shall perform the work with due regard to maintenance of operations and construction staging in accordance with the Specifications. All testing procedures and schedules must be scheduled in advance prior to any work beginning.

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SECTION 16300

UTILITY ELECTRICAL SERVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install electric services and associated equipment at the Site.
2. CONTRACTOR shall furnish and install the following Work regarding the permanent electric service to the elevated Electric Building:
 - a. U-guard and fasten screws at riser pole for primary cable.
 - b. Primary cable, conduits and associated underground ductbanks.
 - c. Transformer concrete vault and associated bonding and grounding, including ground rods, cables and connections.
 - d. Secondary cable and terminations, conduits, and associated underground duct banks.
 - e. Metering current transformer switchboard mounting provisions, meter enclosure and associated conduit and wiring.
3. Electric utility company, PSEG Long Island will perform the following regarding the permanent electric service to the elevated Electric Building:
 - a. Furnish and install final connections at riser pole.
 - b. Furnish and install the submersible transformer.
 - c. Furnish the transformer bushings, load break elbow terminators, surge arresters and hot line clamp.
 - d. Furnish and install the billing transformers, meter, and associated terminations.
4. Electric utility company, PSEG Long Island will also perform modifications associated with the relocation of the existing overhead primary supply lines that serve the facility and the adjacent areas.
5. The CONTRACTOR shall install the permanent electric service transformer bushings, load break elbow terminators, surge arresters and clamps furnished by PSEG Long Island.
6. The CONTRACTOR shall also provide temporary electric services and internet service. The Contractor shall furnish and install the temporary electric service work that will be used to supply the treatment plant in a manner similar to the requirements specified for the permanent electric service.
7. PSEG long Island will perform work associated with the temporary electric service that will be used to supply the treatment plant in a manner similar to the requirement specified for the permanent electric service, except the PSEG Long Island transformer shall be pad mounted.

8. The temporary electric and internet service requirements are further specified under Section 16020, Temporary Electric System.
 9. Work in connection with the electric services specified shall be in accordance with the requirements of the electric utility company.
 10. Primary cables requirements are specified under Section 16121, Electric Wires and Cables. Conduit requirements are specified under Section 16133, Underground Ducts - Ducts in Concrete.
- B. Coordination and Payments:
1. CONTRACTOR shall be responsible to coordinate with electric utility company relative to the relocation of the existing overhead primary supply lines and the electric service connections and requirements for both the permanent and temporary services specified. CONTRACTOR shall make all necessary arrangements with electric utility.
 2. The electric services shall be obtained for the Long Beach Pumping Station at 2 West Pine Street, Long Beach, New York, 11561.
 3. The following PSEG Long Island contact representative has been identified for coordinating the electric service requirements:
 - a. Lianne Altmann, Major Account Executive.
 - b. 631-873-8791.
 - c. Lianne.Altmann@pseg.com.
 4. All work regarding the electric services specified shall be coordinated in advance with the electric utility company.
 5. The Contractor shall include in the Lump Sum price bid all costs associated with the services specified including applicable fees and for providing the necessary coordination to secure the specified services required to the Site.
 6. Contractor shall provide payment to PSEG Long Island immediately after notice to proceed for providing the permanent electric service submersible transformer and the relocation of the existing overhead primary supply lines. The costs due to PSEG Long Island for the submersible transformer and the relocation of the existing overhead primary supply lines shall be payable from the Contract Allowance specified under Division 01. The allowance shall be used for paying PSEG Long Island for construction costs incurred and invoiced to CONTRACTOR relative to electrical service for the Site.
 - a. For purposes of determining Cost of the Work and CONTRACTOR's fee associated with construction by the electric utility company, PSEG Long Island shall be considered as a Subcontractor to CONTRACTOR.
 - b. Comply with Division 01, Allowances, regarding submittal of costs proposed to be paid under the allowance. Do not include in proposed payment under the allowance CONTRACTOR's cost other than cost invoiced to CONTRACTOR by PSEG Long Island and CONTRACTOR fee (overhead and profit). Include such costs, if any, under other, non-allowance payment items.
 - c. Include in an Application for Payment costs invoiced to CONTRACTOR by PSEG Long Island, accompanied by electric

- utility company's invoice to CONTRACTOR for construction associated with the electric service.
- d. If costs payable under the allowance exceeds the allowance, OWNER will issue a Change Order to pay CONTRACTOR such extra amount or will pay CONTRACTOR such extra amount by other means available under the Contract.
 - e. If actual invoiced costs are less than the allowance amount, the Contract Price will be reduced by the difference between cost eligible and recommended by ENGINEER for payment, and the allowance amount via a Change Order.

1.2 QUALITY ASSURANCE

- A. All work associated with the Electric services shall be performed in strict conformance as described by and in accordance with the following latest PSEG Long Island specifications and requirements.
 - 1. Red Book, Specification and Requirements for Electric Installations.
 - 2. Subway Three Phase Transformer Specifications for Customers and Electrical Contractors.
 - 3. Three Phase Pad Mounted Transformer Specifications for Customers and Electrical Contractors.
- B. Obtain in advance the PSEG Long Island specifications and standards and comply with all referenced construction standards as described by the PSEG Long Island specifications and requirements.
- C. Perform all inspections and obtain all approvals as required PSEG Long Island.

1.3 SUBMITTALS

- A. All files associated with shop drawings and product data shall be submitted as Adobe PDF with searchable function. This allows reviewer to search the document for keywords.
- B. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - 2. Drawings showing proposed layout of electrical primary service duct banks and transformer and meter locations for both the temporary and permanent distribution systems. Submit proposed routing, transformer vault and pad, and meter locations to PSEG Long Island in advance for approval prior to proceeding with installation.

PART 2 PRODUCTS

2.1 CONCRETE VAULT

- A. Provide submersible transformer precast concrete vault for the permanent electric service. The concrete vault shall include all grates and equipment in accordance Long Beach WPCP Consolidation Pump Station Conversion

with and as described by PSEG Long Island Subway Three Phase Transformer Specifications.

- B. The submersible transformer precast concrete vault, including all grates and equipment shall be obtained from one of the following PSEG approved suppliers:
 - 1. John Potente & Sons, Hicksville, NY, 11801, 516-935-8585.
 - 2. AFCO Precast Corp, Middle Island, NY, 11953, 631-924-7400.
 - 3. Roman Stone Construction Corp, Bayshore, NY, 11706, 631-667-0566.

2.2 CONCRETE PAD AND DISTRIBUTION BOXES

- A. Provide transformer precast concrete pad for the temporary electric service. The precast concrete pad shall include the footing and foundation in accordance with and as described by PSEG Three Phase Pad-mounted Transformer specifications and requirements.
- B. Provide precast distribution boxes for both the permanent and temporary electric services. The precast distribution boxes shall be in accordance with and as described by PSEG Three Phase Subway and Pad-mounted Transformer specifications and requirements.
- C. The transformer precast pad, including the footing and foundation and the precast distribution boxes shall be obtained from one of the following PSEG approved suppliers:
 - 1. John Potente & Sons, Hicksville, NY, 11801, 516-935-8585.
 - 2. AFCO Precast Corp, Middle Island, NY, 11953, 631-924-7400.
 - 3. Long Island Precast, Brookhaven, NY, 11719, 631-286-0240.
 - 4. Roman Stone Construction Corp, Bayshore, NY, 11706, 631-667-0566.
 - 5. Costal Pipeline, Calverton, NY, Calverton, NY, 11933, 631-369-4000.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The installation of each electric service shall not proceed until the service requirements have been confirmed and approved by the electric utility company.
- B. Install the materials and equipment of each electric service in accordance with requirements of the electric utility company.
- C. Install all conduit seals and cable watertight end caps as required by the electric utility company.
- D. Install grounding at transformers as required by the electric utility company.
- E. Transition duct bank nonmetallic conduits with a PVC coated rigid steel conduit elbow turning up near base of riser pole. Extend conduits above grade to a height

as required by the electric utility company. Continue primary cable up riser pole with U-guard protection to a height of 42 feet per phase or as required and for final connections by the electric utility company.

++ END OF SECTION ++

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SECTION 16400
SWITCHBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, services, and incidentals as shown, specified, and required to furnish and install switchboards.

B. Related Sections:

1. Section 16036, Testing.
2. Section 16076, Labeling and Identification.
3. Section 16282, Surge Protective Devices
4. Section 16292, Power Distribution System Coordination.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. NEMA PB2, Dead-Front Distribution Switchboards.
2. UL 891, Dead-Front Switchboards.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have not less than five years experience manufacturing and servicing materials and equipment substantially similar to those required and upon request shall submit documentation of not less than five installations in satisfactory operation for at least five years each.
2. Manufacturer shall manufacture circuit protective devices within the assembly.

B. Component Supply and Compatibility:

1. Obtain all materials and equipment included in this Section regardless of component manufacturer from a single switchboard manufacturer.
2. Switchboard manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
3. Components shall be suitable for the specified service conditions and shall be integrated into overall assembly by switchboard manufacturer.

- C. Regulatory Requirements: Comply with the following:
 - 1. NEC Article 408, Switchboards and Panelboards.
 - 2. PSEG Long Island Revenue Metering Requirements.

1.4 SUBMITTALS

- A. All files associated with shop drawings and product data shall be submitted as Adobe PDF with searchable function. This allows reviewer to search the document for keywords.

- B. Action Submittals: Submit the following:

- 1. Shop Drawings:
 - a. Three-line diagrams.
 - b. Dimensional information including front view elevation and plan view.
 - c. Construction details of enclosures with conduit entry locations and connection details between assemblies.
 - d. Components list and nameplate schedule.
 - e. Summary sheets with schedules of equipment.
 - f. Interlocking scheme and sequence of operation.
 - g. Control description and sequence of operation.
- 2. Product Data:
 - a. Manufacturer's technical information, including catalog information.
 - b. Manufacturer's technical specifications with assembly and component ratings.
 - c. Time current curves for protective devices.
- 3. Testing Plans, Procedures, and Testing Limitations:
 - a. Submit description of proposed factory testing methods, procedures, and apparatus.
 - b. Submit description of proposed testing methods, procedures, and apparatus.

- C. Informational Submittals: Submit the following:

- 1. Certificates:
 - a. Certifications required in this Section, including seismic requirements.
- 2. Source Quality Control Submittals:
 - a. Report of results of testing and inspections performed at manufacturer's shop.
- 3. Site Quality Control Submittals:
 - a. Report of results of field testing.
- 4. Supplier Reports:
 - a. Submit written report of results of each visit to Site by Supplier's service technician, including purpose and time of visit, tasks performed, and results obtained. Submit within two days of completion of visit to the Site.
- 5. Qualifications Statements:
 - a. Manufacture, when requested by ENGINEER.

- D. Closeout Submittals: Submit the following:

- 1. Operations and Maintenance Data:
 - a. Submit in accordance with Section 01730, Operation and Maintenance Data.

- b. Include acceptable test reports, maintenance data and schedules, description of operation, wiring diagrams, and list of spare parts recommended for one year of operation with current price list.
- c. Include record drawings of control schematics, with point-to-point wiring diagrams.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Upon delivery, check for evidence of water that may have entered equipment during transit.
- B. Handle equipment in accordance with manufacturer's instructions. One copy of these instructions shall be furnished with equipment at time of delivery.
- C. Storage: Store switchboards equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide equipment of one of the following:
 - 1. Eaton/Cutler-Hammer.
 - 2. Schneider Electric/Square D Company.
 - 3. Or equal.

2.2 SWITCHBOARD EQUIPMENT

- A. Ratings:
 - 1. Switchboard shall be 600-volt class, suitable for operation on three-phase, 60-Hertz system.
 - 2. System operating voltage, number of wires, bus ampacity, and short circuit withstand capability and interrupting rating shall be as shown on the Drawings.
- B. General:
 - 1. Switchboard shall be dead-front type, front-accessible with the following five separate compartments:
 - a. Individual mounted utility metering compartment, PSEG Long Island.
 - b. Individual utility main breaker compartment
 - c. Individual generator main breaker compartment.
 - d. Individual portable generator breaker compartment
 - e. Group-mounted feeder breaker compartment.

