

**FOR INFORMATIONAL USE ONLY-DO NOT USE TO SUBMIT A BID  
BID FORM**

**CEDAR CREEK WPCP FUEL SHUTOFF AND  
 EMERGENCY STOP  
 CONTRACT NO. S3C067-15G**

NAME OF BIDDER: \_\_\_\_\_

TO BE COMPLETED BY BIDDER SUBMITTING BID ON  
 CEDAR CREEK WPCP FUEL SHUTOFF AND EMERGENCY STOP  
 CONTRACT NO. S3C067-15G

ITEM NO.	TYPE	DESCRIPTION		
1	Base Bid (Lump Sum)	LUMP SUM PRICE for furnishing all labor, equipment, materials, supervision and incidentals necessary to complete the work and make ready for operation.		
G-A-1	Allowance	Allowance, for identifying, testing, removing, and disposing of hazardous materials.	\$ 50,000	
G-A-2	Allowance	Allowance, for unforeseen conditions not specifically characterized in the Contract Documents but required to complete the project.	\$ 80,000	

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**NOTE TO BIDDER:** Include a separately sealed envelope containing a list of all subcontractors the bidder will use to perform (a) plumbing and gas fitting, (b) heating, ventilating and air conditioning, and (c) electric wiring and standard illuminating fixtures; and the respective agreed-upon amount to be paid to each subcontractor. Write on the outside of the envelope the bidder's name, the contract number, and the words List of Subcontractors.

**NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS  
CEDAR CREEK WATER POLLUTION CONTROL PLANT  
FUEL SHUTOFF AND EMERGENCY STOP**

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**NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS  
CEDAR CREEK WATER POLLUTION CONTROL PLANT  
FUEL SHUTOFF AND EMERGENCY STOP**

**TECHNICAL SPECIFICATIONS  
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## SECTION 01100 – 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 the furnishing of equipment, labor, skill, material and all other items necessary for the Cedar Creek Water Pollution Control Plant Fuel Shutoff and Emergency Stop project, as shown on the Contract Documents and specified herein. This is a single prime contract; all references to multiple contractors, the General Construction Contractor, the HVAC Contractor, the Electrical Contractor, Prime Contractors and alphanumeric designations for these Contractors shall be deemed to refer to the sole General Construction Contractor Contract.
- B. Delays due to lack of available labor, supervision, equipment, etc., shall not be acceptable.
- C. Before bidding, the Contractor shall visit the site of the work. Contractor shall obtain all necessary information and make his own determinations of any and all conditions which may affect in any way the performance of the work and the bid prices under the Contract. All pertinent data and dimensions with regard to existing construction shall be verified by the Contractor.
- D. Where articles of the Instructions to Bidders and General Conditions are repeated in the Section 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 specially noted as such hereinafter.

#### 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Related Section:
  - 1. Division 01 Section 01500 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.3 PROJECT INFORMATION

- A. Project Identification: Project consists of the removal of the installation of new fuel shutoffs and generator emergency stops for Cedar Creek Water Pollution Control Plant within the existing generator building.
- B. Project Location: Project is located at the Cedar Creek Water Pollution Control Plant – 3340 Merrick Rd, Wantagh, NY 11793.
- C. Owner: Nassau County DPW.

- D. Owner's Representative: Contract Documents prepared by Cameron Engineering, an IMEG Company, 177 Crossways Park Drive, Woodbury, NY 11797, Telephone 516-827-4900.
- E. Project Coordinator: General Construction Contractor shall be responsible for coordination of his subcontractors and for overall Project coordination.

#### 1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The following is a general outline of work only and shall not be construed as complete description of the Work to be performed under the Contract.
- B. The principal features of the Work to be performed and equipment to be provided for this Project under this Contract include all labor, equipment, fees, and other related costs necessary to provide for the installation of fuel shutoffs and generator emergency stops including, but not necessarily limited to the following:
  - 1. Emergency Stop Relocation
    - a. Installation of new emergency stop buttons with lockout in the diesel operations control stations, in series with the existing e-stop circuit, so that either button will perform the necessary stop.
  - 2. Engine Fuel Shut-off Valves and Controls
    - a. Installation of new emergency shut off valves on each fuel source (natural gas, digester gas, and diesel fuel) to the engine room with an emergency shut down station at the outer door heading towards the evacuation point and front of the building. The valves will include internal power supplies so they can operate in the event of loss of power. The valves will be installed close to two exterior walls to provide protection in case of a catastrophic fire.

#### 1.5 CONTRACTS

- A. This Project will be bid under a single General Construction Contract. The Work under this Contract shall be the responsibility of a single Contractor skilled in the Work as described. The Contractor may subcontract such Work as may be required, but the entire responsibility for complete performance of the Contract shall remain with the Contractor referred to above.
- B. The Technical Specifications of the Contract Documents include descriptions of all classifications of Work under this Project. Wherever used in a section of Division 02 through Division 16, the term "Contractor" shall refer to the General Construction Contractor, unless specifically referred to otherwise.
- C. The Contractor shall cooperate and coordinate his Work with the Work of any other contractor, utility service company or Owner personnel.
- D. Compensation for all work required by the Contract Documents shall be included in the Bid Form. These specifications are divided into various sections for clarity and ease of understanding. However, at times, various aspects of the work are described under different sections. Whenever a type of labor, material or construction is necessary, the requirements

governing the type of work shall apply regardless of where they may be found in the Contract Documents and regardless of the specific section, title or heading.

#### 1.6 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 and shall be made without additional cost to the Owner and shall include the increase in cost of other Contracts.

#### 1.7 TIME OF WORK

- A. Overtime work by the Contractor necessary to complete the Work 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. 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 Contractor shall have sufficient construction materials, labor, equipment, tools and supervision to support scheduled overtime or second shifts, when required and at no additional cost to the Owner.
- C. It is understood that the Contractor has reviewed the schedule and has included in his bid sufficient monies to meet the schedule and will make no claim for extra compensation because of additional costs to meet scheduled dates.
- D. 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 Owner shall be informed at least 48 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, and/or as directed by the Owner's Representative.
- 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 working hours of 7:00 AM to 3:30 PM, Monday through Friday, or on official holidays. This written request should be received by the Owner 48 hours in advance of beginning the work. The Contractor is responsible for coordination with the Owner and Owner's Representa

tive, prior to the start of the work to determine the dates of observance of the official holidays that may occur during the course of the Contract. The official 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 the above listed official holidays during the preparation of their work plans and schedules shall not be cause for a delay claim against the Owner.

- H. Contractor shall obtain permission from Owner and Owner's Representative 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 regular working hours (7:00 am to 3:30 pm, or as otherwise established for the Project) or on weekends or official 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 Owner for the cost of providing oversight and/or for providing existing service and/or facility assistance, at the rate of \$175 per hour per staff member. The Owner and Owner's Representative 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 Owner.

## 1.8 WORK BY OTHERS

- A. The Contractor shall cooperate fully with the Owner, Owner's Representative and all other contractors working on the site, to effect proper coordination and progress to complete the Project on schedule and in proper sequence. Insofar as possible, decisions of all kinds required from the Owner's Representative shall be anticipated by the Contractor to provide ample time for inspection or preparation of instructions.
- B. The Contractor shall cooperate with all the aforesaid parties and shall allow reasonable provisions for the prosecution of any other work by the Owner, or others, to be done in connection with his work, or in connection with normal use of the facilities.

1.9 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 Owner, Engineer, and Regulatory Agencies including, but not limited to, the New York State Department of Environmental Conservation and Suffolk County Department of Health Services.

1.10 WORKSITE SECURITY – CONTRACTOR’S OBLIGATIONS

- A. All Contractors must participate in a security program designed to safeguard existing facilities, as well as all the site workers and the neighboring public. Each site visitor/worker employed (directly or indirectly) by the Contractor (subcontractors, equipment manufacturer representatives, apprentices, delivery people, etc.) will be required to provide appropriate photographic identification to obtain the necessary authorization for logged entry into the site. In most cases, the only acceptable photographic identification will be a valid driver’s license or passport. Thereafter, the worker/visitor will be issued a pass or badge that allows them certain predetermined access within the site. This badge/pass must be worn on the worker’s/visitor’s outermost garment and be visible to all times. The Contractor must notify the Owner and Owner’s Representative, in advance, of all personnel expected to be at a project site of the aforementioned requirements for entry. At the end of a workers/employees worksite employment, issued passes should be returned.
- B. Site Security Program Requirements will be reviewed for all contractors at the Pre-Construction Meeting and subsequent Project meetings. Failure to adhere to the security program will be viewed as a “contractual obligation failure” and will be subject to remedial actions by the Owner. The security program may be revised as necessary program improvements are incorporated. The Contractor will receive advanced notification of any new program changes and will be expected to comply and at no additional cost to the Owner.

1.11 PRE-CONSTRUCTION MEETING

- A. A Pre-construction Meeting will be held after award of Contract, but prior to starting work at the site to review all the details, delivery of submittals, training and planning of work for completion in time. This meeting is in addition to all other meetings specified elsewhere in this Contract.

1.12 CONSTRUCTION ENTRANCE

- A. Contractor shall exclusively utilize the site construction entrance for access to and from the site.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION 01100





## SECTION 01143 - COORDINATION WITH OWNER'S OPERATIONS

### 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 and all essential Plant services and facilities are maintained operational throughout the construction period.
- B. Except for the scheduled shutdowns specified in this Section and in other Contracts, the existing plant will be maintained in continuous operation by the County during the entire construction period under all Contracts. Work under this Contract shall be so 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. 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 in this Section. All references to days in this Section are consecutive calendar days.
- D. Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without additional cost to the County, and provided that it does not require any other Contractor to perform additional work, and provided that all requirements of these Specifications are fulfilled.
- E. 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 County. The Contractor should be aware that existing valves, 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 complete and maintain dry conditions where required.
- F. 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, to Section 01724 and other applicable Sections, for definition of the equipment, piping, material and appurtenances to be removed and turned over to the County and stored on site, or to become the property of the Contractor and removed from the site.

### 1.2 GENERAL CONSTRAINTS

- A. Article 1.6 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 units other than the designated units shall not be interrupted by the Contractor during the specified time periods. New units may only be used after the specified testing and acceptance of the units.

- 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.
  9. Power, Light and Communication Systems: Electric power, lighting service and communication systems shall be maintained in uninterrupted operation in all areas.
  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 system using hoses, piping, or pumps, if hydraulic conditions so require them, by the Contractor whose Work requires the draining.
    - 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 spillage 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.
  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.

### 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 may interrupt the normal Plant operations shall be accomplished at such times that will be convenient to the County. The Contractor shall note that shutdowns will generally be during the night time hours when plant influent flows are low.
3. The Contractor shall provide 7-day advance notice of 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 shall be satisfied that the Contractor has complied with these requirements, to the fullest extent possible, before shutdowns will be authorized.

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

#### 1.4 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.

#### 1.5 CURRENT CONSTRUCTION CONTRACTS

- A. Bay Park STP to Cedar Creek WPCP conveyance Project (2022 through 2026).
- B. Cedar Creek WPCP Engine Generator Overhead Contract (2023 through 2028).
- C. S35100-07G1: Cedar Creek WPCP Digester Rehabilitation and Cleaning: Phase 1 (2024 through 2026).
- D. S35100-07G1: Cedar Creek WPCP Digester Rehabilitation and Cleaning: Phase 1 (2026 through 2028).

- E. S3C067-08G: Cedar Creek WPCP Secondary Treatment Improvements (2025 through 2028).
- F. S3C067-13G: Cedar Creek WPCP Protective Water Tank Improvements (2025 through 2026).
- G. S3C067-014G: Cedar Creek WPCP Miscellaneous Improvements (2025 through 2026).

1.6 MAINTENANCE OF PLANT OPERATIONS (MOPO) AND SEQUENCE OF CONSTRUCTION

- A. 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, will arrange for necessary shutdowns.
- B. 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.
- C. Contractor shall coordinate construction sequencing with electrical staging requirements as detailed on the Electrical Drawings.

END OF SECTION 01143

## SECTION 01210 - ALLOWANCES

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. 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.
- B. Owner and Owner's Representative shall determine which items qualify to be paid for as allowance items and which items are to be included in other Bid items as non-allowance work.

#### 1.2 SCHEDULE OF ALLOWANCES (NOT USED)

#### 1.3 BASIS FOR PAYMENT

- A. General Construction Contract
  - 1. Construction Contingency Allowance: Payment under this allowance shall be paid on the basis of labor, tools, materials and equipment, plus overhead and profit computed in accordance with the requirements of the General Conditions.
  - 2. Any funds remaining at the Project Completion shall be eliminated by a credit Change Order.

### PART 2 - PRODUCTS - (NOT USED)

### PART 3 - EXECUTION

- A. Hazardous Materials Allowance (G-A-1): An allowance of fifty thousand dollars (\$50,000) for identifying, testing, removing and disposing of hazardous materials.
- B. Construction Contingency Allowance (G-A-2): An allowance of eighty thousand dollars (\$80,000) to cover additional construction work required for unforeseen field conditions related to the improvements and miscellaneous repairs.

END OF SECTION 01210

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## SECTION 01250 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
  - 1. Divisions 2 through 16 Sections for specific requirements and limitations for substitutions.

#### 1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those specified by the Contract Documents and proposed by Contractor.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
- B. Equivalent Materials and Equipment
  - 1. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular manufacturer, the naming of the item is intended to establish the type, function and quality required. If the name is followed by words "or equal", materials or equipment of other suppliers may be accepted by Owner's Representative if sufficient information is submitted by Contractor to allow Owner's Representative to determine that the material or equipment proposed is equivalent or equal to that named. Requests for review of substitute items of material and equipment will not be accepted by Owner's Representative from anyone other than Contractor. If Contractor wishes to furnish or use a substitute item of material or equipment, Contractor shall make written application to Owner's Representative for acceptance thereof. The application shall state that the evaluation and acceptance of the proposed substitute will not prejudice Contractor's achievement of Substantial Completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for work on the Project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed



substitute from that specified shall be identified in the application and available maintenance, repair and replacement service shall be indicated. The application shall also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by Owner's Representative in evaluating the proposed substitute. Owner's Representative may require Contractor to furnish at Contractor's expense additional data about the proposed substitute.

2. Whenever a material or article is specified or described without the phrase "or equal," the phrase "or equal" shall be deemed included.

#### 1.4 SUBMITTALS

A. Substitution Requests: Submit three (3) copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Contractor shall submit his request for substitutions and any monetary changes associated therewith to the Owner. Contractor's submittal shall include all necessary data for Owner's Representative evaluation. The following listing summarizes the data required:
  - a. Complete data substantiating compliance of proposed substitution with Contract Documents. Substitution shall not change design intent.
  - b. For Products:
    - 1) Product identification, including manufacturer's name and address.
    - 2) Manufacturer's literature including, but not necessarily limited to, product description, performance and test data and reference data.
    - 3) Samples where appropriate.
    - 4) Name and address of similar projects on which product was used, and date of installation.
2. Itemized comparison of proposed substitution with product or method specified. Different types of products and methods will be considered provided final performance is at least equal to that specified.
3. Data relating to impact on construction schedule occasioned by the proposed substitution.
4. Relation/impact to other contracts.
5. Accurate cost data on proposed substitution in comparison with product or method specified, including costs of all redesigns required.
6. In making request for substitution, the Contractor represents:
  - a. He has personally investigated proposed product or method and determined that it is equal or superior in all respects to that specified. He will provide the same guarantee for substitution as for product or method specified.
  - b. He will coordinate installation of accepted substitution into work, making such design and construction changes as may be required for work to be completed in all respect.

7. Substitutions will not be considered at any time if:
  - a. They are indicated or implied on shop drawings or project data submittals without formal request submitted in accordance with this section.
  - b. Acceptance will require substantial revision of Contract Documents.
  - c. Acceptance will create problems in stocking of repair parts and in future maintenance by the Owner.
8. Owner's Representative decision regarding evaluation of substitutions shall be considered final and binding. Request for time extension and additional costs based on submission of, acceptance of, or rejection of substitutions will not be allowed.
9. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
10. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution. Provide coordination drawings and coordination details, as requested by Owner's Representative.
11. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
12. Certificates and qualification data, where applicable or requested.
13. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
14. Research reports evidencing compliance with building code in effect for Project.
15. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
16. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
17. Licensed Professional Engineer seal and signature on submittal as determined necessary by Owner's Representative.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers. All data on proposed substitution must substantiate compliance with the Contract Documents. Include product identification and description, performance and test data, references and samples where applicable, and other information required by the Owner's Representative.

## 1.6 PROCEDURES

- A. Coordination: Modify or adjust affected Work as necessary to integrate Work of the approved substitutions at no additional cost to Owner.

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than fifteen (15) days prior to time required for preparation and review of related submittals.
1. Conditions: Owner's Representative will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Owner's Representative will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Substitutions intended as equivalent or alternate that do not conform to the specifications without exception and/or do not meet the pre-approval deadline will be rejected. Only written requests will be considered. Substitutions will not be considered if indicated or implied on shop drawing submissions without the required written request. Substitutions will not be considered if they require substantial revision of the Contract Documents to accommodate their use.
1. Conditions: Owner's Representative will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Owner's Representative will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Owner's Representative for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - d. Substitution request is fully documented and properly submitted.
    - e. Requested substitution will not adversely affect Contractor's construction schedule.

- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION - (NOT USED)

END OF SECTION 01250

NO TEXT THIS PAGE

## SECTION 01290 – SCHEDULE OF VALUES AND PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections:
  - 1. Division 01 Section "Allowances" for procedural requirements governing the handling and processing of allowances.
  - 2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
  - 3. Division 01 Section "Shop Drawing Procedures" for administrative requirements governing the preparation and submittal of the submittal schedule.

#### 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Owner's Representative no later than five (5) business days from date on Notice to Proceed.
- B. Format and Content: Establish line items for the schedule of values in accordance with unit prices and lump sum prices from bid sheet.
  - 1. Identification: Include the following Project identification on the schedule of values:

- a. Project name and location.
  - b. Name of Owner's Representative.
  - c. Owner's Representative's project number.
  - d. Contractor's name and address.
  - e. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703.
- a. Related Specification Section or Division.
  - b. Description of the Work.
  - c. Name of subcontractor.
  - d. Name of manufacturer or fabricator.
  - e. Name of supplier.
  - f. Change Orders (numbers) that affect value.
  - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
    - 1) Labor.
    - 2) Materials.
    - 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the schedule of values for each allowance.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
- a. Temporary facilities that are not direct cost of actual work-in-place shall be shown as separate line items in the schedule of values.
9. Schedule Updating: Update and resubmit the schedule of values before each Application for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.
10. Where a line item is provided for bond, insurance, mobilization or other similar Project setup task, as determined by Owner's Representative, the costs for these setup items shall be equally prorated and paid over the first twelve (12) months of the project.
11. Provide a separate line item for approval of as-built drawings. Amount for as-built line item shall be approved by Owner's Representative.