2. Switchboard shall be equipped with an automatic transfer system for both manual and automatic operation of the utility main breaker and the generator main breaker. The portable generator main breaker shall be manually operated only.
3. Provide switchboard in accordance with the arrangement shown on the Drawings. Switchboard shall consist of bus system, structure, circuit breakers, metering, surge protective device (SPD), transfer controller and auxiliary components as required integrally mounted with an enclosure.
4. Switchboards shall be in accordance with NEMA PB2, UL 891, and NEC Article 408.
5. Switchboard shall be service entrance type and UL-labeled as such. Equip service entrance switchboard with bonding jumper to bond enclosure and ground bus to the neutral bus, and a barrier to isolate service bus bars and terminals.
6. The utility metering compartment shall comply with PSEG long Island revenue metering requirements.

C. Bus Bars:

1. Switchboard bus bars shall be tin-plated copper, supported with high-impact, non-tracking insulating material. Secure bus joints with Belleville type washers, and braced bus joints for mechanical forces exerted during short circuit conditions. Mount main horizontal bus bars with all three phases arranged in the same vertical plane.
2. Bus bar sizes shall be based upon a maximum temperature rise of 65 degrees C over a 40-degree C ambient in accordance with NEMA PB2 and UL 891.
3. Provide copper ground bus secured to each vertical section and extending entire length of equipment. Ground bus size shall be as required for a current capacity equal one-half the capacity of main power bus.
4. Conductor hardware shall be high-tensile strength and zinc-plated. Provide bus joints with conical spring-type washers.

D. Structure:

1. Equipment structure shall be completely self-supporting and shall include required number of vertical sections bolted together to form a single metal-enclosed enclosure.
2. Enclosure structure frame shall be die-formed, 12-gauge steel bolted together and reinforced rated NEMA 1.
3. Equipment shall have identifying nameplates in accordance with Section 16076, Labeling and Identification. Provide nameplates for each breaker circuit and provide typewritten directory of circuits.
4. Cover sides and rear of enclosure with removable, bolt-on covers. Edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within enclosure.

5. Sections of switchboard shall be front- and rear-aligned with depth as shown on the Drawings. Devices shall be front-removable and load connections shall be front-accessible.
6. Provide assembly with adequate lifting means so that assembly is capable of being moved to its installation position.
7. Conduit entry and exit shall be coordinated by Contractor. The quantity of conduits and cables associated with each feeder shall be as shown or indicated on the Drawings.

E. Circuit Breakers:

1. Circuit breakers shall be power break draw out type for the utility main, generator main and portable generator main breakers. Feeder breakers shall be molded case fixed mounted type. Breaker quantity of poles, voltage, and current ratings shall be as shown on the Contract Drawings.
2. Breakers shall be electrically operated for the utility main, generator main and portable generator main and manually operated type for feeders. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by arc chutes.
3. Molded case breakers shall be operated by a toggle-type handle and shall have quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of breakers shall be clearly indicated by handle position.
4. Power break breakers shall be equipped with a stored energy mechanism. Breakers shall include open-close pushbuttons, five-cycle close time, and rotary operated stored energy handle mechanism providing quick make/quick-break protection.
5. Molded case breakers shall have 100-amp frames, minimum. Provide overload protection on all poles, with trip settings as shown. Breakers with frame sizes 250 amps and below shall have thermal-magnetic trip units and inverse time-current characteristics, or equal.
6. Provide breakers 400-amp frame and larger with an electronic solid-state programmable trip unit. Provide push-to-trip button on front of circuit breaker to provide local manual means of exercising trip mechanism. Electronic trip system shall include:
 - a. Plug-in protection programmer, flux shift trip device, and current sensor package. Construct programmer, sensor, and flux-shifting trip device as integral elements of breaker, requiring no externally mounted assemblies for proper operation.
 - b. Solid state, microprocessor-based, nine-function programmer shall provide true RMS current sensing and include adjustable continuous and instantaneous current elements with adjustable long time, short time, zero sequence ground fault pickup and delay.
7. Circuit breakers 1200 ampere and larger shall be provided with Arc Energy Reduction, consisting of energy reducing maintenance switching and local status indicator. Provide dry contacts one for each switch

connected in parallel for remote indication of maintenance mode signaling common status to the main control panel.

8. Where shown, provide breakers with shunt trips, bell alarms, and auxiliary contacts and devices. Provide the following additional auxiliary 52a dry contacts for each breaker:
 - a. Generator breaker 52-G, one 52a contact to signal the VFD accessory control specified under this section.
 - b. Portable generator breaker, 52-PG two 52a contacts, one for remote indication of breaker closed position to the main control panel and the second to signal the VFD accessory control specified under this section.

F. Provide main meter devices as shown on the Drawings, and in accordance with the following.

9. Microprocessor-based Monitoring Devices:
 - a. Device shall provide complete electrical metering in one package. Device shall include self-contained potential transformers and self-protected internal fuses.
 - b. Mount device on compartment door to allow personnel access to meter menu and display.
 - c. Device shall include trend analysis, event logging, and recording. Device shall include the following direct reading metered values:
 - 1) Volts: 0.2 percent accuracy
 - 2) Amperes: 0.2 percent accuracy
 - 3) Watts, Vars, and VA: 0.5 percent accuracy
 - 4) Power Factor: 1.0 percent accuracy
 - 5) Frequency: 0.05 percent accuracy
 - 6) Watts, and VA Hours: 0.5 percent accuracy
 - 7) Var Hours: 1.0 percent accuracy
 - 8) Watts, Var, and VA Demand: 0.4 percent accuracy
 - 9) THD-Voltage: 50th harmonic
 - 10) THD-Current: 50th harmonic
 - 11) Individual Ampere Harmonics: 50th harmonic
 - 12) Individual Voltage Harmonics: 50th harmonic
 - d. Metering device shall have the following additional features:
 - 1) Trend analysis that shall display minimum and maximum values for each metered parameter with date and time of each occurrence.
 - 2) Input range of device shall accommodate external current transformers with ranges from 100/5 to 5000/5 and potential transformers from a ratio of 120:120 to 500,000:120. Three current transformers suitably rated shall be included.
 - 3) Alarm contacts rated five amps at 120 vac.
 - 4) Three analog outputs programmable to reflect the metered parameters, except kilowatt hours and kilovar hours.

- 5) Communication capability, using RS-485, Modbus RTU Protocol or Ethernet. Meter shall communication remotely to the main control panel using Ethernet.

F. Wiring/Terminations:

1. Provide small wiring, necessary fuse blocks, and terminal blocks in switchboard as required. Control components mounted in assembly, such as fuse blocks, relays, pushbuttons, switches, and other components, shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
2. Provide mechanical-type terminals for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of size indicated on the Drawings.
3. Provide lugs in incoming line section for connection of main grounding conductor. Provide additional lugs for connection of other grounding conductors as indicated on Drawings.
4. Control wire shall be Type SIS, bundled and secured with nylon ties. Provide insulated locking spade terminals for all control connections, except where saddle type terminals are provided integral to a device. Current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to another device. Provide groups of control wires leaving switchboard with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

G. Accessories:

1. Provide a surge protective device in accordance with Section 16282, Surge Protective Devices, one for the normal supply and one for the generator supply as shown on the Drawings. The surge protective shall also comply with the following:
 - a. Each surge protective device shall be included and factory-mounted within switchboard-by-switchboard manufacturer. Surge protective device monitoring and display shall be visible from switchboard front.
 - b. Dry contacts from each surge protective device shall be wired together for remote indication signaling common alarm status to the main control panel.
2. Provide a VFD accessory control circuit to remotely signal each VFD when the generator breaker 52-G or the portable generator breaker 52-PG is closed. The VFD accessory control circuit shall consist of the following:
 - a. Bus connected control power transformer with primary and secondary fusing and 120 Volt secondary.
 - b. Control relay supplied from the control power transformer 120 Volt secondary source with six normally open dry contacts wired for remote indication, one for each VFD.

- c. The control relay shall energize whenever the generator breaker 52-G or the portable generator breaker 52-PG is closed, and the bus is supplied from either of the two generator source.

H. Miscellaneous Devices, Spare Parts and Accessories:

1. Provide control power transformers with primary and secondary protection, as indicated on the Drawings or as required for proper operation of equipment.
2. Provide remote racking device suitable for racking out the utility main and generator breakers remotely from the switchboard front.
3. Provide standard spare parts as recommended by the manufacturer.

I. Finishing:

1. Exterior and interior steel surfaces of switchboard shall be properly cleaned and provided with rust-inhibiting phosphatized coating by switchboard manufacturer. Color and finish of switchboard shall be light gray.

2.3 TRANSFER CONTROL SYSTEM

A. The transfer control system shall permit automatic and manual open transition transfer between the utility main breaker and the generator main breaker and manual open-close control of the portable generator main breaker. The transfer control system shall include the following:

1. Automatic transfer controller shall perform the transfer and monitoring functions associated with transition transferring between the utility main breaker and the generator main breaker and for stop-start control of the generator.
2. Manual controller provisions shall permit manual testing to include no load engine run, load transfer engine test or disabled.
3. Manual control provisions shall also permit manual operation to allow the utility main breaker and the generator main breaker to be manually opened and closed in the event the transfer controller is out of service. Generator starting will be manual when this manual mode is selected.
4. Interlocking shall be included to:
 - a. Electrical interlock to prevent both the normal utility main breaker, 52-N and the generator main breaker, 52-G to be closed at the same time. The portable generator breaker, 52-PG shall be prevented to be closed when either the normal utility main breaker, 52-N or generator main breaker, 52-G is closed.
 - b. Key interlock, K1 key for normal utility main breaker 52-N and K2 key for generator main breaker, 52-G shall allow breaker operation when the respective key is held captive and locks out respective breaker operation when the key is withdrawn.

- c. Key interlock dual lock for the portable generator breaker, 52-PG locks out and prevent breaker, 52-PG operation when keys K1 and K2 are withdrawn and allows breaker, 52-PG operation when both keys are held captive.
- B. A master Auto-Off-Manual, switch shall govern the operation of the transfer control:
- C. In auto an electronic transfer controller shall control the transfer and re-transfer operation, monitor the two sources of supply and stop-start the generator. The transfer controller shall be equipped with front mounted display and programming and key functions.
- D. The transfer controller auto sequencing shall include the following:
 - 1. When voltage on any phase of normal source is outside of specified parameters and after a programmable time delay period to allow for momentary dips, engine starting contacts shall close to start the generator.
 - 2. Transfer to emergency source when the generating supply has reached specified voltage and frequency on all phases.
 - 3. After restoration of normal power on all phases to within specified parameters, an adjustable time delay shall delay retransfer to normal to assure stabilization of normal supply. After expiration of the time delay period, controller shall retransfer to normal. Retransfer to normal shall be in-phase, open transition and prevented until two power supplies approach synchronization with voltage decay feature should synchronization not occur within an adjustable delay. Should emergency power source fail during the time delay period, controller shall bypass time delay and automatically return to normal source.
- E. Controller shall be equipped with sensing and time delays. Sensing and time delay settings shall be programmable and adjustable over a standard range suitable for the application and indicated below. Sensing and timing delays shall include at a minimum the following:
 - 1. Voltage, frequency and phase rotation sensing of each source.
 - 2. Normal source failure delay, 0-9999 seconds for engine starting.
 - 3. Transfer to emergency delay on availability of emergency source.
 - 4. Normal source return delay, 0-9999 seconds for transfer from emergency to normal.
 - 5. Emergency source failure, retransfer delay on availability of normal source.
 - 6. Engine cool down following retransfer to normal.
- F. Controller shall be equipped with manufacturer's standard input and outputs with dry contact outputs for remote monitoring and control at a minimum the following:

1. Dry contact output for stop-start control of generator.
2. Separate dry contact outputs for remote signaling the main control panel to include:
 - a. Normal supply available.
 - b. Generator supply available.
 - c. System master switch not in auto.
 - d. Normal utility main breaker 52-N closed.
 - e. Generator main breaker, 52-G closed.