## 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Owner's Representative and paid for by Owner.
  - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Progress payments shall be submitted to Owner's Representative. The period covered by each Application for Payment is one month, ending on the last day of the month.
  - 1. Submit draft copy (pencil copy) of Application for Payment for review by Owner's Representative.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Owner's Representative will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders issued before last day of construction period covered by application.
  - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
  - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  - 3. Provide summary documentation for stored materials indicating the following:
    - a. Materials previously stored and included in previous Applications for Payment.
    - b. Work completed for this Application utilizing previously stored materials.
    - c. Additional materials stored with this Application.
    - d. Total materials remaining stored, including materials with this Application.



- G. Transmittal: Submit six (6) signed and notarized original copies of each Application for Payment to Owner's Representative. One copy shall include waivers of lien and similar attachments if required.
1. Transmit copies with a transmittal form listing attachments and recording appropriate information about application.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Products list (preliminary if not final).
  5. Submittal schedule (preliminary if not final).
  6. Initial progress report.
  7. Report of preconstruction conference.
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner use of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
  6. AIA Document G707, "Consent of Surety to Final Payment."
  7. Evidence that claims have been settled.
  8. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01290

## SECTION 01300 – SHOP DRAWING PROCEDURES

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
- B. Contractor shall submit to Owner's Representative for review and approval with such promptness as to cause no delay in Work, all Shop Drawings and samples required by the Contract Documents.
- C. All submissions shall be identified as Owner's Representative may require.

#### 1.2 RELATED SECTION

- A. Section 01250 – Substitution Procedures.
- B. Section 01830 – Startup Training and Operation and Maintenance Manuals.

#### 1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Owner's Representative accepted form.
- B. Identify Project, Contractor, Subcontractor or supplier, pertinent drawing and detail number, and specification section number, as appropriate.
- C. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
- D. Schedule submittals to expedite the Project and deliver to Owner's Representative. Coordinate submission of related items.
- E. For each required submittal for review, allow fifteen (15) business days, excluding delivery time to and from the Contractor, for Owner's Representative review in accordance with these specifications.
- F. Identify variations from Contract Documents and Product or system limitations.
- G. Provide space for Owner's Representative and Contractor's review stamp.
- H. Revise and resubmit as required. Identify all changes made since previous submission.
- I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.
- J. Submittals not requested will not be recognized or processed.

#### 1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial schedules within five (5) business days after date stated in Notice to Proceed.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each major heading as a separate numbered activity for each principal element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Owner's Representative.
  - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times as specified herein in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Owner's Representative's administrative procedures necessary for certification of Substantial Completion.
  - 5. Punch List and Final Completion: Include at least 30 days for punch list and final completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, completion of each segment of construction, the Notice to Proceed, Substantial Completion, and final completion.
- E. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's construction schedule within five (5) days after date established for the Notice to Proceed. Base schedule on the start-up construction schedule and additional information received since the start of Project.
- F. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one (1) week before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  - 3. As the Work progresses, indicate final completion percentage for each activity.
- H. Contractor's Construction Schedule: Prepare and submit two week "look-aheads" for every two-week period for the entire construction period. Label to comply with requirements for submittals.
- I. Indicate submittal dates required for shop drawings, product data, samples, and product delivery

dates, including those furnished by Owner.

#### 1.5 SCHEDULE OF VALUES

- A. Within five (5) calendar days from the date shown on the Notice to Proceed, submit a Schedule of Values to the Owner, Owner's Representative, Plant management and District for review and approval, showing a breakdown of all construction activities for the Project. The Schedule of Values shall be detailed to indicate separate costs for all Work of the Project.
- B. When a line item is provided for bonds, insurance, mobilization or other similar project setup task, as determined by the Owner's Representative, the costs shall be equally prorated and paid over the first twelve (12) months of the Project.

#### 1.6 SUBCONTRACTOR LIST

- A. Within ten (10) calendar days from the date shown on the Notice of Award, submit a Subcontractor List to the Owner and/or Owner's Representative for review and approval. Include a minimum of three (3) references per subcontractor, listing contact name and telephone number.

#### 1.7 PROPOSED PRODUCTS LIST

- A. Within five (5) business days after Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product. Identify deviation(s) or change(s) or product(s) that will be proposed for substitution from specified products.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

#### 1.8 SHOP DRAWINGS

- A. Number shop drawing submittals consecutively and show:
  - 1. All working and erection dimensions (all measurements shall be field verified).
  - 2. Arrangement and sectional views.
  - 3. Necessary details, including information for making connections to other work.
  - 4. Kinds of materials and finishes.
  - 5. Reference to Contract Drawings and Specifications. Quote drawing number(s) and exact specification section and paragraph.
  - 6. Clearly indicate all deviations from Contract Documents.
- B. Shop Drawings shall be dated and shall contain:
  - 1. Name and Contact Number of Project.
  - 2. Description of required equipment, materials and classified item numbers.
  - 3. Locations at which materials or equipment are to be installed in the work.
- C. Submit shop drawings with a letter of transmittal containing the name of the Project, Owner's Project Number (to be provided), Owner's Representative Project Number (to be provided) Contractor's name, number of drawings, titles and other pertinent data, as requested by the Owner's Representative.
- D. Procedure for Submitting Shop Drawings:

1. Product Data: Submit standard manufactured items, in the form of manufacturer's catalog sheets, showing illustrated cuts of the item to be furnished, scale details, sizes, dimensions, performance characteristics required, operating clearances, capacities, and all other pertinent information. Include manufacturer's Material Data Safety Sheets. Copies of submissions that have been reviewed will be returned to the Contractor.
    - a. Shop Drawings (including Product Data): Submit black and white prints for each drawing. On each drawing, provide clear space approximately 4"x10" on the right-hand side for stamps: "Date Received", "No Exception Taken", etc.
    - b. Shop Drawing Stamp will indicate:
      - 1) "No Exceptions Taken"
      - 2) "Make Corrections Noted"
      - 3) "Amend and Resubmit"
      - 4) "Rejected – See Remarks"
    - c. Shop drawings must be resubmitted until stamped "No Exceptions Taken" or "Make Corrections Noted". The submittal will be reviewed only for general conformance with the design concept and for general compliance with the Contract Documents. The review does not relieve the Contractor from any responsibility for all of the requirements of the Contract Documents, including, but not limited to: job conditions, clearances, physical dimensions, coordination and construction techniques and processes; nor permit any deviation from drawings and specifications-any such deviation requires a specific written order.
  2. All drawings for shop fabricated equipment shall be submitted in the form of one good quality sepia and three good, sharp, direct contract prints of the Seller's original drawing. Original Drawings shall be produced in the same AutoCAD program, version, and operating system as the original Contract Drawings. Electronic data, where applicable, shall be submitted on CD, formatted for IBM compatible systems.
  3. Subcontractor's drawings shall be checked and stamped by the Prime Contractor before submission to the Owner's Representative.
  4. After completion of checking, the Owner's Representative will return the prints to the Contractor.
  5. For drawings returned "Amend and Resubmit" or "Rejected – See Remarks", correct the original drawings, submit corrected reprints, and resubmit until final "No Exceptions Taken" or "Make Corrections Noted" is obtained.
  6. If shop drawing item is rejected, Owner will receive a copy of the transmittal returning shop drawings to Contractor. If shop drawing is marked "No Exceptions Taken" or "Make Corrections Noted", the Owner will receive correspondent shop drawings (two (2) copies minimum) from the Owner's Representative office.
  7. For drawings returned "No Exceptions Taken" and "Make Corrections Noted" the Contractor shall obtain and issue sufficient prints to communicate to all parties involved in the work.
  8. Do not work as called for by shop drawings until Owner's Representative review has been completed. Contractor may proceed with fabrication if shop drawing is stamped "No Exceptions Taken" or "Make Corrections Noted".
- E. If shop drawings show variations from Contract requirements because of standard shop practice, or other reasons, Contractor shall make specific mention of such variation in his letter of transmittal.
- F. Owner's Representative will review with reasonable promptness Shop Drawings and samples, but Owner's Representative's review will be only for conformance with the design concept of the

Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences of procedures of construction (except where a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents) or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate approval of the assembly in which the item functions. Contractor shall make corrections required by Owner's Representative and shall return the required number of corrected copies of Shop Drawings and submit as required new samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Owner's Representative on previous submittals.

- G. Approval of shop drawings is general. It does not relieve the Contractor of the responsibility for accuracy of such drawings, nor for the furnishing of materials or work required by the Contract and not shown on the shop drawings.
- H. Changes shall not be permitted on Shop Drawings that have been previously submitted for approval, except for items that have been noted for corrections or coordination.
- I. If the Contractor should alter any information on previously submitted shop drawings besides the notation called for by the Owner's Representative, he must circle this new information to bring it to the attention of the Owner's Representative.
- J. Where a Shop Drawing or sample is required by the Specifications, any related Work performed prior to Owner's Representative's review and approval of the pertinent submission will be the sole expense and responsibility of Contractor.
- K. In submitting shop drawings for review, submit all associated drawings relating to a complete assembly at one time so that each may be checked in relation to the entire proposed assembly.
- L. Have copies of all "No Exceptions Taken" and "Make Corrections Noted" shop drawings on the job at all times and make them available to the Owner's Representative.
- M. Refer to the relevant specifications sections where shop drawings, product data and samples are required to be submitted.

#### 1.9 ELECTRONIC SUBMITTAL PROCEDURES

- A. Summary:
  - 1. Shop drawings and product data submittals shall be transmitted to Owner's Representative in electronic (PDF) format.
  - 2. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
  - 3. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
- B. Procedures:
  - 1. Submittal Preparation - Contractor may use any or all of the following options:
    - a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor.
    - b. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format.
    - c. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.

2. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.
3. Contractor shall transmit each submittal to Owner's Representative.
4. Owner's Representative review comments will be made available on the submittal. Contractor will receive email notice of completed review.
5. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
6. Submit paper copies of reviewed submittals at project closeout for record purposes in accordance with Section 01830 - Startup Training and Operation and Maintenance Manual.

#### 1.10 HARD COPY SUBMITTAL PROCEDURES

- A. Contractor shall provide one (1) hard copy of all final shop drawings to Owner's Representative Field Office within three (3) days of receipt of approval of final electronic shop drawing submittal.
- B. Contractor shall provide one (1) hard copy of all final shop drawings to Owner's Representative Office within three (3) days of receipt of approval of final electronic shop drawing submittal.

#### 1.11 MANUFACTURER INSTALLATION INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, pre-installation maintenance, maintenance during storage, assembly, installation, start-up, adjusting, and finishing, to Owner's Representative in quantities specified.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

#### 1.12 MANUFACTURER CERTIFICATES

- A. When specified in individual specification sections, submit two (2) copies of certification by manufacturer to Owner's Representative.
- B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product but must be acceptable to Owner's Representative.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION 01300

## SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General Project coordination procedures.
2. Administrative and supervisory personnel.
3. Coordination drawings.
4. Requests for Information (RFI's).
5. Project meetings.

- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

- C. Related Sections:

1. Division 1 Section "Summary" for coordination of Subcontractors and overall Project coordination.
2. Division 1 Section "Shop Drawing Procedures" for preparing and submitting various Shop Drawings.
3. Division 1 Section "Records Drawings" and "Closeout Procedures" for coordinating closeout of the Contract.

#### 1.3 DEFINITIONS

- A. RFI: Request from Owner, Owner's Representative, or Contractor seeking information from each other during construction.

#### 1.4 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.



4. Provide for overall Project coordination.

#### 1.5 KEY PERSONNEL

- A. Key Personnel Names: Within five (5) business days of starting construction operations, submit a list of key personnel assignments, including Project Superintendent, two (2) Project managers and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities, including who will respond to any emergency, at anytime on a 24/7 basis throughout the duration of the Project; list addresses and telephone numbers, including home, office, cellular and pager telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
  1. Post copies of list in Project meeting room(s), in temporary field office(s), and by each temporary telephone. Keep list current at all times.

#### 1.6 PROJECT SUPERINTENDENCE/SUPERVISORS

- A. Project Superintendent and his Supervisor(s) shall be required to be on-site whenever work is being performed by the Contractor and/or his subcontractor(s). Project Superintendent shall not be permitted to conduct day to day "hands on" work unless temporarily instructing personnel on means and methods of construction. Project Superintendent shall be the on-site representative and shall communicate with the Owner's Representative and Owner on a daily basis.

#### 1.7 REQUESTS FOR INFORMATION (RFI's)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  1. Owner's Representative will return RFI's submitted to Owner's Representative by other entities controlled by Contractor with no response.
  2. Coordinate and submit RFI's in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  1. Project name.
  2. Project number.
  3. Date.
  4. Name of Contractor.
  5. Name of Owner's Representative.
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.

13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
  - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above and acceptable to Owner's Representative.
- D. Owner and/or Owner's Representative's Action: Owner and/or Owner's Representative will review each RFI, determine action required, and respond. Allow ten (10) business days for Owner and/or Owner's Representative's response for each RFI. RFI's received by Owner and/or Owner's Representative after 1:00 p.m. will be considered as received the following working day.
  1. The following RFI's will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Owner's Representative's actions on submittals.
    - f. Incomplete RFI's or inaccurately prepared RFI's.
  2. Owner and/or Owner's Representative's action may include a request for additional information, in which case Owner and/or Owner's Representative's time for response will date from time of receipt of additional information.
  3. Owner and/or Owner's Representative's action on RFI's that may result in a change to the Contract Time or the Contract Sum may require Contractor to submit Change Order Proposal.
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Owner and/or Owner's Representative in writing within ten (10) business days of receipt of the RFI response.
- E. On receipt of Owner's Representative's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Owner's Representative within ten (10) business days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFI's organized by the RFI number. Submit log monthly. Include the following:
  1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Owner's Representative.
  4. RFI number including RFI's that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Owner's Representative's response was received.

8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

## 1.8 PROJECT MEETINGS

- A. General: Owner's Representative will schedule and conduct meetings and conferences at Project site at a time convenient to Owner and/or Owner's Representative, unless otherwise indicated.
  1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Contractors' Site Superintendent shall be required to attend all meetings scheduled by the Owner's Representative and shall be a competent supervisor familiar with the Work and have authority to act for the Contractor. If Contractors' Site Superintendent fails to attend any scheduled meetings without prior approval, Contractor shall be directed to replace the current Contractors' Site Superintendent. Non-attendance by the Contractors' Site Superintendent will form the basis for review of the Contractor's responsible bidder status.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Owner's Representative will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned within ten (10) business days of the meeting.
  4. Contractor shall supply an itemized summary of work completed since the previous meeting and an itemized list of work projected for the next Project meeting. The lists shall be reviewed at each meeting for status and compliance with projections. Deviations in the Project schedule shall be monitored, in part, through the review and compliance with the projected work schedules.
- B. Preconstruction Conference: Owner's Representative will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and/or Owner's Representative.
  1. Conduct the conference to review responsibilities and personnel assignments.
  2. Attendees: Owner, Owner's Representative, Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Introduction of all Parties
    - b. Maintenance of Plant Flow and Treatment (MOPO)
    - c. Tentative construction schedule.
    - d. Critical work sequencing and long-lead items.
    - e. Designation of key personnel and their duties, including a list of contact information.
    - f. Lines of communications.
    - g. Procedures for processing field decisions and Change Orders.
    - h. Procedures for RFI's.
    - i. Procedures for testing and inspecting.

- j. Procedures for processing Applications for Payment.
  - k. Distribution of the Contract Documents.
  - l. Submittal procedures.
  - m. Preparation of record documents.
  - n. Use of the premises.
  - o. Work restrictions.
  - p. Working hours.
  - q. Responsibility for temporary facilities and controls.
  - r. Dewatering.
  - s. Procedures for disruptions and shutdowns.
  - t. Construction waste management and recycling.
  - u. Parking availability.
  - v. Office, work, and storage areas.
  - w. Equipment deliveries and priorities.
  - x. First aid.
  - y. Security.
  - z. Progress cleaning.
  - aa. Prevailing Wage and Certified Payroll.
  - bb. Confined Space Entry and Plant Safety Requirements.
  - cc. Payment Procedures.
4. Minutes: Owner's Representative will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned within ten (10) business days of the meeting.
- C. Project Closeout Conference: Contractor will schedule and conduct a Project closeout conference, at a time convenient to Owner's Representative, but no later than thirty (30) days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  - 2. Attendees: Authorized representatives of Owner's Representative and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Requirements for preparing operations and maintenance data.
    - e. Requirements for demonstration and training.
    - f. Preparation of Contractor's punch list.
    - g. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - h. Submittal procedures.
  - 4. Minutes: Owner's Representative will record significant discussions and agreements achieved and distribute the meeting minutes to everyone concerned within ten (10) business days of the meeting.

D. Progress Meetings: Owner's Representative will schedule and conduct progress meetings at monthly intervals.

1. Attendees: In addition to representatives of Owner's Representative, each Contractor, Subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings as requested by Owner's Representative. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work. Contractors' Site Superintendent shall be required to attend all progress meetings scheduled by the Owner's Representative and shall be a competent supervisor familiar with the Work and have authority to act for the Contractor. If Contractors' Site Superintendent fails to attend any scheduled progress meetings without prior approval, Contractor shall be directed to replace the current Contractors' Site Superintendent. Non-attendance by the Contractors' Site Superintendent, will form the basis for review of the Contractor's responsible bidder status.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for previous and next periods.

- b. Review present and future needs of each entity present, including the following:

- 1) Sequence of operations.
- 2) Status of submittals.
- 3) Deliveries.
- 4) Off-site fabrication.
- 5) Access.
- 6) Site utilization.
- 7) Temporary facilities and controls.
- 8) Progress cleaning.
- 9) Quality and work standards.
- 10) Status of correction of deficient items.
- 11) Field observations.
- 12) Status of RFI's.
- 13) Status of proposal requests.
- 14) Pending changes.
- 15) Status of Change Orders.
- 16) Pending claims and disputes.
- 17) Documentation of information for payment requests.
- 18) Review of previous 2-week and upcoming 2-week periods.

3. Minutes: Owner's Representative will record significant discussions and agreements achieved along with changes made to the 2-week look ahead and look back schedules and

note all items that were not completed from the previous progress meeting. Minutes shall be distributed to all concerned parties within ten (10) business days of the meeting.

4. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

#### 1.9 WEEKLY WORK SCHEDULES

- A. Weekly work schedules shall be submitted by Contractor to Owner's Representative and Owner on a weekly basis. Schedules shall be submitted not later than 12:00 noon on the Friday preceding the planned work week. All work for the upcoming week for all Contractor and subcontractor efforts shall be shown. Each day of the week will indicate the work for that day, who is performing the work (Contractor or which sub), any equipment and/or materials needed to perform the work (i.e. crane, backhoe, excavator, concrete, rebar, testing personnel manufacturer's representatives, etc.). Contractor shall reimburse Owner for improper notification as required in Section 01320 – Contractor Cost for Owner's Representative Services. Please note any and all special circumstances required from Owner's Representative and/or Owner such as all shutdown, mark out assistance, conflicts with other on-site Contractors, conflicts with daily Plant operations and maintenance, non holiday days or hours off for required training for Contractor staff and events of similar nature and impact on the Project

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION 01310

NO TEXT THIS PAGE

## SECTION 01311 - MAINTENANCE OF PLANT OPERATIONS

### PART 1 - GENERAL

#### 1.1 COORDINATION OF WORK

- A. The Contractor is responsible for the overall coordination of the construction work and shall prepare a Maintenance of Plant Operation and Sequence of Construction Plan and Schedule and submit to the Engineer for review within 30 days after issuance of the Notice to Proceed. The plan shall provide a detailed step-by-step description and coordination drawings of how the Contractor plans to perform the work while keeping the plant in operation as well as the sequencing of work and each of their Subcontractor's work. The plan shall be coordinated by a critical path method (CPM) construction schedule along with shop drawings and submittal schedules.
- B. The Maintenance of Plant Operation and Sequence of Construction Plan and Schedule will be reviewed at a joint meeting with Contractor, Engineer, and the County's representative. At this meeting adjustments will be made to the plan which are agreeable to the individual parties and seem appropriate for the timely completion of the Project. The Plan shall be incorporated into the Contractors CPM construction schedule as specified in Section 01320.
- C. The Engineer will monitor the progress of the Contractor and review the status of completion of the work at project meetings. At any time during the project, the Engineer will call for a meeting to review and adjust the Plan based on conditions unforeseen during the initial construction phasing plan.

#### 1.2 COORDINATION AND INTERFERENCES

- A. The Engineer's Drawings are generally diagrammatic and indicative of the work and as such cannot show actual construction conditions. Modifications in the work to compensate for minor interferences and structural obstructions shall be accomplished as part of the Work at no additional cost to the County.
- B. As required under Submittal Articles throughout the Specifications, the Contractor shall complete dimensioned installation drawings of the various segments, piping connections to buildings, and all related work required for the construction. Such drawings shall have the Engineer's approval prior to their use.

#### 1.3 MAINTENANCE OF PLANT OPERATIONS

- A. General
  - 1. The intent of this Section is to have the Contractor perform his Work in such a manner that continuous, uninterrupted treatment of the plant flows, and all essential Plant services and facilities are maintained operational throughout the construction period.
  - 2. Except for the scheduled shutdowns specified in this Section, the existing plant will be maintained in continuous operation by the County during the entire construction period. Work under the Contract shall be scheduled and conducted by the Contractor so as not to 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. For performing the Work shown and specified, the Contractor shall plan and schedule his Work to meet both constraints outlined in this Section and plant operating requirements at no additional cost to the County. No discharge of raw or inadequately treated wastewater shall be allowed. The Contractor shall pay all civil penalties, costs, assessments, etc., associated with any discharge of raw or inadequately treated wastewater associated with the Contractor's work.

3. The Contractor shall coordinate with County taking process systems out of service and placing back into service. The Contractor shall not shutdown any operating system of the plant. All plant equipment operations and shutdowns will be executed by the County with the assistance by the Contractors personnel and equipment resources as required.
4. The Contractor should be aware that existing valves, gates, and other shutoff devices may not be tight closing and other means (i.e. blind flange) may have to be provided by Contractor as required at no extra cost to tire County.
5. The Contractor shall be responsible for coordinating the general construction schedule and for ensuring that permanent or temporary power is available for all existing, proposed, and temporary facilities that are required to be on line at any given time.
6. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without cost to the County and provided that all requirements of these Specifications are fulfilled.
7. The County shall have the authority to order Work stopped or prohibited that would, in his opinion, unreasonably result in interrupting the necessary functions of the plant operations.
8. If the Contractor imparts performance or operation of the plant as a result of not complying with specified provisions for maintaining plant operations, then the Contractor shall 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-hours per day, seven work days per week basis.
9. The Contractor shall provide the services of emergency repair crews on call 24-hours per day/seven days pet week.
10. Any temporary work, facilities, roads, walks, protection of existing structures, piping, blind flanges, valves, equipment, etc. that may be required within the Contractor's work limits to maintain continuous and dependable plant operation shall be furnished by the Contractor at the direction of the Engineer at no extra cost to the County.

B. General Constraints

1. Article 1.06 of this section specifies the sequence, detailed system constraints and shutdown duration (where applicable) for Plant units which are to be taken out of service. The operational status of new or existing units other than the designated units shall not be interrupted by the Contractor during the specified time periods.
2. The following constraints shall be applied to all equipment and appurtenant utility systems on the Plant site.
  - a. Access to Plant Site, Roadways, and Parking Areas
    - 1) An unobstructed traffic route through the plant main gate shall be maintained at all times for the County's operations personnel and maintenance equipment. Parking for personal vehicles of construction personnel shall not be allowed to pass thru the main gate but rather the designated areas shown on the Contract Drawings.
    - 2) An unobstructed traffic route around the plant site shall be maintained at all times for the County's operations personnel and maintenance equipment.

Vehicular access to the treatment units and buildings for County personnel shall be maintained at all times by the Contractor.

- 3) The Contractor shall provide temporary measures to protect the existing pavement by filling over with earthen material or supplying other measures acceptable to the Engineer, and he shall repair any damage to existing paved surfaces that occurs during the construction period. Any areas disturbed along the shoulders of the access road and interior roads and elsewhere inside and outside of the plant shall be repaired, graded, seeded, etc. as necessary to match pre-existing conditions.

### 3. Personnel Access

- a. Treatment plant personnel shall have access to all areas which remain in operation throughout the construction period. The Contractor shall locate stored material, dispose of construction debris and trash, provide temporary walkways, provide temporary lighting, and other such work as directed by the Engineer to maintain personnel access to areas in operation. Access and existing parking areas for plant personnel must be maintained throughout construction.

### 4. Plumbing Facilities

- a. Unless otherwise allowed by the Engineer, 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.

### 5. Building Heating and Ventilating

- a. Building heating and ventilating for the existing plant structures shall be in service for the entire construction period. Additional temporary heating and ventilation shall be provided as required to maintain facilities under construction adequately heated and vented. The temperatures to be maintained in any areas occupied by plant operating personnel such as offices, lunchrooms, locker rooms, bathrooms, etc., shall be at least 65°F. The temperatures to be maintained in all other interior plant areas, whether new, existing or temporary, shall be maintained at a minimum of 55°F.

### 6. Power, Light and Communications Systems

- a. Electric power, lighting service and communications systems shall be maintained in uninterrupted operation in all areas which remain in operation.

### 7. Draining Process Pipes and Conduits

- a. Unless otherwise specified, the contents of pipes and conduits undergoing modifications shall be transferred to the Plant drain system using hoses, piping or pumps if hydraulic conditions so require them by the Contractor whose work requires the draining.
- 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 pipe's contents shall be allowed.
- c. All spillage 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.

### 8. Potable Water System

- a. Potable water service shall be maintained in continuous service at all times during construction except for short term interruptions required for tie-ins. Shutdown of the potable water system shall be fully planned and coordinated with the County and shall be limited to not more than two (2) hours. Existing fire hydrants within the plant site shall be operational at all times, unless otherwise approved by the County.
9. Storm Drainage
- a. Storm drainage on the site shall be operational at all times.
10. Sump Pumps and Sumps
- a. All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps provided by Contractor. Interim piping, power and controls shall be provided by Contractor as required by the construction sequence.
11. Dead End Valves and Pipes
- a. The Contractor shall provide blind flanges on all valves or pipe that dead end a line on a temporarily or permanent basis.
12. Lifting Equipment
- a. The Contractor shall not be permitted to use the Plants lifting equipment unless otherwise directed in writing by the County.
13. Temporary Partitions and Enclosures
- a. The Contractor shall provide any temporary partitions and enclosures as shown or ordered by the Engineer necessary to maintain dust-free, heated and ventilated spaces in areas which are adjacent to his work and which must be kept operational by the County.

#### 1.4 SHUTDOWNS

##### A. General

1. Shutdowns 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. All system shutdowns shall be approved by the Engineer and shall conform to the requirements hereinafter specified. If in the judgment of the Engineer a requested shutdown is not required for the Contractor to perform the Work, the Contractor shall utilize approved alternative methods to accomplish the Work. All shutdowns shall be coordinated with and scheduled at times suitable to the County. Contractor shall note that shutdowns will generally be initiated during the night time hours or weekends when the plant influent flows are low. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown period shall commence at a time approved by the Engineer and County, and the Contractor shall proceed with the Work continuously, start to finish, until the Work is completed, and normal plant operation is restored. If the Contractor completes all required Work before the specified shutdown period has ended, the County may immediately place the existing system back into service.
2. For each shutdown, the Contractor shall compile an inventory of its labor and materials required to perform the tasks, 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 procedures shall be submitted to the County for review 30 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.

3. 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 shutdowns without interruptions. Adequate number of personnel shall be scheduled for each shutdown so that the work may be accomplished within the specified time frame. Prefabrication of all piping and other assemblies shall be completed to greatest degree possible prior to any shutdowns. The County shall be satisfied that the Contractor has complied with these requirements to the fullest extent possible before shutdowns will be authorized.

B. Shutdown of Electrical Systems:

1. The Contractor and the County shall each lock out and tag circuit breakers and switches operated by the County and shall check cables and wires to be sure that they are de-energized to ground potential before work begins. Upon completion of the Work the Contractor shall remove the locks and tags and advise the County that the facilities are available for use. The County will then remove their locks and place facilities back into use. The Contractor shall not operate any existing electrical equipment without the approval, direction and supervision of the Engineer.

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.

1.6 CURRENT AND FUTURE CONSTRUCTION CONTRACTS

- A. Refer to Specification Section 01143 for current construction projects.
- B. The Contractor shall coordinate his work with the Contractors for the ongoing and future projects/contracts as outlined in Article 7 of the General Conditions.
  1. For ongoing projects, contract documents may be available for inspection at County offices.
  2. For listed future projects and other (unlisted) that arise, the contract documents, when completed for bidding purposes will be available for purchase at County offices during the bid period.

1.7 MAINTENANCE OF PLANT OPERATIONS (MOPO) AND SEQUENCE OF CONSTRUCTION

- A. In order to maintain a continuous plant operation during construction a detailed MOPO and Sequence of Construction Operations description is included at the end of this Section. The descriptions only represent the major work items and do not include all the work items or

constraints in the Contract. It is not intended to be complete and it is only provided for the Contractor to consider when developing the Maintenance of Plant Operations and Sequence of Construction Plan and Schedule while maintaining the existing plant in operation. The category order and item order within each category are not intended as an exact sequence of work or listings of priorities. However, within each procedural step restrictions and constraints may be outlined.

- B. Work not specifically covered in the detailed MOPO and sequence of construction operations descriptions may in general be done at any time during the Contract Period subject to the operating requirements outlined in this Section.
- C. All references to days and hours in this Section are consecutive calendar days and hours.
- D. 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. Contractor is encouraged to perform concurrent work within the Constraints/Restrictions outlined.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - PART 3 EXECUTION

### 3.1 PERFORMANCE

- A. The means and methods of performing the work are the sole responsibility of the Contractor and are subject to the review of the Engineer and County.

INDEX TO DETAILED MOPO AND SEQUENCE OF CONSTRUCTION OPERATIONS DESCRIPTIONS

<u>ITEM NO.</u>	<u>DESCRIPTION</u>
1.0	Electrical Power System Modifications and Valves
2.0	Generators Engine Control Panel (ECP) E-stops
3.0	Installation of Digester Gas Shutoff Valve
4.0	Installation of Natural Gas Shutoff Valve
5.0	Installation of Fuel Oil Supply Shutoff Valves

Item No.	Description	Suggested Procedure	Constraints	Comments
1	Electrical Power System Modifications and Valves	<ol style="list-style-type: none"> <li>1. Special order parts and custom modify MCC-GE, section 3 of 7, within Electrical Room. Install 100A, 480V, 3P, 42KAIC breaker/MCC bucket.</li> <li>2. Install feeder and new 100A, 40 Circuit 42kaic Main LUGS Only NEMA 12 Panel in the free space on adjacent wall.</li> <li>3. Install and test branch circuiting wires from new panel to junction boxes located with 18" of new electric valves.</li> <li>4. Coordinate connections to actuator with mechanical contractor.</li> <li>5. Install the two remotely located E-stops</li> <li>6. Energize and electrically test the new actuator and E-stop, then repeat for each actuator and E-stop</li> </ol>	Contractor shall complete the MCC-GE modification without de-energizing the MCC lineup which serves support machinery for the primary electric source on site generators.	Coordinate with Operations staff prior to work.
2	Generators Engine Control Panel (ECP) E-stops	<ol style="list-style-type: none"> <li>1. In conjunction with or after the electric valve installations, the generators ECP E-stops shall be installed.</li> <li>2. Starting with the normally off Generator, safely lock out and tag out the electrical power and control system.</li> <li>3. Open the de-energized associated generator ECP and install the new E-stop wiring, which is then routed back to the control room where the new E-stop button shall be installed.</li> <li>4. Test the continuity of the new circuiting prior to conducting a live E-stop test.</li> <li>5. Repeat four more times until all five generator ECPs have a functioning E-stop in the control room.</li> </ol>	Contractor shall complete the Generators Engine Control Panel in coordination with the operation staff.	Coordinate with Operations staff prior to work and for the final location of the E-Stops
3	Installation of Digester Gas Shutoff Valve	<ol style="list-style-type: none"> <li>1. Manually operate the existing fusible link thermal shutoff valve (Valve #D1) to interrupt service to the generators.</li> <li>2. Shutoff existing plug valve at the Digester Gas Filter/Separator (Valve #D2) to isolate area of work and facilitate installation of new valve. Purge piping as required.</li> <li>3. Remove existing plug valve and replace with new digester shutoff valve as specified (Valve #D3)</li> <li>4. Coordinate connections to actuator with electrical contractor.</li> <li>5. Test the new digester gas valve and existing piping which was depressurized from the installation to the required test pressure &amp; time.</li> </ol>		Coordinate with Operations staff prior to work.

4	Installation of Natural Gas Shutoff Valve	<ol style="list-style-type: none"> <li>1. Manually operate the existing fusible link thermal shutoff valve (Valve #N1) to interrupt service to the generators.</li> <li>2. Shutoff existing plug valves at each generator (Valves #N2A, #N2B, #N2C, #N2D, #N2E) to isolate area of work and facilitate installation of new valve. Purge piping as required.</li> <li>3. Remove existing plug valve and replace with new natural gas shutoff valve (Valve #N3) as specified.</li> <li>4. Coordinate connections to actuator with electrical contractor.</li> <li>5. Test the new natural gas valve and existing piping which was depressurized from the installation to the required test pressure and time.</li> </ol>		Coordinate with Operations staff prior to work.
5	Installation of Fuel Oil Supply Shutoff Valves	<ol style="list-style-type: none"> <li>1. Close existing shutoff valve which connects the two existing tanks together. (Valve #FO1)</li> <li>2. Close existing shutoff valve which controls supply of one of the two above ground fuel oil storage tanks. (Valve #FO2A)</li> <li>3. Close existing shutoff valve downstream of location of proposed shutoff valve. (Valve #FO3A)</li> <li>4. Cut in and install new fuel oil shutoff valve as specified. (Valve #FO4A)</li> <li>5. Coordinate connections to actuator with electrical contractor.</li> <li>6. Reopen Valve #FO2A and Valve #FO3A and test the new fuel oil valve and existing piping which was depressurized from the installation to the required test pressure and time.</li> <li>7. Close existing shutoff valve which controls supply of the second of the two above ground fuel oil storage tanks. (Valve #FO2B)</li> <li>8. Close existing shutoff valve downstream of location of proposed shutoff valve. (Valve #FO3B)</li> <li>9. Cut in and install new fuel oil shutoff valve as specified. (Valve #FO4B)</li> <li>10. Coordinate connections to actuator with electrical contractor.</li> <li>11. Reopen Valve #FO2B and Valve #FO3B and test the new fuel oil valve and existing piping which was depressurized from the installation to the required test pressure and time.</li> <li>12. Reopen Valve #FO1.</li> </ol>		Coordinate with Operations staff prior to work.



NO TEXT THIS PAGE

## SECTION 01320 – CONTRACTOR COST FOR OWNER’S REPRESENTATIVE SERVICES

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. In the event that the Owner’s Representative is required to provide additional office or field services as a result of substitution of materials or equipment or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories provided, or as a result of Contractor’s errors, omissions or failure to conform to the requirements of the Contract Documents or if the Owner’s Representative is required to examine and evaluate any changes proposed by the Contractor and solely for the convenience of the Contractor; then the Owner’s Representative charges in connection with such additional services shall be charged to the Contractor by the Owner.
- B. In the event that the Owner’s Representative is not provided with written notification a minimum 24 business hours in advance regarding the cancellation of scheduled work in accordance with the Contractor’s approved construction schedule and required 2-week “look-ahead” submittals as specified in Section 01300 – Shop Drawing Procedures, then the Owner’s Representative charges shall be charged to the Contractor by the Owner.
- C. Contractor shall keep the Owner’s Representative informed of the progress of the Contractor’s Work and particularly when the Contractor intends to cover Work not yet observed by the Owner’s Representative and/or tested by the Contractor. All construction observations by the Owner’s Representative and testing performed by the Contractor shall be completed in such a manner as not to unreasonably delay the Work. Contractor shall be charged for any additional services by the Owner’s Representative when the Work is not ready at the time specified by the Contractor.

#### 1.2 COSTS

- A. Contractor shall respond to required submittals with complete information and accuracy to achieve required approvals within three (3) submissions. All costs to the Owner’s Representative involved with subsequent submissions of Shop Drawings, Samples, RFI’s or other items requiring approval, will be back charged to the Contractor, at the minimum rate of \$1,000 per submittal or the actual cost based upon the number of hours to review the submittal times the Owner’s Representative normal billing rate, whichever is greater. These costs shall be deducted from payments due for Work completed by the Contractor. In the event an approved item is requested by the Contractor to be changed or substituted for, all involved costs in the reviewing and approval process will likewise be back charged to the Contractor unless judged by the Owner’s Representative that the need for such deviation from previously approved data is beyond the control of the Contractor.
- B. Contractor shall provide advanced written notification a minimum 24 business hours regarding cancellation of scheduled work in accordance with the Contractor’s approved construction schedule and required 2-week “look-ahead” submittals as specified in 01300 – Shop Drawing Procedures. All costs involved as a result of the Contractor’s lack of advanced written notification shall be back charged to the Contractor unless judged by the Owner’s Representative that the need for such deviation is beyond the control of the Contractor. The Owner will deduct and retain sufficient sums from the monies due on the Contractor’s Application for Payment to cover the cost of the Owner’s Representative. A minimum of four (4) hours of Owner’s Representative’s time will be back

charged to the Contractor at the Owner's Representative standard hourly billing rate adjusted by the appropriate premium for overtime, whether time-and-one-half, double time, or otherwise, as applicable, prior to applying the Owner's Representative multiplier.