2.4 SOURCE QUALITY CONTROL

A. Tests:

1. Factory-test switchboards in accordance with NEMA PB2 and UL 891.
2. Perform factory tests on equipment prior to shipment. Tests shall consist of the manufacturer's standard tests, and shall include:
 - a. Physical inspection and checking of all components.
 - b. Operation and device function tests under simulated service conditions to verify accuracy of wiring and functioning of all equipment.
 - c. Simulate sequencing, control and communication functions.
 - d. Primary, control, and secondary wiring hi-pot tests.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions under which materials and equipment will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Install equipment on concrete pad, as shown. Coordinate pad dimensions to fit equipment furnished.
- C. Install in accordance with Laws and Regulations, manufacturer's recommendations, and the Contract Documents. Do not energize equipment without permission of OWNER.

3.3 FIELD QUALITY CONTROL

A. Site Tests:

1. After installation, inspect and perform field testing of each switchboard. Testing shall be in accordance with Section 16036, Testing.
2. Testing and inspections shall be by Supplier's factory-trained representative, in accordance with manufacturer's recommendations. Inform OWNER and ENGINEER when Supplier's representative indicates that equipment is correctly installed.
3. Perform the following tests and checks before energizing equipment:
 - a. Verify proper installation.
 - b. Inspect all mechanical and electrical devices for proper operation.
 - c. Check tightness of bolted connections.
 - d. Check for proper anchorage, required area clearances, physical damage, and proper alignment.
 - e. Clean and lubricate as required.
 - f. Insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground.
 - g. Insulation-resistance tests, phase-to-phase and phase-to-ground on each circuit breaker.
 - h. Contact resistance test on each circuit breaker.
 - i. Perform all programming of set points for sensing and time delays. Perform all sequencing and control functional testing.
 - j. Perform other tests and adjustments recommended by equipment manufacturer.
4. Provide additional testing as described by Section 16292, Power Distribution System Coordination.

B. Manufacturer's Services: Provide services of qualified, factory-trained serviceman to perform the following:

1. Instruct CONTRACTOR in installing equipment.
2. Inspect and adjust equipment after installation and ensure proper operation.
3. Instruct operations and maintenance personnel in operation and maintenance of the equipment.
4. Manufacturer's technician shall make visits to the Site as follows:
 - a. First visit shall be for instructing CONTRACTOR in proper equipment installation and assisting in installing equipment.
 - b. Second visit shall be for checking completed installation, start-up of system; and performing field quality control and specified tests and checks.
 - c. Third visit shall be to instruct operations and maintenance personnel.
 - d. At substantial completion at the request of the Owner, the factory trained specialist shall return to the site to make controller adjustments based upon actual operating experience.
 - e. Technician shall revisit the Site as often as necessary until installation is acceptable.
5. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Lump Sum Price bid.

3.4 ADJUSTING

1. Calibrate, set and program protective devices. Coordinate the protective devices furnished under this Section and provide proper settings of devices per the results of the study specified in Section 16292, Power Distribution System Coordination.

+ + END OF SECTION + +

SECTION 16425

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, services, and incidentals as shown, specified, and required to furnish and install low-voltage variable frequency drives, complete and operational.
2. Variable frequency drives required under this Section are low-voltage, voltage source inverter of the following types for the locations specified:
 - a. Low harmonic type utilizing active front end technology for the permanent drives located at the Electrical Building.
 - b. 18 pulse type for the temporary drives located at the Bypass Pumping Station.
3. Variable frequency drives shall be customized for the control functionality specified.

B. Related Sections:

1. Section 11115, Submersible End Suction Pumps- Wet Pit (Bypass).
2. Section 11117, Submersible End Suction Pumps- Wet Pit (Permanent).
3. Section 16076, Labeling and Identification.

1.2 REFERENCES

A. Standards referenced in this Section are:

1. IEEE 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
2. ISO 9000, Quality Management Systems, Fundamentals and Vocabulary.
3. ISO 9001, Quality Management Systems, Requirements.
4. ISO 9002, Quality Systems, Model for Quality Assurance in Production, Installation and Servicing.
5. NEMA ICS 2, Controllers, Contactors and Overload Relays Rated 600 Volts.
6. NEMA ICS 7, Industrial Control and Systems Adjustable Speed Drives.
7. NEMA MG 1, Motor and Generators.
8. UL 489, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
9. UL 508, Industrial Control Equipment.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Low-voltage variable frequency drive manufacturer shall have not less than five years of experience designing and regularly manufacturing and servicing substantially similar equipment to that required, and upon

ENGINEER's request shall submit documentation of not less than five installations in satisfactory operation for not less than five years each.

- b. Manufacturer shall be certified under ISO 9000, ISO 9001, or ISO 9002 for materials and equipment specified.
- c. For all required factory tests, low-voltage variable frequency drive manufacturer shall use a factory test facility that has calibrated its testing apparatus in the previous twelve months, and is staffed by qualified, experienced technicians.

B. Component Supply and Compatibility:

1. The permanent drives located in the electric building shall employ a transistor-based active front end input rectifier that utilizes a selective harmonic elimination algorithm. The temporary drives located at the bypass pump station shall employ eighteen pulse rectifiers and transformers.
2. The drive harmonic mitigation for each pump system shall be enough to meet the IEEE-519 limitations. A harmonic analysis shall be performed by the drive manufacturer for the permanent active front end drives based upon the one line diagram shown on the Contract Drawings and the actual installed equipment. The harmonic analysis shall be performed for the worst case pumping condition which includes a maximum of two 400 horsepower pumps operating simultaneously at the Main Service Switchboard point of common coupling.
3. Drives specified under this Section shall employ a low switching frequency or pattern to minimize instantaneous rate of voltage change over time (dv/dt), and the adverse effects of potential bearing currents. Where alternate manufacturers are proposed, obtain manufacturer recommendations regarding bearing currents and provide equipment required at no additional cost to the Owner.
4. Each low-voltage variable frequency drive shall be fully compatible with associated driven equipment and motors. Variable frequency drives shall be matched to specific load requirements for each system. Operation of variable frequency drive shall not overstress motor insulation.
5. To centralize responsibility and to ensure that all equipment is properly coordinated, variable drives specified under this Section shall be obtained from the Supplier of the associated driven equipment.
6. Similar components of drives associated with each system shall be products of a single manufacturer.

C. Pump Monitoring System:

1. The submersible pumps specified under Section 11115 and 11117 are furnished with a Pump Protective Monitoring System that monitors the various pump-motor temperatures, moistures, and vibrations.
2. The monitoring system of the specified pump vendors differ and includes an electronic module system or discrete controllers for each pump. The actual system required shall be based upon the actual pumping equipment selected. The electronic monitor or discrete controllers shall be mounted in its respective variable frequency drive enclosure subject to the restrictions specified under this Section, Article 2.4.
3. Contractor shall coordinate with his suppliers regarding the actual pumping equipment selected and the monitoring system furnished and make all necessary arrangements to furnish the variable frequency drive manufacture the monitoring system information necessary prior to the preparation of shop

drawings. The variable frequency drive manufacture shall coordinate with the Contractor as required to obtain all information necessary to implement the monitoring system requirements into the variable frequency drive controls.

4. Contractor shall make all necessary arrangements as required to enable factory installation of the furnished monitoring system components into the variable frequency drive enclosures.

1.4 SUBMITTALS

- A. All files associated with shop drawings and product data shall be submitted as Adobe PDF with searchable function. This allows reviewer to search the document for keywords.

- B. Action Submittals: Submit the following:

1. Shop Drawings:
 - a. Dimensional information and construction details of enclosures. Enclosure details shall consist of exterior and interior front door with nameplate legends, interior door front and rear views, and terminal block layout.
 - b. Three-line power and control schematic diagrams.
 - c. Wiring diagrams showing the interconnection of conductors to all devices with terminal assignments for remote devices.
 - d. Functional description of system operation.
 - e. VFD heat dissipation at full load, including heat rejection/cooling system.
 - f. Harmonic analysis report showing compliance with IEEE 519. The report shall include an analysis one line diagram of the system with the percent voltage total harmonic distortion and percent current total demand distortion at the point of common coupling along with the harmonic voltage and current spectrums.
2. Product Data:
 - a. Manufacturer's technical specifications.
 - b. Manufacturer's catalog cuts and product literature.
3. Testing Plans:
 - a. Not less than thirty days prior to source quality control testing, submit descriptions of proposed shop testing methods, procedures, apparatus, and limitations.
 - b. Not less than thirty days prior to field quality control testing, submit descriptions of proposed field testing methods, procedures, and apparatus.

- C. Informational Submittals: Submit the following:

1. Certificates:
 - a. Certification letters from low-voltage variable frequency drive manufacturer and motor manufacturer that the approved driven equipment has been reviewed and that variable frequency drive units and motors are compatible and shall be provided in accordance with the Contract Documents and requirements of the driven equipment.
2. Source Quality Control Submittals:
 - a. Within five days of completing source quality control tests and inspections, submit test results with indication of whether all criteria of the Contract Documents for the specified equipment were met.
3. Field Quality Control Submittals:

- a. Within five days of completing field quality control tests and inspections, submit test results with indication of whether all criteria of the Contract Documents for the specified equipment were met.
 - 4. Manufacturer Reports:
 - a. Within five days of each visit to the Site by manufacturer's representative, submit written report of reason for visit, problems encountered, solutions implemented, and remaining work.
 - 5. Qualifications Statements:
 - a. Manufacturer, when requested by ENGINEER.
- D. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data:
 - a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, list of recommended spare parts, and spare parts ordering information.
 - b. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.
 - c. Include a listing of all programmable drive parameters and their settings at Substantial Completion. Submit parameters as both printed pages in the operations and maintenance manual and in electronic format on compact disc that can be directly uploaded to the drive-in event of drive replacement or repair.
 - d. Comply with Section 01730, Operations and Maintenance Data.
- E. Maintenance Materials Submittals: Submit the following:
 - 1. Spare Parts and Extra Stock Materials:
 - a. Furnish, tag, and box for shipment and long-term storage spare parts and special tools for low-voltage variable frequency drives. Each set of spare parts and tools shall include manufacturer's recommended spare parts inventory for one year and include, at minimum, the following:

Item	Quantity per Four VFDs per HP Rating
1) Transistor and diode modules with accessories	One set for each horsepower size.
2) Power supply module	One
3) Fans	One set
4) Power fuses	One set of each size and type used
5) Control power fuses	Two sets of each size and type used
6) Pilot lights	Two per ten of each type used

- b. Furnish a list of recommended spare parts for an operating period of one year. Describe each part, the quantity recommended, and current unit price.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading:
 - 1. Packing:
 - a. Inspect prior to packing to ensure that assemblies and components are complete and undamaged.
 - b. Protect mating connections.

- c. Cover all openings into enclosures with-vapor inhibiting, water-repellent material.
 - d. Indoor containers shall be bolted to skids.
 - 2. Upon delivery, check materials and equipment for evidence of water that may have entered equipment during transit.
 - 3. Handling:
 - a. Lift, roll or jack low-voltage variable frequency drive equipment into locations shown.
 - b. Variable frequency drives shall be equipped for handling required for installation. Handle equipment in accordance with manufacturer's requirements.
- B. Storage and Protection:
- 1. Store low-voltage variable frequency drive equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.