- C. Contractor shall provide advanced written notification a minimum 24 business hours regarding any delays in required observations by Owner's Representative particularly any delays in testing or covering any work. All costs involved as a result of the Contractor's lack of advanced written notification and/or the Work not ready at the time specified by the Contractor shall be back charged to the Contractor unless judged by the Owner's Representative that the need for such deviation is beyond the control of the Contractor. The Owner will deduct and retain sufficient sums from the monies due on the Contractor's Application for Payment to cover the cost of the Owner's Representative. A minimum of four (4) hours of Owner's Representative's time will be back charged to the Contractor at the Owner's Representative standard hourly billing rate adjusted by the appropriate premium for overtime, whether time-and-one-half, double time, or otherwise, as applicable, prior to applying the Owner's Representative multiplier.
  
- D. Should circumstances arise during the course of the Contract, where the Contractor works outside of the regular working hours (7:00 am to 3:30 pm, or as otherwise established for the Project) or on weekends or official 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 per the approved baseline schedule (resource loaded); the Contractor shall reimburse the Owner for the cost of providing inspection and/or assistance, at a rate of \$175 per hour per staff member. 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 Owner.

PART 2 – PRODUCTS - (NOT USED)

PART 3 – EXECUTION - (NOT USED)

END OF SECTION 01320

## SECTION 01321 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's construction schedule.
  - 2. Daily construction reports.
  - 3. Material location reports.
  - 4. Field condition reports.
  - 5. Special reports.
- B. Related Sections:
  - 1. Division 1 Section "Shop Drawing Procedures" for submitting schedules and reports.

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- C. Event: The starting or ending point of an activity.
- D. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

- E. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. Initial: Electronic (PDF) format.
  - 2. Final: Six (6) (minimum) paper copies.
- B. Contractor's Construction Schedule: Initial schedule and Two week "look-aheads", of size required to display entire schedule for entire construction period and for every two week period for the entire construction period as follows:
  - 1. Submit a working copy of schedule for entire construction period and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date.
  - 2. Submit two week "look-ahead" schedules for entire construction period and labeled to comply with requirements for submittals.
- C. Daily Construction Reports: Submit at weekly intervals.
- D. Material Location Reports: Submit at weekly intervals.
- E. Field Condition Reports: Submit at time of discovery of differing conditions.
- F. Special Reports: Submit at time of unusual event.
- G. Qualification Data: For scheduling consultant.

#### 1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
  - 1. Review content and format for reports.
  - 2. Verify availability of qualified personnel needed to develop and update schedule.
  - 3. Discuss constraints.
  - 4. Review schedule for work of Owner's separate contracts, if applicable.
  - 5. Review time required for review of submittals and resubmittals.
  - 6. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - 7. Review time required for completion and startup procedures.
  - 8. Review and finalize list of construction activities to be included in schedule.
  - 9. Review submittal requirements and procedures.
  - 10. Review procedures for updating schedule.

## 1.6 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities.
- B. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from entities involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

## PART 2 - PRODUCTS

### 2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each major heading as a separate numbered activity for each principal element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Owner's Representative.
  - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Shop Drawing Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  - 4. Startup and Testing Time: Include not less than 30 days for startup and testing.
  - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Owner's Representative's administrative procedures necessary for certification of Substantial Completion.
  - 6. Punch List and Final Completion: Include at least 30 days for punch list and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
  - 1. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Uninterruptible services.
    - c. Partial use before Substantial Completion.
    - d. Use of premises restrictions.

- e. Provisions for future construction.
  - f. Seasonal variations.
  - g. Environmental control.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, completion of each segment of construction, the Notice to Proceed, Substantial Completion, and final completion.
- E. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
  - 2. Unanswered RFIs.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
- G. Recovery Schedule: When periodic update indicates the Work is fourteen (14) or more calendar days behind the current schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- I. Contractor's Construction Schedule: Prepare and submit two week "look-aheads" for every two-week period for the entire construction period. Label to comply with requirements for submittals.

## 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's construction schedule within five (5) days after date established for the Notice to Proceed. Base schedule on the start-up construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
- 1. For construction activities that require three (3) months or longer to complete, indicate an estimated completion percentage in ten percent (10%) increments within time bar.

## 2.3 REPORTS

- A. Daily Construction Reports: Contractor shall prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions, including presence of rain or snow.
6. Accidents.
7. Meetings and significant decisions.
8. Unusual events (refer to special reports).
9. Stoppages, delays, shortages, and losses.
10. Meter readings and similar recordings.
11. Emergency procedures.
12. Orders and requests of authorities having jurisdiction.
13. Change Orders received and implemented.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial completions.
17. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner's Representative within one (1) day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

## PART 3 - EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one (1) week before each regularly scheduled progress meeting.



1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of schedule to Owner's Representative, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

### 3.2 MAINTAINING SCHEDULE

- A. Contractor shall perform the Work in accordance with the Project Schedule and provide all resources necessary to maintain progress of the work activities as scheduled, so that no delays are caused to other Contractors engaged in the Work.
- B. Should Contractor fail to maintain progress according to the Project Schedule or cause delay to contractors, Contractor shall provide such additional manpower, equipment, additional shifts, or other measures as directed to bring the operations back on schedule.

END OF SECTION 01321

## SECTION 01355 - HAZARDOUS MATERIALS CONTROL

### PART 1 GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Hazardous Materials Survey
2. Remedial Action for Unforeseen Hazardous Materials
3. Waste Management Records

#### 1.2 SUBMITTALS

A. Submit to the Engineer for approval in accordance with Section 0133.0 shop drawings, product data and information to establish compliance with this section including:

1. Qualifications, certificates and resume of New York State Department of Labor (NYSDOL)-certified Asbestos Inspector.
2. Qualifications, certificate and resume of Environmental Protection Agency (EPA)-certified Lead Inspector.
3. Qualifications and certificate of NYSDOH ELAP-certified laboratory.
4. Hazardous Materials Survey Report
5. Proposals for remedial action work and evidence of disposal of hazardous and non-hazardous waste at an approved facility in accordance with the requirements of this Section.

#### 1.3 HAZARDOUS MATERIALS SURVEY

A. Prior to commencement of work, the Contractor shall conduct a hazardous materials survey with the Engineer and County of all building, 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:

1. 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.
2. 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.
3. 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.

4. Mercury/PCB-containing fixtures and equipment: An inventory of potential mercury and PCB-containing fixtures and equipment shall be performed by the Contractor.
5. 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 report shall be submitted to the Engineer within ten (10) consecutive calendar days after the field survey. 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.

#### 1.4 REMEDIAL ACTION FOR UNFORESEEN HAZARDOUS MATERIAL

- A. When remedial action is necessary for unforeseen hazardous materials, the Engineer will submit a 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. When hazardous materials have been identified the Contractor must update their Health and Safety Plan as necessary.
- C. 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."

#### 1.5 WASTE MANAGEMENT RECORDS

- A. Disposal of wastes generated by remediation work will be based on the results of testing and shall be at a site permitted to accept such waste by the Environmental Protection Agency (EPA) or an authorized state or local government agency. The Contractor shall provide remediation waste profiles for County signature as generator, permit documentation required for the selected Transportation, Storage and Disposal Facility (TSDF) to receive these wastes, and the transporter's Part 364 Waste Transporter Permit(s) required to transport wastes to the TSDF. The Contractor shall also provide advance copies of the waste manifest(s) for the Engineer's review and approval. 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.
- B. The Contractor shall submit written evidence that selected TSDF's will accept or have accepted the wastes generated during remediation. The Contractor shall also submit copies of

the completed manifest, signed and dated by the initial transporter, in accordance with Federal and State requirements and with associated documentation (e.g., Waste Profile and Hazardous Waste Land Disposal Restrictions (LDR) Notification and Certification Form). Copies of completed and signed waste manifests from TSD's shall be provided to the Engineer within seven (7) days of waste shipment offsite.

#### 1.6 PAYMENT

- A. Payment for identifying, testing, removing and disposing of unforeseen hazardous materials shall be paid out of the allowance included in Section 01210 - Allowances.

END OF SECTION 01355

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## SECTION 01410 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Final Completion construction photographs.
  - 4. Preconstruction video.
  - 5. Training video.
- B. Related Sections include the following:
  - 1. Division 01 Section "Shop Drawing Procedures" for submitting photographic documentation.

#### 1.3 DESCRIPTION

- A. Contractor shall engage the services of a professional photographer, approved by Owner and/or Owner's Representative, to take color job photographs and video as specified herein.
- B. Photographer will be required to take preliminary/preconstruction photographs and videos of the site prior to the commencement of work as directed by the Owner and/or Owner's Representative. Subsequent photographs as determined by the Owner and/or Owner's Representative shall be taken during the construction phase.
- C. Photographer shall visit the site prior to the start of construction, then weekly as the Work progresses, additional visits may be required.
- D. A photograph shall be defined as one exposure.
- E. Owner and/or Owner's Representative shall reserve the right to reject any photograph that is not clear or definitive. Any photograph so rejected shall be subtracted from the total exposures before computations for payment or credit under this section.

#### 1.4 SUBMITTALS

- A. Submit two (2) prints of each photographic view within seven (7) days of taking photographs and two (2) sets of CD version of all photographs.
1. Format: 8-by-10-inch smooth-surface matte prints on single-weight commercial-grade photographic paper.
  2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
    - a. Project Number.
    - b. Name of Project.
    - c. Contract Number and Description.
    - d. Name and address of photographer.
    - e. Photo Number.
    - f. Name of Owner and Owner's Representative.
    - g. Name of Contractor.
    - h. Date photograph was taken if not date stamped by camera.
    - i. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - j. Unique sequential identifier.
  3. Digital Images: Submit a complete set of digital image electronic files in JPEG format as a Project Record Document on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.
- B. Video: Submit two (2) copies of each video on DVD in MPEG Format with protective sleeve or case within seven (7) days of recording.
1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Name and address of photographer.
    - c. Name of Owner and Owner's Representative.
    - d. Name of Contractor.
    - e. Date videotape was recorded.
    - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    - g. Weather conditions at time of recording.

#### 1.5 EXTRA PRINTS

- A. Extra Prints: Prepare extra prints of photographs if requested by Owner and/or Owner's Representative.

### PART 2 - PRODUCTS

## 2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPEG format, produced by a digital camera with minimum sensor size of 8.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.
- B. Video Format: Provide high-quality, DVD's of videotape images.

## 2.2 BINDERS

- A. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pocketed inside covers.
  - 1. If two or more binders are necessary to accommodate data of a system, organize photographs sequentially.
  - 2. Identify each binder on front and spine, with printed title "CONSTRUCTION PHOTOGRAPHS", Project title or name, and subject matter of contents. Indicate volume number of multiple-volume sets and dates included in binder.
- B. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Provide new tab for each month.
- C. Protective Plastic Sleeves: All photographs shall be enclosed in transparent plastic sleeves that are punched for standard 3-ring binder.

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
- B. Film Images:
  - 1. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
  - 2. Field Office Prints: Retain one set of prints of progress photographs in the field office at Project site, available at all times for reference. Identify photographs same as for those submitted to Owner and Owner's Representative.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
  - 1. Date and Time: Include date and time in filename for each image.
  - 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Owner and Owner's Representative.
- D. Preconstruction Photographs: Before starting construction, take color, digital photographs of Project site and surrounding properties, including existing items to remain during construction,



from different vantage points, as directed by Owner and/or Owner's Representative. All preconstruction photographs shall be reviewed by Owner and/or Owner's Representative for completeness and clarity. Images determined unacceptable shall be retaken at no additional cost to the Owner.

1. Flag excavation areas and construction limits before taking construction photographs.
  2. Take fifty (50) photographs to show existing conditions adjacent to property before starting the Work.
  3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take minimum of twenty-five (25) color digital photographs monthly with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Owner and/or Owner's Representative-Directed Construction Photographs: From time to time, Owner and/or Owner's Representative will instruct Contractor about number and frequency of color digital photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- G. Final Completion Construction Photographs: Take fifty (50) color photographs after date of Substantial Completion for submission as Project Record Documents. Owner and/or Owner's Representative will direct photographer for desired vantage points.
- H. Additional Photographs: Owner and/or Owner's Representative may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Take additional photographs within 24 hours of request.
  2. Circumstances that could require additional photographs include, but are not limited to, the following:
    - a. Special events planned at Project site.
    - b. Immediate follow-up when on-site events result in construction damage or losses.
    - c. Substantial Completion of a major phase or component of the Work.
    - d. Extra record photographs at time of final acceptance.
    - e. Owner's and/or Owner's Representative request for special publicity photographs.

### 3.2 PRE-CONSTRUCTION VIDEOS

- A. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of construction. Display continuous running time and date. At start of each video, record weather conditions from local newspaper or television and the actual temperature reading at Project site.
- B. Narration: Describe scenes on video by audio narration while video is recorded. Include description of items being viewed, recent events, and planned activities. At each change in

location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
  2. Begin each videotape with name of Project, Contractor's name, videographer's name, and Project location.
  3. Entire area for all construction sites shall be adequately shown in the videotape.
- C. Preconstruction Video: Before starting construction, record video of Project site and surrounding properties from different vantage points, as directed by Owner and/or Owner's Representative. All preconstruction video shall be reviewed by Owner and/or Owner's Representative for completeness and clarity. Video determined unacceptable shall be retaken at no additional cost to the Owner.
1. Flag excavation areas and construction limits before recording construction videotapes.
  2. Show existing conditions adjacent to Project site before starting the Work.
  3. Show protection efforts by Contractor.
- D. Training Video: Record video of all training sessions as specified in Section 01830, Startup, Training and Operation and Maintenance Manuals and as directed by Owner and/or Owner's Representative.

END OF SECTION 01323

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## SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes requirements for mobilization/demobilization temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections:
  - 1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.
  - 2. Division 01 Section "Cleaning" for progress cleaning requirements.

#### 1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Bid Proposal. Allow other entities to use temporary services and facilities without cost, including, but not limited to Owner's construction forces, Owner's Representative, other Contractors, Engineer, testing agencies, and authorities having jurisdiction.
- B. Sanitary Facilities: Pay and provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- C. Water Service: Provide electric water meter at each source utilized. Contractor, Owner and Owner's Representative shall verify meter reading at start and completion of use of water for the Project. Pay water service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Provide electric meter at each source utilized. Contractor, Owner and Owner's Representative shall verify meter reading at start and completion of use of electric for the Project. Pay electric power service use charges for electricity used by all entities for construction operations.
- E. Telephone/Cell Phone Service: Pay telephone/cell phone service use charges for telephone/cell phone/fax use by all entities for construction operations.

#### 1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## 1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Materials and facilities required for mobilization shall conform to the Contract Documents and any pertinent Local or State law, regulation, or code.
- C. The mobilization work required to provide the above facilities and services for mobilization shall be done in a safe and workmanlike manner and shall conform with any/all pertinent Local and State law, regulation, or code. Good housekeeping, consistent with safety, shall be maintained.

## PART 2 - PRODUCTS

### 2.1 TEMPORARY FACILITIES

- A. Contractor shall prepare a Site Utilization Plan (SUP) showing staging areas, parking areas, stockpile areas, debris container areas, unloading areas, and trailer areas for review by the Owner and Owner's Representative and other contractors.
- B. Evaluate and provide updated site utilization plans monthly, as necessary. Each update shall be submitted to the Owner and Owner's Representative for information purposes and be provided by the last Friday of every month.
- C. Contractor shall install temporary security fencing around staging areas. Owner and Owner's Representative will not be responsible for any stolen items and access control.
- D. Meeting(s) will be held at the site with all concerned parties to assist the Contractor in developing the criteria for the plan. During these meeting(s), all parties will present their needs and requirements for site utilization. Representatives from the local municipality or utility companies may be attending. The requirements of the local municipality and utility companies shall be incorporated into the SUP.
- E. Contractor shall then prepare a draft site plan that attempts to incorporate the needs of all concerned parties. Another meeting will then be held at the site to review and present the plan. The plan shall then be revised at that meeting and adopted for use if it is acceptable to all relevant parties. If all parties cannot agree on an acceptable plan, then the Owner's Representative will establish the SUP without any claims from any contractor.
- F. Contractor, by submitting a bid, understands the importance of a workable SUP and also understands that the Owner's Representative may be required to select a plan for the Contractor to adopt that is not ideal to the planned construction activities anticipated before the bid was submitted. There shall be no claims for damages associated with site utilization. If the Contractor fails to prepare the SUP as stipulated above, then the Owner reserves the right to back charge the Contractor for the costs associated with having a SUP developed.

- G. All facilities, materials and equipment provided under this Section shall be provided and maintained in good working order at all times. Any materials or equipment that malfunctions shall be repaired or replaced at no additional cost to Owner.
- H. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.
  - 2. Project materials and supplies that must be stored outside of the elements.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - 1. Exact location of temporary field trailers, portable sanitary facilities and temporary utilities shall be determined and agreed to at a meeting with the Contractor, Owner and Owner's Representative.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Steps shall be taken by Contractor to comply with all noise, vibration, fume, dust, vapor and gas regulations.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use. Provide backflow prevention device in accordance with Owner's requirements. Provide water meters(s) necessary to measure water usage during construction. Contractor, Owner and Owner's Representative shall verify meter readings for the Project. Usage shall be back charged to the Contractor at rate paid by Owner.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- D. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 1. Install electric power service overhead, unless otherwise indicated.

2. Connect temporary service to Owner's existing power source, as directed by Owner.
  3. Location for power connection shall be determined by Owner. Contractor shall provide electric meters(s) necessary to measure electric usage during construction. Contractor, Owner and Owner's Representative shall verify meter reading at start and completion of use of electric for the Project. Usage shall be back charged to the Contractor at rate paid by Owner.
- E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- F. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one (1) telephone line for each field office.
1. Provide additional telephone lines for the following:
    - a. Provide a dedicated telephone line for each facsimile machine in each field office.
    - b. Provide one (1) telephone line(s) for Owner's Representative and Owner's use.
  2. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Owner's Representative's office.
    - e. Owner's office.
    - f. Principal subcontractors' field and home offices.
    - g. Contact information for all contract parties 24/7 (Owner, Owner's Representation and Contractor).
  3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Owner facilities, equipment, personnel, materials, specialty, supplies and conveyances shall not be utilized at anytime by Contractor or his subcontractor(s) or any worker without written permission by Owner. In order to obtain written permission for use of any Owner item, except personnel, it shall be necessary for Contractor to obtain such qualified manufacturer representatives that shall certify in writing that the item requested for use can be accommodated by the item for the intended use. Further, all maintenance on the item to make the item certifiable by the manufacturer's representative and to keep the item in operating condition shall be paid for by the Contractor intending to use the item for the duration of the construction. The use of the equipment, material, facility, specialty, supply or conveyance shall be back charged at a unit rate to the Contractor for each usage at 4-hour minimum time for each day the item is used.
  2. Owner and Owner's Representative, if needed for anything other than planned shutdowns and emergencies, shall be requested in writing at least 96 hours prior to the anticipated need for them. The Owner and Owner's Representative shall be reimbursed for actual costs including benefits and administrative costs with a multiplier of 3 for Owner and Owner's Representative. Regardless of any activity all overtime costs for Owner and

- Owner's Representative shall be reimbursed by a back charge to the Contractor that shall be deducted from that month's payment request.
3. Provide construction for temporary offices, shops, and sheds located within construction area.
  4. Maintain support facilities until Substantial Completion. Remove following Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner and Owner's Representative.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas, as required and adequate for construction operations.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust. Keep dust within the Project site to a minimum at all times.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
  3. Contractor shall be responsibility to maintain traffic access to all Owner facilities on a 24-hour per day, 7-day per week basis. Traffic maintenance shall be maintained by whatever means necessary at all times by the Contractor and at no additional cost to the Owner.
- D. Parking: On-site parking is limited. Contractor shall provide temporary offsite parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Dewatering shall require permits and permitted discharge(s). Contractor shall obtain all required permits and provide detailed dewatering plan signed and sealed by a Professional Engineer licensed in the State of New York and with a minimum five (5) years experience in the design and construction of dewatering systems. Contractor shall not discharge groundwater directly into creeks, ponds, lakes or waterways without first obtaining approval(s) and/or proper permit(s) from all applicable regulatory agencies. Before discharge into surface waters, dewatering effluents must be filtered through hay bales or detained settling basins to avoid sedimentation to the receiving waters. If necessary, baffling devices shall be used to prevent the scouring of the bed or banks of any receiving stream.
- F. Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations and provide for safe work environment.
- G. Project Signs: No signs or advertisements of any nature will be permitted on the Project without prior approval of the Owner's Representative.
1. Provide signs, as required, to clearly direct deliveries to a location by the Field Office for inspection prior to off loading (if found to be acceptable for off loading).
  2. Provide traffic signs indicating temporary changes to normal traffic flow on site.
  3. Provide temporary, directional signs for construction personnel and visitors.
  4. If required, insert a list of necessary signs and add Project-specific provisions such as special graphics and special lighting.
  5. Maintain and touchup signs so they are legible at all times.



- H. Waste Disposal:
1. Provide waste-collection containers in sizes adequate to handle waste from construction operations.
  2. Comply with requirements of authorities having jurisdiction.
  3. Comply with Division 01 Section "Cleaning" for progress cleaning requirements.
  4. Provide systems for controlling and managing solid waste related to the Work.
  5. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
  6. Properly handle and dispose of solid waste.
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials.
- J. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- K. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- L. Noise control enclosures may be necessary for dewatering and/or bypass pumping. All efforts shall be made by all parties to avoid the erection/construction of temporary enclosures to reduce noise but, if deemed necessary by the Owner and/or Owner's Representative, Contractor shall erect/construct these temporary facilities at no additional cost to the Owner. Contractor vehicles and equipment shall minimize noise to greatest degree practicable. Noise levels shall conform to Laws and Regulations, including OSHA requirements and local ordinances. Noise levels shall not interfere with the work of Owner or others.
- M. Dust Control
1. Control objectionable dust caused by Contractor's operation of vehicles and equipment, clearing, or other actions. To minimize airborne dust, apply water or use other methods subject to acceptance of Owner's Representative and approval of authorities having jurisdiction.
  2. Provide necessary labor, materials, equipment, and incidentals to apply sufficient dust suppressants; properly clean all track-out areas to driveways, roadways, and highways, and provide adequate physical stabilizations of soils to comply with accepted dust control plan. Control fugitive dust generation from Contractor's operations including the following areas:
    - a. Construction areas.
    - b. Vehicle and equipment parking areas.
    - c. Material and equipment storage areas.
    - d. Site office, trailer, and staging areas.
    - e. Haul and access roadways.
    - f. Track-out areas.
    - g. Other areas where Contractor will work, store materials or equipment, or park vehicles and equipment.

3. Do not cause or allow dust generating operations, earthmoving operations, use of property, or other operations that result in fugitive dust emissions that exceed limits prescribed by authorities having jurisdiction.

N. Pollution Control

1. Pollution Control – General:

- a. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere caused by discharge of noxious substances from construction operations.
- b. Equipment used during construction shall conform to federal, state, and local Laws and Regulations.

2. Spills and Contamination:

- a. Provide equipment and personnel to perform emergency measures required to contain spillages, and to remove contaminated soils or liquids.
- b. Excavate contaminated earth and legally dispose of off-site and replace with suitable compacted fill and topsoil.

O. Atmospheric Pollutants:

1. Provide systems for controlling atmospheric pollutants related to the Work.
2. Prevent toxic concentrations of chemicals.
3. Prevent harmful dispersal of pollutants into atmosphere.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 01 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways in accordance with the New York State (NYS) Standards and Specifications for Erosion and Sediment Controls and NYS Stormwater Design Manual. Measures shall cover temporary facility area and all construction sites.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from the Project site during the course of the Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff from rains and snow melt. Protect all new work and existing structures from stormwater and flooding. Implement special measures to prevent harmful substances from entering surface waters. Prevent disposal of wastes, effluents, chemicals, or other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers. 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 to prevent erosion, damage, or nuisance. Provide, operate, and maintain equipment and facilities of adequate size to control surface water. Dispose of drainage water in manner to prevent flooding, erosion, and other damage to any and all parts of the Site and adjoining areas, and that conforms to Laws and Regulations.
- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Site Enclosure Fence: Before construction operations begin and if directed by Owner and/or Owner's Representative, Contractor shall provide site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish four (4) sets of keys for each lock to Owner.
- F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday. Contractor shall be responsible to protect all new work and existing structures.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Safety fence shall be four (4) ft. high and made from UV stabilized extruded polypropylene. Color shall be bright orange. Safety fence shall be lightweight, durable, and highly visible. Wood posts shall be hardwood, four (4) inches diameter minimum, embedded minimum three (3) feet in the ground and spaced maximum eight (8) feet.
- I. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for owner. Perform control operations lawfully, using environmentally safe materials. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.

### 3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor.
  2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  3. Work areas shall be left clean and in neat condition, temporary items removed, any and all damage repaired, and all refuse removed. All cleaning shall be done in a manner acceptable to the Owner and Owner's Representative.
  4. Restore pavements, walks, curbs, lawns, and other exterior surfaces damaged during performance of the Work to match the appearance and performance of existing corresponding surfaces as closely as practicable.
  5. Topsoil and seed or sod lawn areas damaged during performance of the Work and new lawn areas inside the limits of the performance of the Work. Contractor shall water as required until physical completion of the Work.
  6. Repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."
- D. Temporary Fire Protection (NIC): Install and maintain temporary fire-protection facilities of types needed to protect against reasonable predictable and controllable fire losses. Comply with NFPA 241.
1. Prohibit smoking in construction areas.
  2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction. Hot Work permits shall be utilized at all times that open flames, sparks, cutting or welding of metals is performed.
  3. Develop and supervise an overall fire-prevention and –protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.6 REMOVALS

- A. At the conclusion of the Work, all equipment, tools, temporary structures, and materials belonging to the Contractor shall be promptly taken away; he shall remove and promptly dispose of all debris, rubbish, or any foreign substances.

- B. All temporary sanitary facilities shall be removed entirely from the job and the site and all appurtenances restored to as new condition.

3.7 PAYMENT

- A. All costs under this section shall be prorated over the duration of the Project and paid monthly over the duration of the Project.

END OF SECTION 01500

## SECTION 01600 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products and special warranties.
- B. Related Sections:
  - 1. Division 01 Section "Substitution Procedures" for requests for substitutions.

#### 1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

#### 1.4 ACTION SUBMITTALS

- A. Comply with requirements in Division 01 Section "Shop Drawing Procedures." Show compliance with requirements.

#### 1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
  - 1. Contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
  - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Owner and/or Owner's Representative will determine which products shall be used.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Products shall not be delivered to Site until related Shop Drawings have been approved by Owner and/or Owner's Representative.
  - 3. Make all arrangements for transportation, delivery and handling of equipment and materials required for completion of the Work.
  - 4. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 5. Shipments of materials shall be delivered to the site only during regular working hours. Shipments shall be addressed and consigned to the proper party giving name of Project, street number and city. Shipments shall not be delivered to Owner and/or Owner's Representative unless directed by Owner and/or Owner's Representative.
  - 6. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. All shipments shall contain a parts list and manufacturer's part number in a plastic zippered envelope. Inform the Owner and/or Owner's Representative of all equipment deliveries under this Contract. 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.
  - 7. Inspect products on delivery to determine:
    - a. Compliance with the Contract Documents and reviewed submittals.
    - b. Products are undamaged and properly protected.
    - c. Quantities are correct.
    - d. Containers and packages are intact, labels are legible.
    - e. Products are properly protected and undamaged.
  - 8. Do not deliver materials to job until they can be properly protected and until required storage facilities have been provided. Owner shall not provide storage in any building, structure or facility. Should the Owner agree to allow storage the security and responsibility of the stored item(s) lies solely with the Contractor. Any damage, theft, or other problem with any stored item is the solely the responsibility of the Contractor.
  - 9. Provide equipment and personnel necessary to handle products by methods to prevent soiling or damage to products or packaging.
  - 10. Provide additional protection during handling as necessary to prevent scraping, marring or otherwise damaging products or surrounding surfaces.
  - 11. Handle products by methods to prevent bending or overstressing.
  - 12. Lift heavy components only at designated lifting points.
  - 13. 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

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Make every effort to minimize extended storage periods for materials and equipment at the Site by judiciously scheduling deliveries to coincide with construction needs. Do not store unnecessary materials or equipment at the Site and take care to prevent any structure from being loaded with a weight which will endanger its integrity or the safety of persons. All storage and methods of protection for material and equipment at the Site shall be subject to the prior approval of the Owner's Representative. Any costs associated with the storage and protection of materials and equipment shall be included in the lump sum bid and no additional payment will be made.
3. Store materials in a manner that will not endanger surrounding structures.
4. Materials shall not be placed within ten (10) feet of fire hydrants.
5. Avenues for personnel and vehicular movement, gutters, drainage channels and inlets shall be kept unobstructed at all times.
6. In general, minimum protection for all materials shall include storage above ground, under waterproof cover, with ventilation adequate to prevent condensation.
7. Storage of any mechanical or electrical equipment outdoors at any time is absolutely prohibited regardless of the protection furnished. Storage of mechanical and electrical equipment within structures at the Site owned by the Owner will not be permitted.
8. All mechanical and electrical equipment shall be coated, wrapped and otherwise protected from snow, rain, drippings of any sort, dust, dirt, condensed water vapor, etc. during shipment, storage, and subsequent to installation and until placed in service.
9. All equipment having moved parts such as gears, electric motors, etc. and/or instruments shall be stored in a temperature and humidity-controlled building approved by the Owner, until such time as the equipment is to be installed.
10. Should storage of mechanical and electrical equipment become necessary before it can be stored at the Site, the Contractor shall provide storage in a weatherproof warehouse.
11. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
12. Comply with product manufacturer's written instructions for maintenance, temperature, humidity, ventilation, and weather-protection requirements for storage.
13. Protect stored products to prevent damage from moisture, rain, dirt, cold, sunlight, and other harmful influences and liquids from freezing.
14. All costs for equipment protection including warehousing or other work to meet the scheduled completion date shall be included in the Bid and no additional payment will be made.
15. If necessary to move stored materials and equipment during construction, Contractor shall move or cause to be moved materials and equipment without any additional compensation.

D. Material, Services, and Facilities



1. It is understood that except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the work within the specified time.
2. Unless otherwise stated in the Contract Documents, it will be understood that only articles or materials manufactured or produced in the United States will be used on the work.
3. After receipt of the Notice of Award, the Contractor shall furnish the Owner and/or Owner's Representative within ten (10) days the names and addresses of all companies from whom he proposes to purchase materials or manufactured products which are to be incorporated into the work. He shall also designate the location of plant or plants to be used for the mixing or batching of materials. The source of supply of each of the materials specified shall be approved by the Owner and/or Owner's Representative before delivery is started.
4. In those instances where the Owner and/or Owner's Representative deems it necessary to have physical inspections made of materials, products, sources of supply, or of mixing, batching, or manufacturing processes, the Contractor shall give the Owner and/or Owner's Representative not less than ten (10) working days notice plus travel time prior to all inspections.
5. Only materials conforming to the requirements of these Specifications and approved by the Owner and/or Owner's Representative shall be used in the work. No material which, after approval, has in any way become unfit for use, shall be used in the work. Acceptance at any time of any material shall not be a bar to its future rejection if subsequently found to be defective or inferior in quality or uniformity in the materials specified. Any material may be rejected if, in the opinion of the Owner and/or Owner's Representative, service records indicate that it is unsound or otherwise unsatisfactory.
6. Manufacturer and/or supplier shall furnish with each delivery of material a sworn statement certifying that the products furnished meet all the requirements of the Specifications, that all the required tests were performed, and that the product meets or exceeds all specified test requirements. Contractor shall transmit these certified statements along with the original forms reporting results from any and all testing to the Owner and/or Owner's Representative within twenty- four (24) hours of delivery of materials.
7. Materials, supplies, or equipment to be incorporated into the work shall not be purchased by the Contractor or the Subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.
8. Manufactured articles, materials, and equipment shall be stored, applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer, and as approved by the Owner's Representative.
9. Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the work. Stored materials and equipment to be incorporated in the work shall be located so as to facilitate prompt inspection.
10. Aggregate stockpiles shall be located at points approved by the Owner and/or Owner's Representative and so arranged that fine and coarse aggregates or coarse aggregates separated by specification requirements, do not become mixed.
11. Contractor shall provide either approved platforms or a prepared base satisfactory to the Owner and/or Owner's Representative; or at least six (6) inches of the base of the stockpile material shall be left undisturbed until the completion of pavement and structures.
12. Materials from different sources of supply shall not be stored in the same stockpile unless approved by the Owner and/or Owner's Representative.

13. Perishable materials shall be placed in waterproof buildings or otherwise protected from the elements.
14. Stored materials, even though approved before storage, may be subject to further inspection prior to their use in the work and shall meet the requirements of the Specifications at the time it is proposed to use them.
15. Pipe stored adjacent to the trench or on the contract site shall be stored according to the following requirements: (1) Pipe that is stock piled shall be properly checked and strapped to the satisfaction of the Owner and/or Owner's Representative in such a position until ready for use; (2) when pipe is stored singularly adjacent to or in the vicinity of the trench, each length of pipe shall be checked for defects prior to its installation.

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner and/or Owner's Representative reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Owner and/or Owner's Representative shall make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
  1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Substitutions for Contractor's convenience will not be considered.
  2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Substitutions for Contractor's convenience will not be considered.
  3. Products:
    - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Substitutions for Contractor's convenience will not be considered, unless otherwise indicated.
    - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements.
  4. Manufacturers:
    - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with

requirements. Substitutions for Contractor's convenience will not be considered, unless otherwise indicated.

Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements.

PART 3 - EXECUTION - (NOT USED)

END OF SECTION 01600

## SECTION 01651 - TRANSPORTATION AND HANDLING OF PRODUCTS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

##### A. Scope:

1. This Section includes the general requirements for transporting and handling of products.
2. Contractor shall make all arrangements for transporting, delivery, and handling of products required for prosecution and completion of the Work.
3. Move products stored, when necessary, without additional compensation or changes to the Contract Times.

#### 1.2 PREPARATION FOR SHIPMENT

A. When practical, factory-assemble products. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, Owner's contract name and number, Contractor, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Protect products from exposure to the elements and keep thoroughly dry and dust free at all times. Protect painted surfaces against impact, abrasion, discoloration, or other damage. Lubricate bearings and other items requiring lubrication.

##### D. Advance Notice of Shipments:

1. Keep Owner and/or Owner's Representative informed of delivery of all products to be incorporated in the Work.

##### E. Do not have products shipped until:

1. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by Owner and/or Owner's Representative.
2. Related factory testing results, when required in individual Specification Sections, have been reviewed and accepted by Owner and/or Owner's Representative.
3. Required storage facilities have been provided.

#### 1.3 DELIVERY

##### A. Scheduling and Timing of Deliveries:

1. Arrange deliveries of products in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.

2. Schedule deliveries to minimize space required for and duration of on-Site storage of products and equipment.
3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
  - a. Work of other contractors, and Owner.
  - b. Storage space limitations.
  - c. Availability of equipment and personnel for handling products.
  - d. Owner's use of premises.
4. Deliver products to the Site during regular working hours.
5. Do not have products delivered to the site until required storage facilities have been provided.

B. Deliveries:

1. Shipments shall be delivered with Contractor's name, Subcontractor's name (if applicable), Site name, Project name, and contract designation clearly marked.
2. Site may be listed as the "Ship To" or "Delivery" address; but Owner and/or Owner's Representative shall not be listed as recipient of shipment, unless otherwise directed in writing by Owner and/or Owner's Representative.
3. Provide Contractor's telephone number to shipper; do not provide Owner and/or Owner's Representative telephone number.
4. Arrange for deliveries while Contractor's personnel are on-Site. Contractor shall receive and coordinate shipment upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner and/or Owner's Representative, and Contractor shall be responsible for delays and additional costs, if incurred.

C. Containers and Marking:

1. Have products delivered to Site in manufacturer's original, unopened, labeled containers.
2. Clearly mark partial deliveries of component parts of equipment to identify equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Immediately upon delivery, inspect shipment to verify that:

1. Products comply with the Contract Documents and approved or accepted (as applicable) submittals.
2. Quantities are correct.
3. Products are undamaged.
4. Containers and packages are intact and labels are legible.
5. Products are properly protected.

E. Promptly remove damaged products from the Site and expedite delivery of new, undamaged products, and remedy incomplete or lost products to provide that specified, to avoid delaying progress of the Work.

1.4 PRODUCT HANDLING

- A. Provide equipment and personnel necessary to handle products, including those provided by Owner, by methods that prevent soiling or damaging products and 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 that prevent bending or overstressing.
- D. Lift heavy components only at designated lifting points.
- E. Handle products in safe manner and as recommended by manufacturer to prevent damage. Do not drop, roll, or skid products off delivery vehicles or at other times during handling. Hand-carry or use suitable materials handling equipment.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION 01651

NO TEXT THIS PAGE

## SECTION 01661 – STORAGE AND PROTECTION OF PRODUCTS

### PART 1 – GENERAL

#### 1.1 DESCRIPTION

- A. This Section includes general requirements for storing and protecting materials and equipment.