PART 2 PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. System Performance:
- 1. Driven equipment to be controlled by a low-voltage variable frequency drive shall be provided with a customized variable frequency drive. Each drive unit shall include an adjustable frequency controller with associated controls for continuous speed adjustment and protection of the driven equipment. Output speed control of motor shall be continuous throughout speed range of two to 60 Hertz under variable torque load or constant torque as specified for the driven equipment.
 - 2. Low-voltage variable frequency drives associated with each set of driven equipment shall be similar to each other.
 - 3. Variable frequency drives shall be UL-listed or ETL-listed and designed, built, and tested in accordance with UL 489, NEMA ICS 2, NEMA ICS 7, and UL 508.

2.2 MANUFACTURERS

- A. Provide low-voltage variable frequency drives by one of the following:
- 1. Rockwell Automation, Allen Bradley.
 - 2. Siemens.
 - 3. ABB.
 - 4. Or equal.

2.3 VARIABLE FREQUENCY DRIVE CABLE

- A. Refer to Specification 16121 for special requirements for VFD Cables.

2.4 ENCLOSURE

- A. Provide each low-voltage variable frequency drive with a freestanding front-access, type enclosure. Enclosure shall house all components required for the associated variable frequency drive.
- B. Enclosure for the drives located at the Electric Building shall be NEMA 1, filtered and gasketed enclosure.
- C. Enclosure for the drives located at the Bypass Pumping Station shall be NEMA 3R. The NEMA 3R enclosures exterior shall be given two coats of white paint and shall be equipped with anti-condensation heaters thermostatically controlled and a side mounted air conditioning unit.
- D. Enclosure shall provide adequate cooling for components within, NEMA type 1 enclosures shall include positive ventilation.
- E. Enclosure shall include circuit breaker disconnect switch. Circuit breakers shall be in accordance with UL 489. Switch handle shall be suitable for padlocking and be through-the-door type with handle height not exceeding six feet. Operation of switch shall remove the service supply from all internal components. Power devices shall be suitable for interrupting capacity of 65,000 RMS symmetrical amperes. Include current limiting semi-conductor fuses where required for protection of solid state components.
- F. Enclosure door shall include an operator interface for access to controller's digital keypad and display.
- G. The pump protective monitoring system devices are noise sensitive and shall be isolated from the variable frequency drive power supplies in a sectionalized location in the drives control bay. When the drive enclosure normally does include a control bay, a dedicated add on enclosure shall be included. The size of the enclosure shall be limited in size based upon the recommendations of the pump manufacturer and located based upon the space allocations of the pump station.
- H. Equip enclosure front with nameplates for identification of equipment and operating functions. Nameplates shall be in accordance with Section 16076, Labeling and Identification.
- I. Equip enclosure with phenolic type terminal blocks suitably labeled for all internal and remote wiring requirements, plus twenty percent spare.

2.5 ADJUSTABLE FREQUENCY CONTROLLER

- A. General:
 - 1. Adjustable frequency controller shall be design, suitable for operation on a 480-volt, three-phase supply. Controller shall produce an adjustable AC voltage/frequency output to vary speed of driven equipment.
 - 2. Controllers located at the Electrical Building shall be low harmonic type:
 - a. Microprocessor-based inverter and converter logic isolated from power circuits.
 - b. Fixed DC bus section.

- c. Switched Insulated Gate Bi-Polar Transistor (IGBT) bridge inverter and converter, input section (Active Front End).
- 3. Controllers located at the Bypass Pumping Station shall be 18 pulse type:
 - a. Phase shifting transformer for eighteen pulse operation.
 - b. Eighteen -pulse diode bridge converter input section.
 - c. Fixed DC bus section.
 - d. Six-pulse power transistor inverter output section.
- 4. Controller switching frequency shall be adjustable and allow operation at 5,000 Hertz or less. Controller technology shall include a switching scheme that reduces the dv/dt of output supply.
- 5. Controller shall include an LCL filter suitable for reducing EMI/RFI emissions.
- 6. Controller shall include MOV protection, phase to phase and phase to ground.
- 7. Overload rating of 110 percent variable torque, 150 percent constant torque for one minute.
- 8. RMS harmonic content of output current shall be less than five percent of fundamental current.
- 9. Able to withstand output terminal line-to-line short circuits without component failure.

B. Operating Criteria:

- 1. Operating criteria shall be in accordance with the following:
 - a. Ambient temperature range of zero to 40 degrees C.
 - b. Operational humidity of up to 90 percent non-condensing.
 - c. Altitude up to 3,300 feet above sea level.
 - d. Nominal voltage of 480-volts plus or minus ten percent, three-phase, three-wire. Include an under-voltage feature to allow trip-free operation down to 20 percent undervoltage.
 - e. Nominal frequency of 60 Hertz plus or minus three Hertz.
 - f. Input power factor of 97 percent displacement power factor at all operating speeds.
 - g. Efficiency of 96 percent at full speed and full load.

C. Features:

- 1. Controller shall have the following features:
 - a. Digital keypad and display module shall provide parameter setting, adjustments, and monitoring of control functions and faults. Display messages shall be in English.
 - b. Controllers shall be equipped with a built-in dual port EtherNet/IP interface with capability of communicating at a minimum EtherNet/IP for remote monitoring.
 - c. HMI interface with integral LCD display, operating and programming keys.
 - d. Independent acceleration/deceleration rates shall provide two to 600 seconds minimum. When called to stop, motor shall decelerate to minimum speed before stopping.
 - e. Power loss feature shall allow 15 milliseconds at full load ride through capability for input supply interruptions.
 - f. Time delay automatic restart shall allow restart after controller fault conditions with programmable attempts.
 - g. Coasting motor restart shall allow controller to restart into a coasting motor without damage or tripping.
 - h. Isolated control inputs and outputs.

D. Protection:

1. Controller shall have electronic protective functions as follows:
 - a. Power loss.
 - b. Over-current phase to phase and phase to ground.
 - c. Inverse time overload protection with thermal memory retention.
 - d. Over-temperature.
 - e. Current limit trip protection.
 - f. Over and under-voltage.

2.6 OUTPUT FILTER

A. General:

1. Provide output filter to prevent overstressing motor insulation system. Provide output filter with each low-voltage variable frequency drive, when cable length between motor and variable frequency drive exceeds the following based on noted switching frequencies.
 - a. One KHZ switching frequency, 200 feet cable length.
 - b. Three KHZ switching frequency, 175 feet cable length.
2. Provide output filters in all other cases, based on recommendations of low-voltage variable frequency drive and motor manufacturers, when actual voltage peaks at motor terminals exceed NEMA MG 1 limits.

B. Features and Criteria:

1. Filter shall be three-phase, 600-volt class motor-protecting type consisting of suitable values of inductance, capacitance and resistance to form a damped, low pass filter.
2. Filter shall be low-loss type specifically designed to reduce voltage wave form dv/dt . Filter shall allow cable lengths at minimum exceeding actual application distances with waveform resulting in voltage spikes at motor terminal that are within NEMA MG 1 Part 31 voltage stress levels.
3. Filter shall be suitable for mounting within low-voltage variable frequency drive enclosure.

2.7 CONTROLS

A. General:

1. Equip each low-voltage variable frequency drive control system with relays, switches, fuses, indicating lights, and components required for a complete, functional system.
2. Variable frequency drive control shall be powered from a suitably sized and protected control power transformer.
3. Variable frequency drive control shall include status indicators, controller, and system fault condition displays and operating controls. Provide status indicators and operating controls associated with drive control on front door of enclosure.
4. Control arrangement shall be such that variable frequency drive internal electronic supply voltage is isolated from field wiring.

B. Control and Pilot Devices:

1. Relays shall be electrically operated, electrically held type, and pneumatic or solid-state time delay type. Provide relays with contacts rated ten amps, quantity as required.
2. Pilot devices shall be heavy duty type, rated 10 amps continuous. Indicating lights shall be push-to-test transformer LED type with 12-volt secondaries.

C. Operation:

1. Stop/Start and Speed Control: Drives shall respond to drive-mounted Local-Off-Remote selector switch. With switch in "REMOTE" position, stop/start and speed control shall be based on a remote stop/start contact and a four- to 20-mADC speed signal from remote main control panel. With switch in "LOCAL" position, stop/start and speed control shall be from the keypad located at the Drive.
2. Auxiliary Controls shall include the following, unless specifically noted otherwise:
 - a. Emergency Stop Control: Emergency stop control shall include a drive mounted stop station and a remote field mounted stop station, maintained type located adjacent to driven equipment. When activated driven equipment shall stop immediately in all operating modes.
 - b. Discharge Valve Limit Switch: Drive shall monitor discharge valve limit switch whenever the pump is in operation. If the discharge valve closes when the pump operates the limit switch shall activate a status light and alarm after an adjustable delay. The pump shall continue to operate and not shutdown.
3. Pump Monitoring System: Pump operation shall be monitored by the electronic control module or discrete relays furnished by the pump vendor as more fully described under this section. The following includes the monitoring requirements of the system:
 - a. Motor thermal device.
 - b. Motor housing Leak device.
 - c. Pump seal leakage.
 - d. Bearing temperature.
 - e. Pump Vibration.
4. Drive controls shall monitor the discrete relay output contacts and provide the additional auxiliary relays and timers as may be required for drive indication, shutdown, and remote monitoring of each device function. The additional circuitry shall be in accordance with the monitoring system vendor recommendations and requirements.
5. Generator Operation: The active front end drives shall be compatible for generator operation. A remote dry contact closure shall signal each drive whenever drive operation on the generator supplies are required.

D. Status Lights and Contact Outputs:

1. Provide the following separate drive mounted status pilot lights for each drive, unless specifically noted otherwise:
 - a. Motor run (red).
 - b. Motor stop (green).
2. Provide the following separate drive mounted shutdown pilot lights, (amber) except where noted otherwise for each drive. Arrange shutdown indication circuitry so that, when activated, indicator requires manual reset.
 - a. Drive fault.

- b. Pump-Motor fault.
 - c. Discharge Valve Closed when Operating, shutdown not required.
 - d. Motor Terminal fault.
 - e. Motor Leak fault.
 - f. Pump Seal Leakage fault.
 - g. Bearing Temperature alarm
 - h. Bearing Temperature fault.
 - i. Pump Vibration fault.
3. Provide the following dry contact outputs for remote indication of each drive:
 - a. Pump-Motor fault.
 - b. Motor run.
 - c. VFD fault.
 - d. Emergency stop activated. Provide relay to repeat contact for remote indication.
 - e. Local-Off-Remote switch not in remote.
 - f. Discharge valve Closed when Operating.
 - g. Motor Terminal fault.
 - h. Motor Leak fault.
 - i. Pump Seal Leakage fault.
 - j. Bearing Temperature alarm
 - k. Bearing Temperature fault.
 - l. Pump Vibration fault.
 4. Speed Output: Provide a speed output four- to 20-mADC signal for remote indication of motor speed.

E. Wiring and Device Identification:

1. Provide control wiring and device identification for each low-voltage variable frequency drive:
 - a. Identify all control conductors with permanent type wire markers. Each wire shall be identified by a unique number and shall be attached to wire at each termination point.
 - b. Identify each control device with permanent type marker. Each device shall be identified by a unique number and shall be attached to each device.
 - c. Numbering system for each wire and control device shall be identified on wiring diagrams and shall reflect actual designations used in the Work.

2.8 SOURCE QUALITY CONTROL

A. Tests:

1. Perform factory tests on each low-voltage variable frequency drive prior to shipping. Tests shall consist of simulating expected load to be driven by operating load through speed ranges specified for driven equipment, for minimum of two hours per drive unit.
2. Provide factory control and alarm tests on each drive unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.
3. Perform specified tests in addition to standard factory tests typically performed.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine conditions under which the Work will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations and instructions and in conformance with Laws and Regulations, and the Contract Documents.
- B. Install equipment with sufficient access and working space provided for ready and safe operation and maintenance.
- C. For installations against masonry walls, provide an insulation board, 1/4-inch minimum thickness, between equipment and wall for corrosion protection. Trim board neatly within outline of equipment.
- D. Install all terminations, lugs, and required appurtenances necessary to properly terminate power supplies.
- E. Install control wiring terminations and appurtenances necessary to complete installing control and monitoring devices.
- F. Immediately prior to Substantial Completion, replace all enclosure filters and frames provided under this Contract with new filters and frames, except expanded metal filter types. Immediately prior to Substantial Completion, clean expanded metal filters.