#### 1.2 STORAGE

- A. Store and protect materials and equipment in accordance with manufacturer's printed recommendations and the Contract Documents.
- B. Contractor shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid injuring the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to Owner and/or Owner's Representative, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to provide easy access for inspection.
- C. Areas available at the Site for storing materials and equipment shall be approved by Owner and/or Owner's Representative.
- D. Store materials and equipment to become property of Owner to facilitate their inspection and ensure preservation of quality and fitness of the Work, including proper protection against damage by freezing, moisture, and high temperatures. Store in indoor, climate-controlled storage areas all materials and equipment subject to damage by moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to Owner and/or Owner's Representative. When placing orders to Suppliers for equipment and controls containing computer chips, electronics, and solid-state devices, Contractor shall request, coordinate and comply with specific temperature and humidity limitations on materials and equipment, including temperatures inside cabinets and components that are stored in warm temperatures.
- E. Contractor shall be fully responsible for loss or damage (including theft) to stored materials and equipment.
- F. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer or otherwise specified in the Contract Documents.
- G. Do not store materials or equipment in structures being constructed unless approved by Owner and/or Owner's Representative in writing.
- H. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises.



### 1.3 PROTECTION

- A. Equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01651 - Transportation and Handling of Products.
- B. Store all materials and equipment off the ground or floor on raised supports such as skids or pallets.
- C. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of Owner and/or Owner's Representative.
- D. Protect electrical equipment, controls, and instrumentation against moisture, water damage, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

### 1.4 UNCOVERED STORAGE

- A. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
  - 1. Reinforcing steel.
  - 2. Structural steel.
  - 3. Piping, except polyvinyl chloride (PVC) or chlorinated PVC (CPVC) pipe.
  - 4. Precast concrete materials.
  - 5. Castings.
  - 6. Handrails and railings.
  - 7. Grating.
  - 8. Checker plate.
  - 9. Metal stairs.
  - 10. Metal access hatches.
  - 11. Fiberglass products.
  - 12. Rigid electrical conduit.

### 1.5 COVERED STORAGE

- A. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
  - 1. Rough lumber.
  - 2. PVC and CPVC pipe.
  - 4. Masonry units.
  - 5. Grout and mortar materials.
- B. Tie down covers with rope, and slope covering to prevent accumulation of water.
- C. Store loose granular materials, with covering impervious to water, in well-drained area or on solid surfaces to prevent mixing with foreign matter.

## 1.6 FULLY PROTECTED STORAGE

- A. Store all material and equipment on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on all sides. Covering with visquine plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:
  - 1. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
  - 2. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.
  - 3. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
  - 4. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

## 1.7 HAZARDOUS PRODUCTS

- A. Prevent contamination of personnel, storage area, and the Site. Comply with manufacturer's instructions.

## 1.8 MAINTENANCE OF STORAGE

- A. On scheduled basis, periodically inspect stored materials and equipment to ensure that:
  - 1. State of storage facilities is adequate to provide required conditions.
  - 2. Required environmental conditions are maintained on continuing basis.
  - 3. Materials and equipment exposed to elements are not adversely affected.
- B. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer's instructions for servicing each item, with notice of enclosed instructions shown on exterior of container or package.
  - 1. Comply with manufacturer's instructions on scheduled basis.
  - 2. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is placed in service and permanently connected.

## 1.9 MICROPROCESSORS, PANELS, AND INSTRUMENTATION STORAGE

- A. Store panels, microprocessor-based equipment, electronics, and other devices subject to damage or decreased useful life because of temperatures below 40 degrees F or above 100 degrees F, relative humidity above 90 percent, or exposure to rain or exposure to blowing dust in climate-controlled storage space.
- B. Requirements:
  - 1. Storage shall be indoors and climate controlled.
  - 2. Owner and/or Owner's Representative have the right to inspect materials and equipment during normal working hours.
  - 3. Placed inside each panel or device a desiccant, volatile corrosion inhibitor blocks (VCI), moisture indicator, and maximum minimum indicating thermometer.
  - 4. Check panels and equipment at least once per month. Replace desiccant, VCI, and moisture

indicator as often as required, or every six months, whichever occurs first.

5. Certified record of daily maximum and minimum temperature and humidity in storage facility shall be available for inspection by Owner and/or Owner's Representative. Certified record of monthly inspection, noting maximum and minimum temperature for month, condition of desiccant, VCI, and moisture indicator, shall be available for inspection by Owner and/or Owner's Representative.

C. Costs for storing climate-sensitive materials and equipment shall be paid by Contractor. Replace panels and devices damaged during storage, or for which storage temperatures or humidity range has been exceeded, at no additional cost to Owner. Delays resulting from such replacement are causes within Contractor's control.

D. Do not ship panels and equipment to the Site until conditions at the Site are suitable for installation, including slabs and floors, walls, roofs, and environmental controls. Failure to have the Site ready for installation shall not relieve Contractor from complying with the Contract Documents.

#### 1.10 RECORDS

A. Keep up-to-date account of materials and equipment in storage.

PART 2 – PRODUCTS - (NOT USED)

PART 3 – EXECUTION - (NOT USED)

END OF SECTION 01661

## **SECTION 01710 – RECORD DRAWINGS AND CLOSEOUT PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section includes administrative and procedural requirements for record drawings contract closeout, including, but not limited to, the following:

- 1. Progress record drawings.
- 2. Project record drawings.
- 3. Substantial completion procedures.
- 4. Final completion procedures.
- 5. Warranties.
- 6. Final cleaning.

- B. Related Sections:

- 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- 2. Division 01 Section "Job Photographs" for submitting final completion construction photographic documentation.
- 3. Division 01 Section "Temporary Facilities and Controls" for construction waste disposal.
- 4. Division 01 Section "Cleaning" for progress cleaning of project site.
- 5. Division 01 Section "Startup, Training and Operation and Maintenance Manuals" for operation and maintenance manual requirements.
- 6. Divisions 02 through 17 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

#### **1.3 RECORD DRAWINGS**

- A. Record Prints: Maintain one (1) set of blue or black-line white prints of the contract documents and shop drawings on-site in Contractor's field office.

- 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is installer, Subcontractor, or similar entity, to prepare the marked-up record prints.
  - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
  - b. Accurately record information in an understandable drawing technique.

- c. Record data shall be updated on a monthly basis. Record and check the mark-up before enclosing concealed installations.
2. Content: Types of items requiring marking include, but are not limited to, the following:
  - a. Dimensional changes to drawings.
  - b. Locations and depths of underground utilities.
  - c. Revisions to routing of piping and conduits.
  - d. Actual equipment locations.
  - e. Changes made by Change Order.
  - f. Changes made following Owner's Representative's written orders.
  - g. Details not on the original Contract Drawings.
  - h. Field records for variable and concealed conditions.
  - i. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
7. Maintain in the Contractor's field office in a clean, dry and legible condition complete sets of the following: Contract drawings, specifications, addenda, approved shop drawings, samples, change orders, modifications to contract, test records, field/change orders, and all other documents pertinent to the Contractor's work.
8. Provide files and racks for proper storage and easy access. File in accordance with filing format of Construction Specification Institute (CSI) unless otherwise approved by Owner and/or Owner's Representative.
  - a. Make documents available at all times for inspection by the Owner and/or Owner's Representative.
  - b. Record documents shall not be used for any other purpose and shall not be removed from the office without the Owner and/or Owner's Representative approval.
9. Contractor shall submit on a monthly basis two (2) prints of all Record Plans developed or added to so as to reflect that month's construction activity and progress. This submittal by the Contractor shall accompany his monthly requisition for payment and the submittal's accuracy and adequacy must be approved as a prerequisite to processing said requisition. Substantial completion payment or final payment to the Contractor will not be processed until the Record Plans are approved by the Owner and/or Owner's Representative.
10. All Record Plans shall have the following data as applicable contained thereon:
  - a. The notation "Record Plan" in prominent lettering.
  - b. Description of material.
  - c. Explanatory notes qualifying the information contained on the Record Plan.
  - d. Contractor's name, address, and phone number.

11. Contractor shall be responsible for all costs associated with reproducing Record Plans if they are lost, damaged, or otherwise marred at any time prior to final Owner acceptance of the entire set of Record Plans.
- B. Record AutoCAD Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Owner's Representative. Prepare a full set of corrected mylar AutoCAD Drawings of the Contract Drawings, as follows:
1. Format: Same AutoCAD program, version, and operating system as the original Contract Drawings.
  2. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Owner's Representative for resolution.
  4. Owner's Representative will furnish Contractor one (1) set of AutoCAD Drawings of the Contract Drawings for use in recording information.
    - a. Owner's Representative makes no representations as to the accuracy or completeness of AutoCAD Drawings as they relate to the Contract Drawings.
    - b. CAD Software Program: Contract Drawings are available in AutoCAD.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing Record Drawings where Owner's Representative determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
  2. Consult Owner's Representative for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in two (2)-inch high printed letters, in a prominent location.
1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets. Prior to final payment, provide five (5) paper copies and two (2) mylar copies of all record drawings once record drawings have been approved.
  2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
  3. Record AutoCAD Drawings: Organize AutoCAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each AutoCAD file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Owner's Representative.

- e. Name of Contractor.
5. The additional cost for preparation of record plans resulting from an approved Change Order is considered included in the cost of the Change Order.

#### 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
- 1. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Owner's Representative.
    - d. Name of Contractor.
    - e. Page number.
  - 2. Submit list of incomplete items in the following format:
    - a. Three (3) paper copies of product schedule or list, unless otherwise indicated. Owner's Representative will return one (1) copy.

#### 1.5 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
- 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
  - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  - 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  - 8. Complete startup testing of systems.
  - 9. Submit test/adjust/balance records.
  - 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  - 11. Advise Owner of changeover in heat and other utilities.
  - 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  - 13. Complete final cleaning requirements, including touchup painting.

14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. Within ten (10) days after receipt of such notice, Owner's Representative shall either proceed with inspection or notify Contractor of unfulfilled requirements. Owner and Owner's Representative shall generate punch list and any outstanding items preventing substantial completion for transmittal to Contractor.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for final completion.
- C. Follow-up Inspection:
1. At time of completion of guarantee period, Owner's Representative will make arrangements with Contractor for follow-up inspection and send written notice to said parties to inform them of date and time of inspection. After inspection, Owner's Representative will inform the Contractor of any corrections required.
- D. Spare Parts and Special Tools: Contractor shall submit a list of spare parts and special tools for each piece of equipment installed for this Project to be turned over to the Owner to the Owner's Representative. The list shall include all spare parts and special tools mentioned in Contract Documents and those included in the approved O&M Manuals. Each list shall include the name of the part or tool along with the corresponding manufacturer's reference number shown in the parts list of the O&M Manuals. Each and every spare part, including those in any kit to be turned over, shall be marked with the corresponding spare part number shown on the list. Each kit shall also be marked with the corresponding kit number in addition to each individual part number in the kit. Any discrepancy found at the time of the turnover to the Owner shall be reason to reject the parts, either partial or in total by the Owner at the Owner's discretion. After two (2) attempts by Contractor to turnover the spare parts without achieving compliance, the Contractor will be back charged for the time and effort of the Owner's Representative to participate in the review of any and all lists for the parts and tools as well as the time and effort to participate in the turnovers. All spare parts and tools shall be delivered by Contractor to a location designated by Owner once the spare parts and special tools have been accepted, in writing, by Owner.

## 1.6 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
1. Submit certified copy of Owner's Representative's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Owner's Representative. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  2. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  3. Train Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems in accordance with Section 01830 - Start-up, Training and Operation and Maintenance Manuals.



- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Owner's Representative will either proceed with inspection or notify Contractor of unfulfilled requirements.
  - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
- C. When in the opinion of the Owner's Representative the Contractor has fully performed the Work under the Contract, the Owner's Representative will recommend to the Owner the acceptance of the Work so completed. The Owner's Representative's recommendation will indicate the value of the work performed and materials and equipment furnished, and exact aggregate amount of the compensation to which the Contractor will become entitled under the terms of the Contract.

## 1.7 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Owner's Representative for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated. Original warranty documentation shall be submitted with copies in each O&M manual. Original warranty submittals shall have the beginning and end date of each warranty clearly indicated on the warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor. Occupancy or use of any portion of the Work by Owner before final completion and written acceptance shall not be construed as evidence of final acceptance of the Work.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
  - 4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.
- E. Related Damages and Losses: When correcting warranted work that has failed, removal and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

- F. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation as determined by Owner's Representative.
- G. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.
- H. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- I. Rejection of Warranties: Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the contract Documents.
- J. Owner reserves the right to refuse to accept work for the Project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments have done so.
- K. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers and subcontractors required to countersign special warranties with the Contractor.
- L. Warranties shall be provided for all equipment specified in Divisions 02 to 17.
- M. Unless more stringent requirements are specified in the various specification Sections of Divisions 02 to 17 and the General and Supplementary Conditions, all warranties shall be for a minimum of one (1) year from beneficial use by Owner or from Substantial Completion.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
- B. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations. Contractor shall maintain cleaning until Project is accepted by the Owner.

- C. Construction Waste Disposal: Comply with waste disposal requirements in Division 1 Section "Temporary Facilities and Controls."

END OF SECTION 01710

## SECTION 01724 - CONNECTIONS TO EXISTING FACILITIES

### PART 1 – GENERAL

#### 1.1 DESCRIPTION

##### A. Scope:

1. This Section includes requirements for connections to existing facilities.
2. Contractor shall provide labor, materials, tools, equipment, and incidentals shown, specified, and required for connections to existing facilities.

##### B. Coordination:

1. Review installation procedures under other Sections and coordinate Work that must be performed with or before the Work specified in this Section.
2. Notify other contractors in advance of Work for connections to existing facilities to provide other contractors sufficient time for work included in their contracts that must be installed with or before Work specified in this Section.

##### C. Related Sections:

1. Section 01723 - Cutting and Patching.

##### D. General:

1. To extent possible, materials, equipment, systems, piping, and appurtenances that will be placed into service upon completion of connection to existing facilities shall be checked, successfully tested, and in condition for operation prior to making connections to existing facilities, if valves, gates, or similar watertight and gastight isolation devices are not provided at the connection point.

### PART 2 – PRODUCTS (NOT USED)

### PART 3 – EXECUTION (NOT USED)

END OF SECTION 01724

NO TEXT THIS PAGE

## SECTION 01740 - CLEANING

### PART 1 – GENERAL

#### 1.1 DESCRIPTION

##### A. Scope:

1. Contractor shall execute cleaning during the Work, at completion of the Work, and as required by the General Conditions.
2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

#### 1.2 REFERENCES

##### A. Standards referenced in this Section are:

1. NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

#### 1.3 PROGRESS CLEANING

##### A. General: Clean the Site, work areas, and other areas occupied by Contractor at least weekly. Dispose of materials in accordance with the General Conditions and the following:

1. Comply with NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold non-combustible materials at the Site more than three days if the temperature is expected to rise above 80 degrees F. When temperature is less than 80 degrees F, dispose of non-combustible materials within seven days of their generation.
3. Provide suitable containers for storage of waste materials and debris.
4. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

##### B. Owner's Right to Clean: Should the Contractor fail, refuse or neglect to remove rubbish and waste materials and temporary work or clean the contract area as required herein, then the Owner may without obligation to do so, remove and dispose of the said rubbish, waste materials and temporary work, clean the contract area and deduct the cost thereof from any money due, or to become due, the Contractor under this Contract.

##### C. Site:

1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
2. At least weekly, brush-sweep roadways and paved areas at the Site that are used by construction vehicles or otherwise affected by the Work.

D. Work Areas:

1. Clean areas where Work is in progress to level of cleanliness necessary for proper execution of the Work.
2. Remove liquid spills promptly and immediately report spills to Owner, Owner's Representative, and authorities having jurisdiction.
3. Where dust would impair proper execution of the Work, broom-clean or vacuum entire area of Work, as appropriate.
4. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

E. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning agents and methods specifically recommended. If manufacturer does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health or property and that will not damage exposed surfaces.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.

G. Cutting and Patching:

1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
2. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal:

1. Properly dispose of waste materials, surplus materials, debris and rubbish off the Site.
2. Do not burn or bury rubbish and waste materials at the Site.
3. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers or sanitary sewers.
4. Do not discharge wastes into surface waters or drainage routes.
5. Contractor shall be solely responsible for complying with federal, state, and local Laws and Regulations regarding disposal of waste.

I. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where required for protection from damage or deterioration, until Substantial Completion.

J. Clean completed construction as frequently as necessary throughout the construction period.

K. Field Offices shall be cleaned weekly at a minimum. Cleaning shall include removal of trash and garbage, vacuuming of carpeted surfaces and mopping of other floor surfaces, dusting and washing of sanitary facilities as well as other surfaces and office items, once monthly cleaning of interior and exterior windows and ventilation and heating equipment (including ductwork interiors) as directed. All costs shall be included in Contractor's Bid.

#### 1.4 CLOSEOUT CLEANING

A. Complete the following prior to requesting inspection for Substantial Completion:

1. Clean and remove from the Site rubbish, waste material, debris, and other foreign substances.
2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
3. Hose-clean sidewalks and loading areas.
4. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
5. Leave surface waterways, drainage routes, and gutters open and clean.
6. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to specified condition; if condition is not specified, restore to original condition.
7. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition.
9. Remove debris from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, and similar spaces.
10. In unoccupied spaces, sweep concrete floors broom-clean.
11. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
12. Remove non-permanent tags and labels.
13. Touch up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
  - a. Do not paint over "UL" or similar labels, including mechanical and electrical nameplates.
14. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign substances.
15. Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.
16. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
17. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace temporary lamps provided in permanent fixtures. Replace existing light fixture components that are burned out or noticeably dimmed from use during the Work. Replace defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
18. Leave the Site clean, and in neat, orderly condition, satisfactory to Owner and Owner's Representative.

PART 2 – PRODUCTS - (NOT USED)

PART 3 – EXECUTION - (NOT USED)

END OF SECTION 01740



NO TEXT THIS PAGE

## SECTION 01752 - EQUIPMENT AND SYSTEMS STARTUP AND PERFORMANCE TESTING

### PART 1 – GENERAL

#### 1.1 DESCRIPTION

##### A. Scope:

1. Contractor shall provide all labor, materials, services, equipment, and incidentals required for performance testing of all specified equipment and systems.
2. Conduct performance testing for each item of process; mechanical; instrumentation and control; electrical systems and equipment; and other systems and equipment, to demonstrate compliance with the performance requirements of the Contract Documents.
3. Objectives of performance testing are to:
  - a. Demonstrate to satisfaction of Owner and Owner's Representative that structures, systems, and equipment tested comply with all functional and performance requirements in the Contract Documents.
  - b. Demonstrate that facility is Substantially Complete.
  - c. Establish baseline operating conditions for Owner's use in establishing standard operating procedures and preventative maintenance programs.
4. Utilities and Consumables:
  - a. Contractor shall provide the following: electricity, fuel, compressed air, chemicals, temporary piping and appurtenances, and all other items and Work required for completing performance testing.
  - b. Owner shall provide wastewater or water as required by the system undergoing performance testing. Contractor shall provide temporary piping and appurtenances required to convey to the testing location utilities and consumables furnished by Owner. If re-testing is required, cost of utilities and consumables furnished by Owner shall be paid by Contractor at Owner's cost or standard rates, as applicable.
5. Sequence: The following general sequence applies to performance testing:
  - a. Furnish submittals required prior to performance testing, in accordance with this Section.
  - b. Complete the Work associated with starting and placing equipment in operation.
  - c. To the extent practicable, complete Site quality control Work specified in Specification Sections for individual equipment items and systems.
  - d. Proceed with performance testing in accordance with this Section, simulating the range of actual operating conditions to the greatest extent possible.
  - e. Successful completion of performance testing is required to achieve Substantial Completion.