3.3 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. After installation, inspect, adjust, and test each low-voltage variable frequency drive at the Site. Testing and inspection shall be in accordance with manufacturer's recommendations and be performed by manufacturer's factory-trained representative. Through CONTRACTOR, manufacturer's factory-trained representative shall inform OWNER and ENGINEER when equipment is correctly installed and ready to be energized. Do not energize equipment without permission of ENGINEER.
 - 2. Perform the following equipment inspection and testing and provide reports documenting procedures and results.
 - a. Verify all device settings and drive adjustments.
 - b. Inspect all mechanical and electrical interlocks and controls for proper operation.
 - c. Test each drive through specified speed ranges and loads for a minimum of two hours per drive unit.
 - d. Test each drive by using actual control signal for remote and local operation.
 - e. Test each drive alarm function and field devices.
 - f. Verify signals and communication functions with the process control panel.
 - g. Perform other tests recommended by equipment manufacturer.

3. The variable frequency drive manufacturer representative shall coordinate with the pump vendor control technician to ensure proper operation of the pump protective and monitoring devices.

B. Manufacturer Services:

1. Unloading and Installation: Manufacturer's factory-trained representative shall be present during unloading of equipment and installation at equipment's final location. Representative shall train installing personnel in advance in the proper handling and rigging of equipment.
2. Post-installation Check: Manufacturer's factory-trained representative shall check and approve the installed equipment before initial operation. Manufacturer shall calibrate, set and program low-voltage variable frequency drives provided.
3. Manufacturer's factory-trained representative shall test the system as specified in Paragraph 3.3.A of this Section. Representative shall operate and test the system in presence of ENGINEER and verify that equipment is in conformance with the Contract Documents.
4. Representative shall revisit the Site as often as necessary until all deficiencies are corrected, prior to readiness for final payment.
5. Provide services of manufacturer's factory-trained representatives to correct defective Work within 72 hours of notification by OWNER during the correction period specified in the General Conditions as may be amended by the Supplementary Conditions.
6. Replacement parts or equipment provided during the correction period shall be equal to or better than original.
7. Training: Provide services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of equipment.

3.4 ADJUSTING

- A. Immediately prior to Substantial Completion, when testing is acceptably completed and low-voltage variable frequency drives are operating, manufacturer's representative shall return to the Site and make final adjustments as required to each variable frequency drive furnished under this Section.

END OF SECTION

SECTION 16441

PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing panelboards. Panelboards shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The panelboards shall include all power distribution, lighting, appliance and instrument panels.

1.2 RELATED SPECIFICATIONS

- A. Specification 16076 - Labeling and Identification

1.3 PAYMENT

- A. Payment for panelboards shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. Panelboards shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. UL Standard No. 67, Panelboards.
 - 3. UL Standard No. 489, Molded Case Circuit Breakers.
 - 4. UL Standard No. 943, Ground Fault Circuit Interrupters.
 - 5. NEMA PB1, Panelboards.
 - 6. NEMA AB1, Molded Case Circuit Breakers.
 - 7. UL Standard No. 50, Enclosures for Electrical Equipment.

- B. Working Drawings:
 - 1. Manufacturer's technical information for the panelboards proposed for use including all components.
 - 2. A listing of the panelboards with the number and size of circuit breakers identified.
 - 3. Dimensional drawings showing panelboard enclosure details.
 - 4. Panelboard anchorage details with design calculations signed by licensed Engineer.
- C. Certificates of Compliance: Seismic qualification certification from the manufacturer including mounting recommendations.
- D. Reports: Shop test reports shall be submitted.
- E. Operations and Maintenance Manuals shall be submitted in accordance with the Specifications.

1.6 QUALITY ASSURANCE

- A. General:
 - 1. All panelboards shall conform to the applicable NEMA and UL Standards and shall be built by one approved manufacturer who shall use only best commercial materials and processes of manufacture.
 - 2. All panelboards shall be UL listed.
 - 3. The panelboards manufacturer shall use a shop test facility that has recently calibrated testing apparatus and qualified, experienced technicians, for all shop tests. Calibration of testing apparatus shall be within one year.
 - 4. All test equipment and instrument calibration shall be in accordance with the latest edition of the accuracy standard of the U.S. National Institute of Standards and Technology.
- B. The panelboards shall be designed, constructed and installed suitable for earthquake regulations in accordance with the applicable Building Codes and the seismic criteria as shown on the Contract Drawings.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Panelboards shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Panelboards shall be manufactured by Cutler-Hammer, General Electric Company or approved equal.

2.2 PANELBOARDS

A. General:

1. The panelboards shall be dead-front type with automatic trip-free, bolt-on, molded case circuit breakers.
2. The panelboards shall be equipped with main breakers or main lugs, branch circuit breakers, 1-pole, 2-pole and 3-pole, as shown on the Contract Drawings.
3. The panelboards shall be enclosed in flush or surface mounted cabinets as shown on the Contract Drawings.

B. Ratings:

1. Panelboard ampacities, voltage, number of phases and wires shall be as shown on the Contract Drawings. Panelboard frequency shall be 60 Hz.
2. Panelboards shall be labeled with a UL short circuit rating. All panelboards shall be fully rated.
3. Panelboards rated 240VAC or less shall have a short circuit rating of 22,000A RMS symmetrical, unless shown otherwise on the Contract Drawings.
4. Panelboards rated 480VAC shall have a short circuit rating of 65,000A RMS symmetrical, unless shown otherwise on the Contract Drawings.

C. Bus Bars:

1. Bus bars shall be copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.
2. Bus bar taps for single-pole branches shall be arranged for sequence phasing of the branch circuit devices.
3. A bonded ground bus shall be included in all panels.
4. Full-size neutral bars shall be provided for panelboards, unless noted otherwise on the Contract Drawings.

D. Cabinets:

1. Cabinets shall be constructed of 12 gauge galvanized steel with stainless steel hardware. Fronts shall have doors over circuit breakers and trims of proper width. Doors shall be fastened to the trims with concealed hinges and shall be equipped with flush-type catches and locks. All locks shall be keyed alike.
2. Cabinets shall have wiring gutters on the sides. Cabinets shall be at least 5-3/4 inches deep and 20 inches wide for panelboards with maximum branch

circuit breakers of 100A. When branch circuit breakers are above 100A, cabinets shall be at least 9-1/2 inches deep and 31 inches wide.

3. Cabinets shall be NEMA 12 for dry, indoor areas and NEMA 4X for corrosive areas. In hazardous locations, panelboards shall have a NEMA 7 rating.
4. Cabinets shall have identifying nameplates in accordance with the requirements of Specification 16076 - Labeling and Identification.
5. All panelboard directories shall have both the equipment name and the tag identification number. Where this will not physically fit in the standard panelboard directory, an additional expanded directory mounted behind the standard directory shall be supplied containing the above information.

E. Circuit Breakers:

1. Circuit breakers shall be the molded case type conforming to NEMA Standard AB-1.
2. Breakers shall be the bolt-on type with quick-make, quick-break, toggle mechanism for manual as well as automatic operation. Breakers shall have 100 amp frames, with 15 amp trip elements as minimum, unless otherwise shown on the Contract Drawings. All 100 amp frame breakers shall be fixed thermal magnetic trip units. Frame sizes above 100 amp shall have interchangeable thermal magnetic trip units.
3. Where specifically shown on the Contract Drawings or stated in the Specifications, breakers shall be provided with electronic trip units. Electronic trip units shall provide long time, short time, instantaneous and ground fault settings and time adjustments as minimum.
4. Where specifically shown on the Contract Drawings or stated in the Specifications, ground fault circuit interrupters shall be provided. Ground fault breakers shall be equipped with solid state sensing and 5 milliamp sensitivity.
5. Breakers used for lighting circuit switching shall be suitable for the purpose and shall be marked "SWD". Breakers requiring continuous operation shall be provided with a lock-on device.
6. Where specifically shown on the Contract Drawings or stated in the Specifications, shunt trips, bell alarms, and auxiliary devices shall be provided.

F. Directories:

1. Each panel shall be provided with a directory. Panel directories shall be typewritten, and shall have designations of each branch circuit. The directory shall be protected by a glass or noncombustible plastic cover.
2. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service and the number of spares. This directory shall be updated as work

progresses, and final, typewritten directories shall be provided at the end of the Contract.

3. Where execution of the work under this Contract requires certain circuits to be modified, the Contractor shall update the panelboard directories if available to reflect the modifications. Final typewritten directories shall be provided at the end of the Contract.

2.3 PAINTING

- A. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one coat of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a nitro-cellulose enamel lacquer.
- B. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI No. 61.

2.4 SHOP TESTS

- A. Shop tests shall be performed at the panelboard's manufacturer's plant prior to shipment. Shop tests shall demonstrate that the equipment tested conforms to the requirements specified.
- B. Each panelboard shall be given a 60 Hertz, AC, Hi-Pot test, phase to phase and phase to ground, at twice rated voltage plus 1000 volts for one minute, 1500 volts minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Panelboard shall be mounted rigidly and securely to the building structure or to supporting devices which are rigidly and securely supported to the building structure. Anchor panelboards to satisfy seismic requirements in accordance with the anchorage details.
- B. Panelboards shall be fastened with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on metal.
- C. Mount all panelboards parallel or perpendicular to walls, such that panelboards are installed in a neat and professional manner.

- D. All wiring shall be neat within the panelboards. Wires shall be run vertically in the wire gutter and then terminate horizontally at a breaker.
- E. The Contractor shall install blanking devices within panelboard spaces so bus bars are not exposed.
- F. Install panelboard nameplates for identification of equipment.
- G. Panelboard circuits shall be installed so to balance the loads on each of the panelboards.

+ + END OF SECTION + +

SECTION 16442

ELECTRIC CONTROL EQUIPMENT - LOW VOLTAGE AC MOTORS & DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing electric control equipment. Electric control equipment shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.

1.2 PAYMENT

- A. Payment for electric control equipment shall be made as provided in the Specifications.

1.3 REFERENCES

- A. Electric control equipment shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electrical Code.
 - 2. UL Standard No. 98, Enclosed Switches.
 - 3. UL Standard No. 508, Industrial Control Equipment.
 - 4. NEMA Standard KS-1, Enclosed Switches.
 - 5. NEMA Standard ICS, Industrial Control and Systems, General Requirements.
 - 6. NEMA Standard ICS 2, Industrial Control and Systems, Controllers, Contactors and Overload Relays.
 - 7. NEMA Standard ICS 5, Industrial Control and Systems, Control Circuit and Pilot Devices.
 - 8. NEMA Standard ICS 6, Industrial Control and Systems, Enclosures.

1.4 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.

- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with products they produce proposed for the contract.
 - 2. Manufacturer's catalog cuts, technical information and enclosure details for the electric control equipment.
- C. Operations and Maintenance Manuals shall be submitted in accordance with the Specifications.

1.5 QUALITY ASSURANCE

- A. Unless otherwise shown on the Contract Drawings, stated in the Specifications or directed by the standards and codes referenced under this section, the Contractor shall provide for each low voltage motor or other power device, complete equipment for starting and control.
- B. The starting and control equipment shall be provided with features of protection, current limitation and functioning and be complete with all accessories, appurtenances and supporting structures.
- C. Control equipment shall be UL listed and properly designed with relation to the characteristics of operation of the motor and device controlled.
- D. Unless otherwise shown on the Contract Drawings or stated in the Specifications, each motor shall be provided with control equipment consisting of apparatus as follows:
 - 1. Motors of 1/4 HP or less may, in the absence of other requirements, shall be controlled by a manual motor starter having thermal overload protection at all times.
 - 2. Motors larger than 1/4 HP shall be controlled by a magnetic motor starter.
- E. Each motor shall include overload protection based on latest standards.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Electric control equipment shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

1.7 SPARE PARTS

- A. The Contractor shall furnish and deliver to the Engineer, at that part of the site and at such time as the Engineer may direct, spare parts for the electric control equipment in accordance with the Specifications.

- B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.
- C. The following spare parts shall be furnished to the extent applicable:
 - 1. One (1) set of contact tips, shunts and coils shall be provided for each 6 or less of each size motor starter.
 - 2. One (1) auxiliary contact unit or one set of auxiliary contact tips shall be provided for each 6 or less motor starter.
 - 3. Two (2) sets of arc chutes shall be provided for each type and rating of magnetic contactor.
 - 4. One (1) timing relay shall be provided of each type installed as part of control equipment installation.
 - 5. One (1) complete auxiliary relay shall be provided of each type installed as part of control equipment installation.
 - 6. One (1) control transformer shall be provided of each rating and type installed as part of control equipment installation.
 - 7. Two (2) complete fuse replacements shall be provided of each rating and type installed as part of control equipment installation.

PART 2 - PRODUCTS

2.1 SWITCHING DEVICES

- A. Switching devices shall be provided in accordance with the details shown on the Contract Drawings. The switching devices required under this section shall be the disconnect switch and circuit breaker types.
- B. Switching devices shall be enclosed in NEMA type enclosures in accordance with the requirements specified under Article 2.5.
- C. Disconnect switch type switching devices shall be in accordance with the following:
 - 1. Switches shall be heavy duty type with number of poles, voltage and current ratings as shown on the Contract Drawings.
 - 2. Switches shall be capable of interrupting the full rated current at full rated voltage. Where specifically shown on the Contract Drawings, disconnect switches shall be complete with fuses.
 - 3. Switches shall be the quick make and quick break type covered with an arc resisting barrier. The switch shall be provided with provision for locking in either open or closed position. The ratings shall be as follows:

Motor Horsepower

<u>Switch Rating in Amperes</u>	<u>208-240 v.</u>	<u>480v.</u>
60	Over 5 to 15	Over 5 to 30
100	Over 15 to 25	Over 30 to 60
200	Over 30 to 50	Over 60 to 125
400	Over 50 to 75	Over 125 to 200

- D. Circuit breaker type switching devices shall be in accordance with the following:
1. Circuit breakers shall be the molded case type with number of poles, voltage and current ratings as shown on the Contract Drawings.
 2. Breakers shall be manually operated thermal magnetic type, including inverse-time overload and instantaneous short-circuit protection. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes.
 3. Breakers shall have 100 amp frames as a minimum. Overload protection shall be provided on all poles, with trip settings as shown on the Contract Drawings. Breakers with frame sizes 225 amp or larger shall have interchangeable trip units and adjustable magnetic trip elements.
 4. Breakers shall be operated by a toggle-type handle and shall have a quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Breaker enclosure shall be equipped with an external lockable handle with provision for locking in the closed or open position.
 5. Where specifically shown on the Contract Drawings or stated in the Specifications, breakers shall be provided with electronic trip units. Electronic trip units shall include long time, short time, instantaneous and ground fault settings as minimum.
 6. Where specifically shown on the Contract Drawings or stated in the Specifications, breakers shall be provided with shunt trips, bell alarms and auxiliary devices.
- E. Switching devices shall be by Cutler-Hammer, General Electric Company or approved equal.

2.2 MAGNETIC MOTOR STARTERS

- A. Magnetic motor starters shall be provided complete with fused control power transformer, pilot devices, auxiliary contacts and accessories as shown on the Contract Drawings or stated in the Specifications.
- B. Magnetic motor starters shall be enclosed in NEMA type enclosures in accordance with the requirements specified under Article 2.5. The starter shall be combination type. The enclosure shall be equipped with an external operable,

pad lockable handle, arranged so that it is impossible to open the door unless the breaker is open.

- C. The starter shall be magnetic coil operated, and shall include a magnetic only motor circuit protector with trip unit range adjustable from 700 to 1300 percent of full load. The combination starters shall be suitable for interrupting 65,000 amps through 480 volts.
- D. Magnetic contactors shall be 3 pole, single throw, 110-550 volt, ac, 60 cycles with auxiliary contacts for under-voltage protection. Contactors shall be mounted upon steel bases with insulated mountings or upon bases of insulating material. Contactors shall be provided with necessary barriers and arc chutes.
- E. Contactors shall be NEMA rated as follows:

<u>Motor Horsepower</u>		
<u>NEMA Size of Contactor</u>	<u>208-240v.</u>	<u>480v.</u>
1	1/4 to 7-1/2	1/4 to 10
2	over 7-1/2 to 10	over 10 to 25
3	over 15 to 25	over 25 to 50
4	over 30 to 40	over 50 to 100
5	over 50 to 75	over 100 to 200

- F. Contactors in Sizes 1 through 4 shall have double break, silver to silver main contacts. Contactors in Size 5 shall have silver plated tips which close with rolling action and which have self-aligning and self-cleaning features. Auxiliary and interlocking contacts for all sizes shall be of the silver button type. All contact tips shall be easily renewable. Flexible shunts shall be tinned copper braid or tinned extra flexible copper cable.
- G. Thermal overload relays shall be of the ambient compensated bi-metallic type with separate interchangeable heaters and manual reset feature. Relay shall include a normally open auxiliary contact for remote alarm purposes. Heaters for overload relays shall be selected to match full load currents of the motors to allow motor operation at maximum safe loads without damage to equipment. Full load current data shall be obtained from nameplates of motors actually installed.
- H. Pilot devices shall be heavy duty type, rated 10 amp continuous. Pushbuttons, selector switches, indicating lights, and other devices shall be located on the starter enclosure. Indicating lights shall be push-to-test, transformer type with 12 volt secondaries.

- I. Relays shall be standard, latching type and pneumatic or solid state time delay type. Relays shall be provided with contacts rated 10 amp with number as required.
- J. Special overload protection shall be provided where definite purpose motors cannot be protected by standard thermal overload relay applications.
- K. Magnetic motor starters shall be by Cutler-Hammer, General Electric Company, Furnas Electric Company or approved equal.

2.3 MANUAL MOTOR STARTERS

- A. Manual motor starters shall be provided complete with pilot devices as shown on the Contract Drawings or stated in the Specifications.
- B. Manual motor starters shall be enclosed in NEMA type enclosures in accordance with the requirements specified under Article 2.5.
- C. Manual motor starters shall be toggle operated, NEMA horsepower rated, single phase type with thermal overload protection unless shown otherwise on the Contract Drawings or stated in the Specifications. Pilot devices when required shall be in accordance with the requirements specified under Article 2.2.
- D. Where shown on the Contract Drawings, manual motor starters shall be 600 volt, three phase type without overload protection for use as manual starting disconnect switches. The switches shall be NEMA size 0 or 1 horsepower rated, as required for the application intended.
- E. Manual motor starters shall be by Cutler-Hammer, General Electric Company, Furnas Electric Company or approved equal.

2.4 CONTROL STATIONS

- A. Control Stations shall be provided in accordance with the following:
 - 1. The sewage pump control stations shall be emergency stop type. Emergency stop stations shall be push-pull type with maintained contacts, one normally open and one normally closed.
 - 2. The grinder control stations shall include an emergency stop, push pull type with maintained contacts and a start pushbutton momentary type.
- B. Control Stations shall be enclosed in NEMA type enclosures in accordance with the requirements specified under Article 2.5.

- C. Control stations shall be industrial, heavy duty, oil tight construction with clearly marked legend plates. Stations shall have operating devices as shown on the Contract Drawings.
- D. Contact ratings shall be 10 amp minimum. All indicating lights shall be transformer type with 6 volt lamp, lens color shall be as shown on the Contract Drawings.
- E. Control stations shall be by General Electric Company, Furnas Electric Company, Cutler-Hammer, or equal to be approved by the Engineer.

2.5 ENCLOSURES

- A. Enclosures shall be provided for the electric control equipment. Enclosures located indoors in dry, dusty areas shall be gasketed and shall be constructed of 14 gauge sheet steel. Cabinet type enclosures shall include hinged and gasketed front doors.
- B. Enclosures shall be provided in accordance with NEMA requirements as required for the area classifications indicated on the Contract Drawings.
- C. For dry, dusty locations, enclosures shall meet NEMA 12 requirements. For wet and corrosive locations, enclosures shall meet NEMA 4X requirements. NEMA 4X enclosures shall be fabricated from 316 stainless steel.
- D. Unless specifically noted otherwise on the Contract Drawings or stated in the Specifications, enclosures within hazardous locations shall meet Class 1, Division 1, Group D requirements. Hazardous enclosures shall be fabricated from cast metal.

2.6 DOCKING STATIONS

- A. The Contractor shall provide a docking station for connection of a portable generator as shown on the Contract Drawings.
- B. Docking station shall be UL and ETL listed suitable for 480 Volt, 3 phase operation with a 1600 ampere continuous rating and a 65KA short circuit rating.
- C. Docking station enclosure shall be free standing aluminum construction rated NEMA 3R. Enclosure shall include a pad lockable door and removable panels suitable for bottom conduit entry with access to terminations.
- D. Docking station shall be equipped with silver plated copper bus bars, male camlock panel mounts with protective covers and mechanical lugs terminations,

phase and ground sufficient for the quantity and size of cables shown on the Contract Drawings.

- E. The portable generator docking station shall include a phase rotation monitor.
- F. Docking stations shall be manufactured by Trystar Incorporated or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment shall be mounted so that sufficient access and working space is provided for ready and safe operation and maintenance.
- B. Equipment shall be securely fasten to walls or other surfaces on which they are mounted. Independent supports shall be provided where no wall or other surface exists.
- C. Electric control equipment shall be installed in conformance with and the National Electrical Code.

+ + END OF SECTION + +

SECTION 16511

LIGHTING FIXTURES
AND DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for providing lighting fixtures and devices. Lighting fixtures and devices shall be provided in accordance with the requirements specified under this section, the Specifications and the Contract Drawings.
- B. The lighting system shall be complete and include all luminaires, devices and accessories as required for the installation of the lighting fixtures and devices.
- C. The following index of this Specification is presented for convenience.

<u>Article</u>	<u>Title</u>	<u>Page</u>
		16511-
PART 1	GENERAL	
1.1	Section Includes	1
1.2	Related Specifications	2
1.3	Payment	2
1.4	References	2
1.5	Submittals	2
1.6	Quality Assurance	3
1.7	Deliver, Storage and Handling	4
PART 2	PRODUCTS	
2.1	Light Fixtures	4
2.2	LEDs and Drivers	5
2.3	Receptacles and Switches	5
PART 3	EXECUTION	
3.1	Installation of Luminaires	7
3.2	Installation of Devices	7
3.3	Field Tests	8
3.4	Cleaning of Luminaires	8

1.2 RELATED SPECIFICATIONS

- A. Specification 16076 - Labeling and Identification
- B. Specification 16131 - Electric Conduit System

1.3 PAYMENT

- A. Payment for lighting fixtures and devices shall be made as provided for in the Specifications.