##### B. Coordination:

1. Review procedures under this and other Sections and coordinate installation and testing of items that must be started up and tested with or before performance testing Work.
2. Notify other Contractor's in advance of performance testing Work to provide them with sufficient time for installing and testing items included in their contracts that must be installed and tested with or before performance testing Work.

3. A Maintenance of Plant Operation (MOPO) plan may need to be developed and agreed upon by Owner, Owner's Representative and Contractor in order to perform the testing procedure as the testing may affect Plant operations. The requirement for any MOPO shall be determined solely by the Owner. Contractor shall be notified in writing of the requirement to develop a MOPO. No testing, or any other action that could possibly affect Plant operations shall be permitted to proceed until an agreed upon MOPO has been developed by Contractor and accepted by the Owner. Owner shall make every effort to accommodate the needs and methods of the Contractor, but maintenance of Plant operations shall take precedence over all other concerns.

## 1.2 TERMINOLOGY

- A. The following words or terms are not defined but, when used in this Section, have the following meaning:

1. A "system" includes all required items of equipment, devices, and appurtenances connected so that their operation or function complements, protects, or controls the operation or function of the others.

## 1.3 QUALITY ASSURANCE

- A. Qualifications:

1. Contractor's Performance Testing Manager:

- a. Appoint a performance testing manager, who shall:

- 1) Manage, coordinate, and supervise Contractor's performance testing.
- 2) Assist in coordinating and documenting Site quality control Work specified in individual Specifications Sections.
- 3) Prepare, or review and approve, all submittals for the Work under this Section
- 4) Coordinate activities of Subcontractor's and Suppliers relative to performance testing.
- 6) Make frequent visits to the Site during performance testing.
- 7) Contact and schedule all manufacturer's and/or supplier's representatives for their presence at scheduled Performance and Acceptance testing stages.

- B. Pre-performance Testing Conference:

1. After initial submittal of documentation plan and performance testing plan and prior to starting performance testing, arrange a meeting at Site with Contractor's performance testing manager, Contractor's other key personnel, equipment Suppliers' technical representatives, authority having jurisdiction over operating permit(s), Owner's Representative, Owner, and other representatives directly concerned with performance testing Work. Record discussions of conference and decisions and agreements and disagreements and furnish a copy of record to each party attending. Review foreseeable methods and procedures relating to performance testing Work including:

- a. Review Project requirements including Contract Documents, submittals related to performance testing, requests for interpretations relative to performance testing, and other pertinent documents.
- b. Review required submittals, both completed and to be completed.
- c. Review status of the equipment and systems to be performance tested and work to be

- completed prior to performance testing.
  - d. Review Progress Schedule and testing schedule.
  - e. Review status of utilities and consumables required for performance testing.
  - f. Review required inspections, testing, certifying, and quality control procedures.
  - g. Review methods for complying with Laws and Regulations and requirements of authorities having jurisdiction, such as compliance with facility operating permit requirements, insurance requirements, environmental protection, health, safety, fire, and similar regulations.
  - h. Review any MOPO's and safety requirements developed for the testing.
2. Reconvene meeting at earliest opportunity if additional information must be developed to conclude the required topics of the meeting.
  3. Record revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

#### 1.4 SUBMITTALS

##### A. Action Submittals: Submit the following:

1. Documentation plan, as specified herein.
2. Performance testing plans, as specified herein.
3. Any Owner required MOPO's.
4. Yellow and blue tag procedures.

##### B. Informational Submittals: Submit the following:

1. Records of pre-performance testing conference.
2. Testing schedules, as specified herein.
3. Notices: Written notice to Owner's Representative and Owner at least 72 hours prior to beginning each test.
4. Site Quality Control Submittals: All records produced during, and results of, performance testing.
5. Qualifications Statements:
  - a. Testing laboratory qualifications and certifications, if not previously submitted under other Sections.
  - b. Qualifications of Contractor's performance testing manager and other required performance testing personnel, including copies of valid operators' licenses issued by authority having jurisdiction.

#### 1.5 DOCUMENTATION PLAN, PERFORMANCE TESTING PLAN, AND TESTING SCHEDULE

##### A. Documentation Plans: Develop recordkeeping system to document compliance with requirements of this Section and authorities having jurisdiction.

1. Calibration documentation including identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, date(s) of subsequent calibrations, calibration method, and test laboratory verifying calibration.
2. Documentation to be provided for each equipment item and system to be tested shall include date of test, equipment tag number or system name, nature of test, test objectives, test results, test instruments employed, and signature spaces for Contractor's performance testing manager

and Owner's and Owner's Representative's observers. Establish separate file for each system and equipment item to be tested. Files shall include the following information, as applicable, when associated tests, source quality control, or Site quality control measures are required in the Contract Documents:

- a. Metallurgical tests, when required.
  - b. Source quality control (factory) tests.
  - c. Accelerometer recordings made during shipment, when such recordings are required.
  - d. Field calibration tests, in accordance with the Contract Documents.
  - e. Field hydrostatic tests for equipment and systems that operate under pressure, in accordance with the Contract Documents.
  - f. Site quality control testing, in accordance with the Contract Documents.
  - g. Vibration analyses, amperage, load testing, megger testing, mandril testing, and voltage readings for generators, conduit, wires, motors, pumps and control panels as appropriate.
3. Forms:
- a. Develop forms specific to each item of equipment and system being tested, to document results of testing.
  - b. Provide forms approved by Owner's Representative in sufficient quantity to document all testing Work.

B. Performance Testing Plans:

1. Develop performance testing plans describing in detail coordinated, sequential performance testing of each system and equipment item to be tested. Each performance testing plan shall be specific to the system or equipment item to be performance-tested, and shall identify by specific equipment or tag number each device or control station to be manipulated or observed during performance testing, and specific results to be observed or obtained. Performance testing plans shall also be specific regarding support systems required to complete the performance testing Work, temporary devices and systems required (if any) during performance testing, Subcontractor's and Suppliers to be present during performance testing, and planned performance testing duration. Performance testing plans shall include:
  - a. Summary of start-up, check-out, and Site quality control testing required for each system or equipment item prior to starting performance testing.
  - b. Calibration of all field instruments and control devices.
  - c. Description of and information on temporary systems, equipment, and devices proposed for performance testing, including calibration data for temporary instrumentation and controls.
  - d. Plan and procedures for implementing performance testing of systems and equipment. Performance tests shall duplicate the operating conditions described in the Contract Documents.
  - e. Description of data reduction required, if any, and proposed time between collection of data and submittal of results to Owner's Representative.
  - f. Summary of criteria for acceptance of test results. Summary shall include performance tolerances (if any) included in the Contract Documents. Where performance tolerances are not included in the Contract Documents, testing plan shall include proposed performance tolerances.
2. Performance testing plans shall contain complete description of proposed procedures to achieve desired testing environment.
3. Following Owner's Representative's review of performance testing plans, Contractor shall reproduce performance testing plans in sufficient quantity for Contractor's purposes plus five

copies to Owner's Representative and five copies to Owner. Do not start performance testing until required quantity of approved performance testing plans is provided.

C. Testing Schedule:

1. Provide a testing schedule that sets forth the planned sequence for performance testing Work.
2. Testing schedule shall be part of the Progress Schedule and shall conform to requirements for Progress Schedule, except as specified in this Section.
3. Test schedule shall:
  - a. Detail the equipment and systems to be performance-tested, and the testing duration required for each.
  - b. Show planned start date, duration, and completion of each performance test.
  - c. Submitted no later than four weeks in advance of the date performance testing is to begin. Owner's Representative will not observe performance testing Work until test schedule is accepted by Owner's Representative.
  - d. Be updated weekly and resubmitted to Owner's Representative. Updates shall indicate actual dates of performance testing Work, indicating systems and equipment for which performance testing is in progress, and that are satisfactorily completed in accordance with the Contract Documents.

1.6 FIELD TESTING OF EQUIPMENT

A. General:

1. Field testing of equipment shall conform to the requirements of the General Conditions, 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, 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. 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. Contractor shall furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.
5. Contractor shall make all changes, adjustments and replacements required to place equipment in service and test it.
6. Owner's Representative and Owner shall be given a minimum 72 hours prior notice to observe tests.
7. When Contractor has demonstrated to Owner's Representative that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Owner's Representative and attached to the equipment. The tag shall not be removed. Owner may require a MOPO for preliminary field testing.
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 Owner's Representative, 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, 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 Owner's personnel.
  - c. In compliance with design conditions, material specifications and all other requirements of the Contract Documents.
4. Contractor shall submit test procedure for review by Owner's Representative. The procedure shall specify the duration and the parameters of the test. Owner may require a MOPO for final field testing.
5. Contractor shall notify the Owner's Representative at least 72 hours prior to beginning of tests. Contractor shall keep notes and data on tests and submit copy to the Owner's Representative. Owner's Representative and Owner's operating personnel shall observe all tests.
6. The equipment will be placed in continuous operation as prescribed or required and observed by the Owner's Representative.
7. Until final field tests are acceptable to the Owner's Representative, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to Owner.
8. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
9. Upon acceptance of the field tests a blue tag will be issued. The tag will be signed by the Owner's Representative 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 Owner's Representative.
10. All costs in connection with such tests including all materials, equipment, instruments, labor, etc. shall be borne by the Contractor.
11. Manufacturer shall provide written verification on company letterhead that the equipment has been fully tested and is ready to be placed into service.

PART 2 – PRODUCTS - (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

- A. Before starting the performance testing, complete the following:
  1. Prepare and align equipment in accordance with equipment Specifications.
  2. To the extent practicable, complete equipment tests and check-out in accordance with the Contract Documents and manufacturers' recommendations.
  3. Complete other tests required by the Contract Documents, including instrumentation and controls calibration and testing, piping tests, electrical tests, and other tests required prior to full operation of the system or facility.

B. Temporary Systems and Devices Required for Performance Testing:

1. Minimize the need for temporary systems and devices required for performance testing.
2. Provide temporary connections and bulkheads as required, and make other provisions to recirculate process fluids and gasses as required or otherwise simulate the range of anticipated operating conditions for the systems and equipment being performance-tested. During performance testing, Contractor's performance testing manager and team shall monitor the characteristics of each equipment item and system and report unusual conditions to Owner's Representative.
3. Properly install temporary systems. Test temporary equipment and devices in accordance with manufacturer's instructions to verify suitability for use in performance testing. Test temporary piping using in accordance with requirements for associated permanent piping.

3.2 PERFORMANCE TESTING

- A. Contractor's performance testing manager shall organize teams comprising qualified representatives of Suppliers, Subcontractor's, Contractor's independent testing laboratory (if applicable), and others as appropriate, to efficiently and complete performance testing Work within the Contract Times and in accordance with the accepted Progress Schedule.
- B. Performance testing shall be done in accordance with the approved performance testing plan, approved documentation plan, and accepted testing schedule.
- C. Field testing of equipment shall conform to the requirements of the General Conditions, Technical Specifications and as hereinafter specified.
- D. Preliminary Field Tests, Yellow Tag (as mentioned in Section 1.6)
- E. Final Field Tests, Blue Tag (as mentioned in Section 1.6)

END OF SECTION 01752



NO TEXT THIS PAGE

## SECTION 01783 - SPARE PARTS AND MAINTENANCE MATERIALS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. Contractor shall furnish spare parts data and maintenance materials for products per the Contract Documents.
- B. List of Spare Parts and Maintenance Materials: With the Shop Drawings and product data for each Specification Section, submit to Owner's Representative, a complete list of spare parts, extra materials, maintenance supplies, and special tools required for maintenance ("spare parts and maintenance materials"), with current unit prices in U.S. funds, and source (or sources) of supply for each.
- C. Packaging and Labeling: Furnish spare parts and maintenance materials required per the Contract Documents in manufacturer's unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion or deterioration for maximum length of storage normally anticipated by manufacturer. Packaging of spare parts and maintenance materials shall be clearly marked and identified with name of manufacturer or Supplier, applicable equipment, part number, part description, and part location in the equipment. Protect and package spare parts and maintenance materials for maximum shelf life normally anticipated by manufacturer.
- D. Storage Prior to Delivery to Owner: Prior to delivering spare parts and maintenance materials to Owner, store spare parts and maintenance materials per the Contract Documents and manufacturers' printed recommendations.
- E. Delivery Time and Eligibility for Payment:
  - 1. Deliver to Owner spare parts and maintenance materials no later than date of Substantial Completion for products or system associated with spare parts and maintenance materials. Do not deliver spare parts and maintenance materials earlier than date that start-up commences for associated equipment or system.
  - 2. Spare parts and maintenance materials are not eligible for payment until delivered to Owner.
- F. Procedure for Delivery to Owner: Deliver spare parts and maintenance materials to location specified by Owner's Representative. When spare parts and maintenance materials are delivered, the Owner's Representative shall coordinate with Owner and Contractor a mutually agreed upon time and date to review the inventory of spare parts that are to be turned over to verify compliance with the Contract Documents regarding quantity and part numbers. Upon completion of the turnover, Contractor shall be responsible for moving the parts to Owner's storage location for the parts. Additional procedures for delivering spare parts and maintenance materials to Owner, if required, will be developed by Owner's Representative and complied with by Contractor.

G. Transfer Documentation:

1. Provide on Contractor letterhead a letter of transmittal for spare parts and maintenance materials furnished under each Specification Section. Letter of transmittal shall accompany spare parts and maintenance materials. Do not submit letter of transmittal separate from products.
2. Provide three original, identical, signed letters of transmittal for each Specification Section. Upon delivery of specified quantities and types of products to Owner, designated person from Owner will countersign each original letter of transmittal indicating Owner's receipt of spare parts and maintenance materials. Owner will retain one fully signed original, Contractor will furnish one fully signed original to Owner's Representative, and Contractor will retain one fully signed original for Contractor's file.
3. Letter of transmittal shall include the following:
  - a. Date of letter.
  - b. Project name, and contract name and number.
  - c. Contractor's name and address.
  - d. Transmittal shall list for spare parts and maintenance materials furnished under each Specification Section. List each individual part or product and quantity provided.
  - e. Provide space for countersignature by Owner as follows: space for signature, space for printed name, and date.

H. Contractor shall be fully responsible for loss or damage to spare parts and maintenance materials until products are received by Owner.

I. Spare Parts and Special Tools: Contractor shall submit a list of spare parts and special tools for each piece of equipment installed for this Project to be turned over to the Owner to the Owner's Representative. The list shall include all spare parts and special tools mentioned in Contract Documents and those included in the approved O&M Manuals. Each list shall include the name of the part or tool along with the corresponding manufacturer's reference number shown in the parts list of the O&M Manuals. Each and every spare part, including those in any kit to be turned over, shall be marked with the corresponding spare part number shown on the list. Each kit shall also be marked with the corresponding kit number in addition to each individual part number in the kit. Any discrepancy found at the time of the turnover to the Owner shall be reason to reject the parts, either partially or in total by the Owner at the Owner's discretion. After two (2) attempts by Contractor to turnover the spare parts without achieving compliance, the Contractor will be back charged for the time and effort of the Owner's Representative to participate in the review of any and all lists for the parts and tools as well as the time and effort to participate in the turnover. All spare parts and tools shall be delivered by Contractor to a location designated by Owner once the spare parts and special tools have been accepted, in writing, by Owner.

PART 2 – PRODUCTS - (NOT USED)

PART 3 – EXECUTION - (NOT USED)

END OF SECTION 01783

**SECTION 01830 – STARTUP, TRAINING, AND OPERATION AND MAINTENANCE MANUALS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. Contractor shall provide all labor, materials, services, equipment, appurtenances and all related materials to successfully startup and test the equipment, provide operations and maintenance manuals, train operators and maintenance personnel and provide all necessary spare parts.
- B. Coordination: Review installation procedures under other Specification Sections and coordinate Work that must be performed with or before the Work specified in this Section.
- C. Notify other Contractors in advance of Work requiring coordination with Owner's Operations.
- D. Submittals:
  - 1. Provide detailed description of equipment and testing procedures including testing sequence, coordination, documentation plan, field testing summary, and consumables.
  - 2. Operations and Maintenance Manual Preliminary Submittal:
    - a. Three (3) copies, exclusive of copies required by Contractor.
    - b. Provide submittal to Owner's Representative by the earlier of: ninety (90) days following approval of Shop Drawings and related submittals, or thirty (30) days prior to starting operations and maintenance personnel training and preliminary field operational testing at the Site.
  - 3. Operations and Maintenance Manual Final Submittal: Provide final submittal prior to Substantial Completion, unless submittal is specified as required prior to an interim Milestone.
    - a. Printed Copies: Three (3) copies.
    - b. Electronic Copies: Two (2) copies.
  - 4. Personnel Training Information:
    - a. Lesson Plan: Acceptable proposed lesson plan for training on each product or equipment item, per Table 01780-A and Specifications. Lesson plan shall conform to requirements of this Specification Section. Include with lesson plan copy of handouts that will be used during training sessions. Provide lesson plan submittals per time frames specified in this Specification Section.
    - b. Qualifications: Credentials of Supplier's proposed operations and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Specification Section and shall include brief resume and specific details of instructor's operation, maintenance, and training experience relative to the specific products for which instructor will provide training.
  - 5. Spare parts list anticipated delivery times, special tools list and transfer documentation.