1.4 REFERENCES

- A. Lighting fixtures and devices shall comply with the latest applicable provisions and recommendations of the following:
 - 1. NFPA 70, National Electric Code.
 - 2. UL Standard No. 20, General Use Snap Switches.
 - 3. UL 844, Luminaires for Use in Hazardous (Classified) Locations.
 - 4. UL Standard No. 924, Emergency Lighting and Power Equipment.
 - 5. UL 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
 - 6. UL 1598, Safety of Luminaries.
 - 7. UL-8750 LED Equipment used in Lighting Products.
 - 8. LM-79, IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 - 9. LM-80, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - 10. NEMA SSL-1, Electronic Drivers for LED Devices

1.5 SUBMITTALS

- A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article GC-14 – Contractor Submissions; and as specified under Division 1 of the Specifications.
- B. Working Drawings:
 - 1. Prior to equipment submission, submit a list of proposed manufacturers with the products they produce proposed for the contract.
 - 2. Manufacturer's catalog cuts and drawings showing all technical information, and construction details for lighting fixtures.

3. Test data photometric data, fixture IES lighting classification, and isolux diagram developed for each fixture type.
4. Lamp type and technical information.
5. Technical information including power factor, input watts and amperes.
6. Scaled working drawings showing the locations of all fixtures and devices. The Drawings shall include the proposed routing of the branch circuits.

C. Reports:

1. Field test reports shall be submitted.

D. Operations and Maintenance Manuals shall be submitted in accordance with the Specifications.

1.6 QUALITY ASSURANCE

A. General:

1. Lighting fixtures shall be UL listed. The lighting fixture types are noted within the fixture schedule. The descriptions and catalog numbers serve to establish the quality, appearance and performance of the specified lighting fixtures.
2. All lighting fixtures shall be the products of lighting equipment manufacturers who have previously demonstrated, by performance and reputation, the ability to manufacture products of the quality specified. Such manufacturers must maintain an organization and manufacturing facility capable of actually manufacturing the specified lighting fixtures. For the purpose of inspection, Contractor shall assure the Engineer, free and easy access to the manufacturing facilities and inventories of any manufacturer whose equipment the Contractor proposes to supply.
3. The Contractor shall be responsible to assure that the exact inscription for exit and stairway signs required by local code is checked against that specified, prior to providing same. The Engineer shall be advised of any changes required to conform to local codes before such changes are affected.
4. The Contractor shall be responsible for reviewing all drawings and coordinating with all trades the installation of lighting fixtures and devices. The lighting fixture and device finishes and construction shall be compatible with the wall and ceiling types based upon the Contractor's review of all drawings.
5. All industrial fixtures shall be of the highest quality material and construction for their respective types.
6. Fixtures shall be suitable for connection to concealed or exposed conduit runs as required in each particular location and shall be of sizes suitable for lamp sizes indicated on the Contract Drawings.

8. Fittings and other materials for special fixtures not definitely shown or specified shall be of approved material, make and quality and shall have a finish that will harmonize with other parts of the fixtures. Where suitable standard materials are not available such parts of the fixtures shall be specially manufactured.

B. Field Testing:

1. The lighting fixtures shall be field tested. The field testing shall be performed in accordance with the requirements specified under Article 3.3.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Lighting fixtures and devices shall be delivered, stored and handled in accordance with the Specifications and the manufacturer's instructions.

PART 2 - PRODUCTS

2.1 LIGHT FIXTURES

- A. A lighting fixture shall be provided for each fixture symbol shown on the Contract Drawings. Light fixtures shall be provided in accordance with the lighting fixture schedule shown on the Contract Drawings.
- B. Fixtures located in hazardous locations shall be listed in accordance with UL 1598 and UL 844 and be approved as a complete assembly, shall be clearly marked to indicate maximum wattage of lamps for which they are approved, and be protected against physical damage by suitable guards.
- C. Light fixtures shall be provided with all necessary hangers, supports, conduit adaptors, reducers, hooks, brackets and other support hardware. All hardware shall have a protective, non-corrosive finish.
- D. Pendant fixtures shall be suspended by means of an enclosed and gasketed cushion type hanger. The hanger shall be suitable to be mounted directly to the fixture outlet box and shall provide a minimum of 8 degrees swing from the vertical. Fixture stems shall be threaded rigid metal conduit, 1/2 inch minimum size. In corrosive areas stems shall be PVC coated.
- E. Where fixtures are subjected to moisture, or assembled of dissimilar metals, gaskets of approved material and thickness shall be provided.

- F. Fixtures shall be completely wired except where they will be directly connected to branch circuit wiring. The conductors shall be not less than No. 12 gauge, stranded, with approved heat resistant covering.
- G. Mounting heights of all fixtures shall be as shown on the Contract Drawings. For special types, the height shall be determined at the time of installation.

2.2 LEDs AND DRIVERS

- A. LED Lamps shall have voltage ratings suitable for the voltages shown on the Contract Drawings.
 - 1. LED diodes shall be acceptable for use in the luminaires that it was designed, tested and listed for.
 - 2. Individual LED Diodes shall be designed such that failure of one LED will result in the loss of only the damaged LED. A loss of a single LED shall be isolated to prevent cascading failures.
 - 3. The LED light source shall be comprised of LED modules connected to an integrated driver.
- B. LED Drivers shall be compatible with LED light sources with rated output voltage and maximum output power suitable for the LED's.
 - 1. Driver efficiency shall be greater than ninety percent at full load, at 25 degrees Celsius.
 - 2. Driver shall have an operating ambient temperature range suitable for operation in the ambient temperature typically found for the intended installation.
 - 3. Driver shall have a life expectancy consistent with the life expectancy of the LED's.

2.3 RECEPTACLES AND SWITCHES

- A. General:
 - 1. Receptacles and switches shall be provided in accordance as shown on the Contract Drawings. The receptacles and switches shall be complete and shall include all accessories for proper installation.
 - 2. Outlet boxes for receptacles and switches shall be in accordance with Specification 16131 - Electric Conduit System.
- B. Receptacles:
 - 1. Receptacles shall be duplex grounding type, two pole, three wire, 125 volt AC, 15 ampere. Where shown on the Contract Drawings, other special receptacles with number of poles, voltage and current rating shall be provided. Matching plugs shall be provided for each special receptacle.

2. Receptacles for indoor dry, dusty locations shall be heavy duty, straight blade type, with reinforced polyester base and impact resistant nylon face.
3. Receptacles for wet and corrosive locations shall be marine duty, straight blade type, with heat resistance melamine body. Special receptacles in wet and corrosive locations shall be Type 316 stainless steel.
4. Receptacles for hazardous locations shall conform to UL 1010, factory-sealed suitable for installation in Class I, Group D hazardous locations. Material shall be copper-free aluminum receptacle and cover with cast gray iron alloy or cast malleable iron mounting box with zinc electroplate finish. Receptacle rated at 20 amperes, 125 to 250 volts AC, two-wire, and three-pole. Provide a matching plug for each receptacle located in a hazardous location.
5. Ground fault interrupting receptacles shall be two pole, three-wire, 120 Volt, AC, 20 ampere with ground fault protection complying with UL 943.
6. Receptacles shall be by Hubbell Incorporated, Arrow-Hart Incorporated or approved equal. Receptacles for hazardous locations shall be Series CPS by Crouse-Hinds Company or Type CPS by Appleton Electric Company or approved equal.

C. Switches:

1. Switches shall be industrial-heavy duty, AC toggle, quiet type. Switches shall be rated 120/277 volt, 20 ampere. Poles and switching shall be as shown on the Contract Drawings.
2. Switches for hazardous or corrosive locations shall be factory sealed tumbler type. The switch body and cover shall be cast gray iron alloy or cast malleable iron with zinc electroplate finish.
3. Switches shall be by Hubbell Incorporated, Arrow-Hart Incorporated or approved equal. Hazardous or corrosive located switches shall be by Crouse-Hinds Company, Appleton Electric Company, or approved equal.

D. Plates and Covers:

1. Stainless steel plates shall be furnished for devices in indoor dry, dusty locations. They shall have beveled edges and shall be made of Type 302/304, stainless steel.
2. Plates shall have satin finish. Attachment screws shall have matching head finish.
3. For wet and corrosive locations neoprene gasketed covers shall be used. Covers shall be galvanized ferrous or cast ferrous metal. Covers shall be PVC-coated in corrosive locations. Covers shall be equipped with gasketed spring doors for receptacles and an external operating mechanism for switches.
4. Plates shall be by Hubbell Incorporated, Arrow-Hart Incorporated or approved equal. Covers shall be by Crouse-Hinds Company, Appleton Electric Company, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF LUMINAIRES

- A. Luminaires shall be installed at locations shown on the Contract Drawings. Luminaires locations shall be adjusted where necessary to clear conflicts and obstructions.
- B. All luminaires shall be installed complete with all hardware, and supporting devices necessary to make a safe complete and fully operative installation. The Contractor shall obtain from the manufacturer for each lighting fixture, diagrams, illustrations and other installation instructions. The Contractor shall install in strict conformance with such instructions and the requirements of NFPA 70 National Electrical Code.
- C. LED fixtures shall be installed in conformance with manufacturer's recommendations and to suit the architectural details of the area involved. Independent supports from structural members of the building shall be provided. Unless otherwise shown on the Contract Drawings or stated in the Specifications, every fluorescent fixture shall have at least two supports, and continuous lines of LED fixtures shall be supported at 4 foot intervals,
- D. Pendant mounted fixtures shall be installed with pendants 1/2 inch for stems up to 5 feet and 3/4 inch for longer lengths.
- E. All pendant stem hangers shall be furnished with suitable aligner canopies or outlet box covers so that the lighting fixtures hang vertical to the finished floor irrespective of the angle of the surface from which they are suspended. When lighting fixtures or hanger canopies are mounted flush to the ceiling or wall, and where raceways and outlet boxes serving the lighting fixtures are surface mounted to the ceiling or wall, finishing rings shall be provided to conceal the outlet box. All visible hanging devices and appurtenances shall have the same finish as the lighting fixture.

3.2 INSTALLATION OF DEVICES

- A. Receptacles and Switches:
 - 1. Receptacles and switches shall be installed within outlet boxes at locations indicated on the Contract Drawings and in accordance with code requirements.

2. Receptacles located indoors shall be mounted 2 feet above the finished floor, except in hazardous and outdoor locations where receptacles shall be mounted 4 feet-6 inches above the finished floor, unless noted otherwise.
3. Switches shall be mounted 4 feet 6 inches above the finished floor.
4. Where devices are grouped they shall be mounted under a common plate. Where directed or where space conditions limit gang mounting, tandem or tandem gang arrangement shall be provided.
5. Where four or more switches controlling fixtures that are not visible from the switch location are grouped, the switch plate shall be engraved and filled with colored material or otherwise suitably marked to designate the control of each switch.

3.3 FIELD TESTS

- A. After installation, the completed lighting system and receptacle devices shall be field tested for operation and conformance. The field tests shall be witnessed by the Engineer and certified by the Contractor. The Contractor shall provide testing consisting of the following:
 1. Wiring continuity test shall be performed.
 2. Branch circuit load balance test shall be performed.
 3. Fixture and control operation test shall be performed.
 4. Receptacle polarity, grounding and operation shall be performed.
- B. The Contractor shall provide a field test report. The report shall identify the test performed and the results obtained.

3.4 CLEANING OF LUMINAIRES

- A. Luminaires shall be cleaned inside and out to remove construction dust prior to substantial completion.

+ + END OF SECTION + +

SECTION 16720

FIRE PROTECTION AND ALARM

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope :

1. Contractor shall provide all labor, materials, equipment and incidentals shown, specified and required to design, furnish, install, calibrate, test, adjust and place into satisfactory operation a fire protection and alarm system.
2. Contractor shall retain the services of a designer/installer regularly engaged in the installation of fire alarm systems to design and install the fire alarm system in accordance with requirements of federal, state, and local codes and standards.
3. Permits and Inspections: Contractor shall be responsible for the following:
 - a. Preparation and submission of plans for permitting to the Authority Having Jurisdiction (AHJ).
 - b. Obtaining and paying associated fees of all permits required.
 - c. Arranging and coordinating inspections of the installation at the times and stages of construction required by the AHJ.
 - d. Arranging and coordinating the final inspection and acceptance testing of the system by the AHJ.
 - e. Obtaining the final inspection permit.
4. A fire alarm system is required in the Electric Building.

B. System Description and Requirements:

1. The basic design shall be an addressable system that will include initiation and notification devices as required for proper fire protection and alarming. The design shall provide 100% detection coverage through each specified area.
2. The system shall include a single Fire Alarm Control Panel, (FACP) located in the Electric Building that shall provide system monitoring, control and notification. System initiation and notification devices are not shown on the Drawings but shall be provided for proper coverage of the building.
3. Products listed in Part 2 of this specification are general features normally encountered with desired options. CONTRACTOR shall coordinate the location and types of the devices required with the actual areas to be protected and select the devices that are most appropriate for the actual conditions where the devices will be used.

1.2 QUALITY ASSURANCE

A. General:

1. It is the intent of these Specifications to provide a complete fire alarm system that complies with the requirements of all applicable federal, state, and local codes and standards. Equipment, materials, software, installation practices, etc. that do not meet these requirements or do not meet the performance standards herein specified shall not be acceptable.
2. All references to model numbers and other pertinent information herein is intended to establish the standards of performance, quality and appearance, and is based upon equipment already designed and manufactured.

B. Supplier:

1. In order to insure standardization, proper interfacing and compatibility, it is required that all equipment offered under this Section shall be furnished by a single supplier. The supplier shall provide all equipment required for a proper installation and shall coordinate all design and shop drawings.
2. All items of equipment, including wire and cable, shall be compatible.
3. Supplier shall have and maintain an adequate service organization or service representatives located within 200 miles of the project site knowledgeable in the maintenance and installation of equipment required.

C. Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified.

1. National Fire Protection Association.
2. National Electrical Code.
3. National Electrical Manufacturer Association.

1.3 SUBMITTALS

A. Shop Drawings:

1. Manufacturer's literature, illustrations, specifications and engineering data including: general arrangement, outline drawings, dimensions, materials, size, and performance data.
2. Riser diagram showing the system devices including the wiring of devices and power supply to the fire alarm control panel.
3. Fabrication, assembly, and installation drawings. Operation and maintenance data.
4. Spare parts and maintenance materials.
5. Design drawings and calculations prepared by designer/installer shall be submitted to Engineer for review and approval prior to submission to AHJ and prior to proceeding with work.

B. The design calculations and design drawings for the fire alarm system shall be prepared under the direction of a Professional Engineer or Architect registered in the state where the work is located.

- C. All design drawings and the first sheet of calculations shall bear the professional's seal and signature.
- D. The design drawings shall be prepared in sufficient detail that all fire alarm system components are clearly defined and located.
- E. The design drawings shall show the following:
 - 1. Complete point-to-point connection and riser diagrams clearly labeling all interconnected components, conduit and wire.
 - 2. Component locations superimposed on project plan drawings.
- F. Field Inspections:
 - 1. Submit copies of the signed, approved permit forms following each inspection by the AHJ.
- G. Provide Operation and Maintenance manuals.
- H. Provide a list of spare parts recommended by the manufacturer. The list shall describe each part, quantity recommended and the unit price of each part.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Manufacturers:
 - 1. Simplex.
 - 2. Cerberus, Division of Siemens Fire-Lite Co.
 - 3. Or equal.
- B. Fire Alarm Control Panel (FACP):
 - 1. General: The FACP shall provide power, annunciation, supervision and control for initiating devices and notification devices. The FACP shall also provide alarm and trouble reporting.
 - 2. All external circuits shall be listed as power limited circuits per Article 760 of The National Electric Code.
 - 3. The FACP shall be modular in construction, and contain all modules necessary to operate according to applicable codes and standards, this Section and the Drawings.
 - 4. The FACP shall operate from a 120 Vac single phase power supply.
 - a. Provide internal standby power supply.
 - 1) The standby power shall be capable of powering the system for 24 hours in a quiescent state and then providing at least 5 minutes of full scale alarming.

- 2) Provide charger and monitoring for the standby power system
6. The FACP shall provide supervision of system electronics, wiring, initiation devices, notification devices, software and support of specified features.
 - a. Failure of system hardware or wiring shall be indicated by a trouble indication on the FACP.
 - b. Software and processor operation shall be monitored by an independent hardware watchdog, which will indicate their failure. Each processor in the system shall have its own hardware watchdog circuitry.
 - c. Ground fault detection shall be provided for all system circuits.
 - d. Support for addressable analog detectors and other addressable initiating devices.
 - e. Support for addressable notification devices.
 - f. Alarm verification programmable on a device-by-device basis.
 - g. "Almost" dirty detector reporting.
 - h. Peak value logging (by device).
 - i. Automatic drift compensation of detectors.
 - j. Event history: shall store alarm, supervisory and trouble information.
 - k. Subsequent alarm and trouble annunciation with reminder of acknowledged or silenced conditions.
 - l. One person test feature allowing one individual to test the devices in the system.
 - m. The FACP shall have the ability to bypass a zone, an initiating device, or an output through programming. There shall be a separate indication to show that part of the system has been bypassed.
7. FACP user interface:
 - a. Light emitting diodes (LED's) shall indicate system power, alarm, supervisory/trouble, part of system bypassed, and Test/Program mode.
 - b. An LCD display shall display system messages and also allow for display of custom label information as it relates to system messages.
 - c. Switches for Alarm acknowledge, Alarm silence, System reset and a System drill function.
8. FACP Enclosure:
 - a. FACP enclosure shall be designed to accommodate the control unit, input and output modules, power supplies and all other components utilized in the system.
 - b. Enclosure shall be suitable for surface mounting unless noted or shown otherwise on the Drawings.
 - c. Enclosure shall consist of a back box and door cover assembly fabricated of sheet steel.
 - d. Door cover shall be mounted with a sag resistant, steel piano hinge and fitted with a key locking arrangement.
 - e. Door cover shall contain viewing slots to permit viewing of the user interface.
9. Support modules: The following modules shall be available for use as required:

- a. Relay output modules: Form "C" relays for programmable outputs such as fire alarm and trouble outputs.
 - 1) Contacts shall be rated at 120 Vac, 3 amp. The relay coil shall be supervised.
 - b. Relay input module: The module shall accept dry contact inputs from remote sources. Action taken upon receipt of contact change of state shall be programmable.
- C. Horn/Strobe:
 - 1. Operates from 24 vd-c power supply.
 - 2. Die cast metal housing.
 - 3. Textured red enamel finish.
 - 4. Sound output 99 dBA at 10 feet.
 - 5. White polycarbonate lens, with red "FIRE" lettering, to protect strobe circuitry.
 - 6. Strobe shall produce 8000 peak candlepower at approximately 1 flash per second.
 - 7. Horn/strobes shall be of sufficient quantity and locations so that an alarm shall be clearly visible and audible to all occupants of the building(s) regardless of where occupants are at (including bathrooms).
- D. Manual Pull Station:
 - 1. Molded polycarbonate with red matte finish. Raised molded lettering highlighted in white.
 - 2. Alarm switch resetting requires opening front cover. Cover shall be hinged to backplate assembly and locked by allen head screw.
 - 3. Normally open SPST switch.
 - 4. Weather proof gasket, as required.
 - 5. Manual Pull Stations shall be of sufficient quantity and locations to make the buildings be in conformance with applicable codes and standards.
- E. Area Smoke Detectors
 - 1. Photo-electric type surface mounted
 - 2. Listed per UL268A.
 - 3. Contacts and Ratings: two Form C, 120 Vac, 1 ampere and 30 Vac/dc, 2 ampere; and one Form A, 30 Vac/dc, 2 ampere.
 - 4. Provide with electrical outlet box and all mounting accessories, 120 Vac wiring kit.
 - 5. Provide subbase and all other accessories required for a functioning detector.
 - 6. Area Smoke Detectors shall be of sufficient quantity and locations so to make the buildings be in conformance with applicable codes and standards.
- F. Heat Detectors:

1. Heat detectors shall be fixed temp and/or 135°F rate compensation/fixed temperature thermistor element detector. Unit shall be UL for a maximum coverage area of 2,500 sq. ft. Rate-of-rise alarm threshold rate shall be 15°F per minute. Activation of this rate-of-rise heat detector shall be self restoring. All detectors shall be addressable and have a white finish. The thermal detectors shall be individually annunciated on the control panel. Thermal detectors shall contain an integral alarm lamp. The detector's address shall be set by electronic means only, no mechanical means such as programming pins, dipswitches or rotary dials shall be used.
- G. Intelligent/Analog Heat Detectors quantity and locations shall be as deemed appropriate for areas subject to corrosive or dusty conditions that considerably shorten the life of smoke detector elements.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install fire alarm system devices so that they are accessible and in accordance with the approved Shop Drawings and the manufacturer's recommendations.
- B. Install all conduit and cable required for the complete system. Provide pull and junction boxes as required.
- C. Bond metallic conduits entering non-metallic enclosures to a ground terminal within the enclosure.

3.2 FIELD QUALITY CONTROL SERVICES

- A. Required Suppliers Services:
 1. Retain a qualified representative of the Supplier to assist in the installation of the equipment, check the installation before it is placed into operation, assist in the completion of performance tests, supervise the initial operations, and instruct the Owners personnel in the proper care, operation and maintenance of the equipment.
 2. Suppliers representative shall make visits to the site as necessary to perform the specified services. Perform site visits to check the completed installation, to complete performance tests, and supervise initial operations. An additional site visits shall be to instruct the Owners personnel in the proper care, operation and maintenance of the equipment.
 3. The Supplier's representative shall revisit the site as often as necessary until all deficiencies are corrected, at no additional cost to Owner.
- B. Startup and Performance Tests:

1. After Contractor and Engineer have mutually agreed that the equipment installation is complete, Contractor and Suppliers representative shall conduct performance tests of the fire alarm equipment and appurtenances in the presence of the Engineer as follows:
 - a. Verify that the entire installation has been made in accordance with the approved shop drawings, and that the fire alarm system is ready for total operation.
 - b. Verify the operation of devices, alarms and communications.
 - b. Adjust and leave equipment in proper working order.
- C. Contractor shall make available to Owner a local service department of a duly authorized distributor of the equipment supplier which shall stock the supplier's standard parts.
- D. Contractor shall provide a service and maintenance agreement. On-the-premises maintenance parts, and labor, shall be provided during normal working hours at no cost to the Owner for a period of twelve months. Said period shall start upon Owner's acceptance of entire fire alarm system.
- E. Instruction of Owner's Operations and Maintenance Personnel:
 1. After equipment is fully operational, and before Owner will assume responsibility for the operation of the equipment, the Suppliers representative shall instruct the Owner's operation and maintenance personnel in the proper care, maintenance and operation of the equipment.
 2. Instruction course shall include a combination of classroom and hands on training in the field. Training sessions shall be held as follows:
 - a. Operations Personnel Training: 2 sessions, 1-hour each.
 - b. Maintenance Personnel Training: 2 sessions, 1-hour each..
 3. Contractor shall coordinate the specific time and location for each training session with the Owner.
 4. All instruction courses may be video-taped by Owner at Owners expense.
- F. Supplier's Installation Report:
 1. Prepare Supplier's installation report and submit within 30 days after completion of performance testing and instruction of Owner's personnel. The report shall include the following:
 - a. Supplier's Installation Certification for each product specified in Part 2.
 - 1) Description of installation deficiencies found and corrective actions taken.
 - 2) A certificate from the Supplier stating that the installation is satisfactory and is ready for its intended operation.
 - b. Suppliers Performance Testing Reports:
 - 1) Description of performance test procedures.
 - 2) Copies of performance test results.

- c. Suppliers Training Certifications
 - 1) Names of Owner's personnel who attended the training sessions.
 - 2) Record copy of all materials and handouts used in the training sessions including an outline summary of the course.

END OF SECTION