## 1.2 STARTUP AND TESTING

### A. Description:

1. Contractor shall provide all labor, materials, services, equipment, and incidentals required for performance testing of the equipment.
2. Conduct performance testing for each item of process; mechanical; instrumentation and control; electrical systems and equipment; and other systems and equipment, to demonstrate compliance with the performance requirements of the Contract Documents.
3. Objectives of performance testing are to:
  - a. Demonstrate to satisfaction of Owner and Owner's Representative that structures, systems, and equipment tested comply with all functional and performance requirements in the Contract Documents.
  - b. Demonstrate Substantial Completion.
  - c. Establish baseline operating conditions for Owner's use in establishing standard operating procedures and preventative maintenance programs.
4. Utilities and Consumables:
  - a. Contractor shall provide the following: electricity, fuel, compressed air, chemicals, temporary piping and appurtenances, and all other items and Work required for completing performance testing.
  - b. Owner shall provide partially treated wastewater, water, or potable water as required by the system undergoing performance testing. Contractor shall provide temporary piping and appurtenances required to convey to the testing location utilities and consumables furnished by Owner. If re-testing is required, cost of utilities and consumables furnished by Owner for initial testing shall be paid by Contractor at Owner's cost or standard rates, as applicable.
5. Sequence: The following general sequence applies to performance testing:
  - a. Provide submittals required prior to performance testing, in accordance with this Section.
  - b. Complete the Work associated with starting and placing equipment in operation.
  - c. To the extent practicable, complete Site quality control Work specified in Specification Sections for individual equipment items and systems.
  - d. Proceed with performance testing in accordance with this Section, simulating the range of actual operating conditions to the greatest extent possible.
  - e. Successful completion of performance testing is required to achieve Substantial Completion.

### B. Coordination:

1. Review procedures under this and other Sections and coordinate installation and testing of items that must be started up and tested with or before performance testing Work.
2. Notify other Contractor's in advance of performance testing Work to provide them with sufficient time for installing and testing items included in their contracts that must be installed and tested with or before performance testing Work.
3. A Maintenance of Plant Operation (MOPO) plan may need to be developed by the Contractor and agreed upon by Owner and Owner's Representative in order to perform the testing

procedure as the testing may affect Plant operations. The requirement for any MOPO shall be determined solely by the Owner. Contractor shall be notified in writing of the requirement to develop a MOPO. No testing, or any other action that could possibly affect Plant operations shall be permitted to proceed until an agreed upon MOPO has been developed by Contractor and accepted by the Owner. Owner shall make every effort to accommodate the needs and methods of the Contractor, but maintenance of Plant operations shall take precedence over all other concerns.

C. Pre-Performance Testing Conference:

1. After initial submittal of documentation plan and performance testing plan and prior to starting performance testing, arrange a meeting at Site with Contractor's performance testing manager, Contractor's other key personnel, equipment Suppliers' technical representatives, authority having jurisdiction over operating permit(s), Owner's Representative, Owner, and other representatives directly concerned with performance testing Work. Record discussions of conference and decisions and agreements and disagreements and furnish a copy of record to each party attending. Review foreseeable methods and procedures relating to performance testing Work including:
  - a. Review Project requirements including Contract Documents, submittals related to performance testing, requests for interpretations relative to performance testing, and other pertinent documents.
  - b. Review required submittals, both completed and to be completed.
  - c. Review status of the equipment and systems to be performance tested and work to be completed prior to performance testing.
  - d. Review Progress Schedule and testing schedule.
  - e. Review status of utilities and consumables required for performance testing.
  - f. Review required inspections, testing, certifying, and quality control procedures.
  - g. Review methods for complying with Laws and Regulations and requirements of authorities having jurisdiction, such as compliance with facility operating permit requirements, insurance requirements, environmental protection, health, safety, fire, and similar regulations.
  - h. Review any MOPO's and safety requirements developed for the testing.
2. Reconvene meeting at earliest opportunity if additional information must be developed to conclude the required topics of the meeting.
3. Record revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

D. Performance Testing Plans:

1. Develop performance testing plans describing in detail coordinated, sequential performance testing of each system and equipment item to be tested. Each performance testing plan shall be specific to the system or equipment item to be performance-tested and shall identify by specific equipment or tag number each device or control station to be manipulated or observed during performance testing, and specific results to be observed or obtained. Performance testing plans shall also be specific regarding support systems required to complete the performance testing Work, temporary devices and systems required (if any) during performance testing, Subcontractor's and Suppliers to be present during performance testing, and planned performance testing duration. Performance testing plans shall include:

- a. Summary of start-up, check-out, and Site quality control testing required for each system or equipment item prior to starting performance testing.
  - b. Calibration of all field instruments and control devices.
  - c. Description of and information on temporary systems, equipment, and devices proposed for performance testing, including calibration data for temporary instrumentation and controls.
  - d. Plan and procedures for implementing performance testing of systems and equipment. Performance tests shall duplicate the operating conditions described in the Contract Documents.
  - e. Description of data reduction required, if any, and proposed time between collection of data and submittal of results to Owner's Representative.
  - f. Summary of criteria for acceptance of test results. Summary shall include performance tolerances (if any) included in the Contract Documents. Where performance tolerances are not included in the Contract Documents, testing plan shall include proposed performance tolerances.
2. Performance testing plans shall contain complete description of proposed procedures to achieve desired testing environment.
  3. Following Owner's Representative's review of performance testing plans, Contractor shall reproduce performance testing plans in sufficient quantity for Contractor's purposes plus two (2) copies to Owner's Representative and three (3) copies to Owner. Do not start performance testing until required quantity of approved performance testing plans is provided.

E. Testing Schedule:

1. Provide a testing schedule that sets forth the planned sequence for performance testing Work.
2. Testing schedule shall be part of the Progress Schedule and shall conform to requirements for Progress Schedule, except as specified in this Section.
3. Test schedule shall:
  - a. Detail the equipment and systems to be performance-tested, and the testing duration required for each.
  - b. Show planned start date, duration, and completion of each performance test.
  - c. Submitted no later than four (4) weeks in advance of the date performance testing is to begin. Owner's Representative will not observe performance testing Work until test schedule is accepted by Owner's Representative.
  - d. Be updated weekly and resubmitted to Owner's Representative. Updates shall indicate actual dates of performance testing Work, indicating systems and equipment for which performance testing is in progress, and that are satisfactorily completed in accordance with the Contract Documents.

1.3 FIELD TESTING OF EQUIPMENT

A. General:

1. Field testing of equipment shall conform to the requirements of the General Conditions, Technical Specifications and as hereinafter specified.

B. Preliminary Field Tests:

1. As soon as conditions permit, after the equipment has been secured in its permanent position, 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. 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. Contractor shall furnish all labor, materials, instruments, fuel, incidentals, and expendables required, unless otherwise provided.
5. Contractor shall make all changes, adjustments and replacements required to place equipment in service and test it.
6. Owner's Representative and Owner shall be given a minimum 72 hours prior notice to observe tests.

C. Final Field Tests:

1. Upon completion of the installation, and at a time approved by the Owner's Representative, 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, 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 Owner's personnel.
  - c. In compliance with design conditions, material specifications and all other requirements of the Contract Documents.
4. Contractor shall submit test procedure for review by Owner's Representative. The procedure shall specify the duration and the parameters of the test. Owner may require a MOPO for final field testing.
5. Contractor shall notify the Owner's Representative at least 72 hours prior to beginning of tests. Contractor shall keep notes and data on tests and submit copy to the Owner's Representative. Owner's Representative and Owner's operating personnel shall observe all tests.
6. The equipment will be placed in continuous operation as prescribed or required and observed by the Owner's Representative.
7. Until final field tests are acceptable to the Owner's Representative, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to Owner.
8. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
9. All costs in connection with such tests including all materials, equipment, instruments, labor, etc. shall be borne by the Contractor.
10. Manufacturer shall provide written verification on company letterhead that the equipment has been fully tested and is ready to be placed into service.

1.4 OPERATIONS AND MAINTENANCE MANUALS

A. Binding and Cover:

1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s),



- comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.
2. Binders shall be locking three-ring/"D"-ring type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front of each volume.
  3. Do not overfill binders.
  4. Covers shall be oil, moisture, and wear resistant, including identifying information on cover and spine of manual.
  5. Provide the following information on cover of each volume:
    - a. Title, "OPERATING AND MAINTENANCE INSTRUCTIONS".
    - b. Name or type of equipment covered in the manual.
    - c. Volume number, if more than one volume is required.
    - d. Name of Project and, if applicable, contract name and number.
    - e. Name of building or structure, as applicable.
  6. Provide the following information on spine of each volume:
    - a. Title, "OPERATING AND MAINTENANCE INSTRUCTIONS".
    - b. Name or type of equipment covered in the manual.
    - c. Volume number, if more than one volume is required.
    - d. Project name and building or structure name.
- B. Pages:
1. Print pages in manual on 30-pound (minimum) paper, 8.5 inches by 11 inches.
  2. Reinforce binding holes in each individual sheet with plastic, cloth, or metal. When published, separately bound booklets or pamphlets are included in the manual, reinforcing of pages within booklet or pamphlet is not required.
  3. Provide each page with binding margin of at least one inch wide. Punch each page with holes suitable for the associated binding.
- C. Drawings:
1. Bind into the manual drawings, diagrams, and illustrations up to and including 11 by 17 inches in size, with reinforcing specified for pages.
  2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Provide no more than three (3) drawings per pocket.
- D. Copy Quality and Document Clarity:
1. All contents shall be original-quality copies. Materials shall either be original manufacturer-printed materials or first-generation photocopies indistinguishable from originals. Manuals that contain copies that are not clear; not completely legible; off-center; skewed; or where text or drawings are cut by binding holes, will be rejected. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable. Faxed copies are unacceptable.
  2. Clearly mark in ink all components of equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options provided or cross out inapplicable material. Use of highlighters is unacceptable.
- E. Organization:

1. Table of Contents:
  - a. Provide table of contents in each volume of each operation and maintenance manual.
  - b. In table of contents and at least once in each chapter or section, identify products by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is explained in table bound at or near end of each volume. Using product model or catalog designations for identification is not acceptable.
2. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

F. Electronic Copies of Manuals:

1. Electronic copy shall include all information provided in hardcopy.
2. Provide each electronic copy on a separate compact disc (CD).
3. File Format:
  - a. Files shall be in “portable document format (PDF)”. Files shall be electronically searchable.
  - b. Provide separate file for each separate document in the hardcopy.
  - c. Within each file, provide bookmarks for the following:
    - 1) Each chapter and subsection listed in the hardcopy document’s table of contents.
    - 2) Each figure.
    - 3) Each table.
    - 4) Each appendix.

G. Copies of Programming and Configuration Files:

1. Provide on CD copy of all software programming prepared specifically for the Project. Third-party, commercially available software is excluded from requirements of this article; provide copies of commercially available, third-party software as specified in the Contract Documents.
2. Provide on CD copies of system configuration prepared specifically for the Project, such as SCADA display configurations.
3. Provide number of programming and configuration files as specified for electronic copies of operation and maintenance data.

H. Content:

1. Provide complete, detailed written operating instructions for each product including function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by product and proper responses to such alarm conditions.
2. Provide written explanations of all safety considerations relating to operation and maintenance procedures.
3. Provide complete, detailed, written preventive maintenance instructions including all information and instructions to keep product or system properly lubricated, adjusted, and maintained so that products function economically throughout design life. Instructions shall include:

- a. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Provide pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.
  - b. Recommended schedule for each preventive maintenance task.
  - c. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
  - d. Table of alternative lubricants.
  - e. Troubleshooting instructions.
  - f. List of required maintenance tools and equipment.
4. Complete bills of material or parts lists for products provided. Lists or bills of material may be provided on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
- a. Manufacturer's name, address, telephone number, fax number, and Internet website address.
  - b. Manufacturer's local service representative's or local parts supplier's name, address, phone number, fax number, and Internet and e-mail addresses, if applicable.
  - c. Manufacturer's shop order and/or serial number(s) for product or assembly furnished.
  - d. For each part or piece provide:
    - 1) Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawing, Shop Drawing, or other type of illustration where the part is clearly shown.
    - 2) Part name or description.
    - 3) Manufacturer's part number.
    - 4) Quantity of each part used in each assembly.
    - 5) Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.
5. Complete instructions for ordering of all replaceable parts, including reference numbers (e.g., shop order or serial number) that will expedite ordering process.
6. Manufacturer's recommended inventory levels for spare parts and consumable supplies for the first two years of operation. Consumable supplies are those items consumed or worn by operation of equipment, and items used in maintaining the operation of product, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Provide estimated delivery times, shelf-life limitations, and special storage requirements. Manufacturer/supplier parts list part numbers shall correspond to each and every spare part turned over to the Owner. It shall be the Contractor's responsibility to coordinate and confirm all parts numbers between manufacturer's literature and the spare parts to be turned over. All corrections necessary to the O&M manuals shall be the Contractor's responsibility.
7. Provide manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Avoid providing catalog excerpts unless they are the only material available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific product supplied. Marking may be in the form of checking, arrows, or underlining to show pertinent information, or by crossing out or other means of obliterating information that does not apply to the products furnished.
8. Provide original-quality copies of each approved and accepted Shop Drawing and submittal, updated to as-installed condition. Reduced drawings are permissible only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

9. Provide complete electrical schematic and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
10. Copy of warranty bond and service contract as applicable.
11. When copyrighted material is used in operations and maintenance manual, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

#### 1.5 OPERATOR TRAINING

- A. Provide acceptable lesson plan fourteen (14) days prior to starting associated training.
- B. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be provided, and training procedures. Handouts to be used in training shall be attached to lesson plan when applicable. Describe in lesson plan "hands-on" demonstrations planned for training sessions.
- C. Lesson plan shall include estimated duration of each training segment.
- D. Lesson plan shall include the following:
  1. Equipment Overview (required for all types of operations and maintenance training):
    - a. Describe equipment's operating (process) function and performance objectives.
    - b. Describe equipment's fundamental operating principles and dynamics.
    - c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
    - d. Identify all support equipment associated with operation of subject equipment (i.e., air intake filters, valve actuators, motors, etc.).
    - e. Identify and describe all safety precautions and potential hazards related to operation.
    - f. Identify and describe in detail safety and control interlocks.
  2. Operations Personnel Training:
    - a. Equipment Overview: As described above.
    - b. Operation:
      - 1) Describe operating principles and practices.
      - 2) Describe routine operating, start-up, and shutdown procedures.
      - 3) Describe abnormal or emergency start-up, operating, and shutdown procedures that may apply.
      - 4) Describe alarm conditions and responses to alarms.
      - 5) Describe routine monitoring and recordkeeping procedures.
      - 6) Describe recommended housekeeping procedures:
    - c. Troubleshooting:
      - 1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.

3. Mechanical Maintenance Training:

- a. Equipment Overview: As described above.
- b. Equipment Preventive Maintenance:
  - 1) Describe preventative maintenance inspection procedures required to:
    - a) Inspect equipment in operation.
    - b) Spot potential trouble symptoms and anticipate breakdowns.
    - c) Forecast maintenance requirements (predictive maintenance).
  - 2) Define recommended preventative maintenance intervals for each component.
  - 3) Provide lubricant and replacement part recommendations and limitations.
  - 4) Describe appropriate cleaning practices and recommend intervals.
  - 5) Identify and describe use of special tools required for maintenance of equipment.
  - 6) Describe component removal/installation and disassembly/assembly procedures.
  - 7) Perform “hands-on” demonstrations of preventive maintenance procedures.
  - 8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
  - 9) Define recommended torquing, mounting, calibrating, and aligning procedures and settings, as appropriate.
  - 10) Describe recommended procedures to check and test equipment following corrective maintenance.
- c. Equipment Troubleshooting:
  - 1) Define recommended systematic troubleshooting procedures.
  - 2) Provide component-specific troubleshooting checklists.
  - 3) Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
  - 4) Describe common corrective maintenance procedures with “hands on” demonstrations.

4. Instrumentation/Controls Maintenance Training:

- a. Equipment Overview: As described above.
- b. Preventative Maintenance and Troubleshooting: Owner’s Representative may grant waiver(s) to allow all training for a given system to be at the Site.

E. Training Aids:

- 1. Supplier’s instructor shall incorporate training aids as appropriate to assist in the instruction. Provide text and figure handouts. Other appropriate training aids include:
  - a. Audio-visual aids, such as videos, power point presentations, overhead transparencies, posters, blueprints, diagrams, catalog sheets.
  - b. Equipment cutaways and samples, such spare parts and damaged equipment.
  - c. Tools, such as repair tools, customized tools, measuring and calibrating instruments.

2. Handouts:
  - a. Supplier's instructor shall utilize descriptive class handouts during training. Customized handouts developed especially for training at the Site are encouraged.
  - b. Photocopied handouts shall be good quality and completely legible.
  - c. Handouts should accompany the instruction with frequent reference made to handouts.
3. Provide a minimum of 10 copies of approved training manuals and handouts.
4. Trainee Sign-in Sheets: In format acceptable to Owner, provide sign-in sheet for trainees for each session. Sign-in sheets shall include the Project name, product or system for which training was provided, and type of training (e.g., operations, mechanical maintenance, instrumentation/controls maintenance, or other), and name of each trainee. Upon completion of training, provide copy of each sign-in sheet to Owner's training coordinator.
5. "Hands-on" Demonstrations:
  - a. Supplier's instructor shall present "hands-on" demonstrations of operations and maintenance of equipment for each training session, per lesson plan accepted by Owner's Representative.
  - b. Contractor and Supplier shall all provide tools necessary for demonstrations.

F. Training Schedule:

1. Travel time and expenses are responsibility of Supplier and are excluded from required training time.
2. Training Sessions Required:
  - a. Operators: Maximum training per day is eight (8) hours; sessions longer than eight (8) hours shall be spread over multiple, preferably consecutive, days.

1.6 SPARE PARTS DESCRIPTION

- A. Contractor shall furnish spare parts data and maintenance materials for products per the Contract Documents.
- B. List of Spare Parts and Maintenance Materials: With the Shop Drawings and product data for each Specification Section, submit to Owner's Representative, a complete list of spare parts, extra materials, maintenance supplies, and special tools required for maintenance ("spare parts and maintenance materials") required for two (2) years of operation, with current unit prices in U.S. funds, and source (or sources) of supply for each.
- C. Packaging and Labeling: Furnish spare parts and maintenance materials required per the Contract Documents in manufacturer's unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion or deterioration for maximum length of storage normally anticipated by manufacturer. Packaging of spare parts and maintenance materials shall be clearly marked and identified with name of manufacturer or Supplier, applicable equipment, part number, part description, and part location in the equipment. Protect and package spare parts and maintenance materials for maximum shelf life normally anticipated by manufacturer.

- D. Storage Prior to Delivery to Owner: Prior to delivering spare parts and maintenance materials to Owner, store spare parts and maintenance materials per the Contract Documents and manufacturers' recommendations.
- E. Delivery Time and Eligibility for Payment:
  - 1. Deliver to Owner spare parts and maintenance materials no later than date of Substantial Completion for products or system associated with spare parts and maintenance materials. Do not deliver spare parts and maintenance materials earlier than date that start-up commences for associated equipment or system.
  - 2. Spare parts and maintenance materials are not eligible for payment until delivered to Owner.
- F. Procedure for Delivery to Owner: Deliver spare parts and maintenance materials to location specified by Owner's Representative. When spare parts and maintenance materials are delivered, the Owner's Representative shall coordinate with Owner and Contractor a mutually agreed upon time and date to review the inventory of spare parts that are to be turned over to verify compliance with the Contract Documents regarding quantity and part numbers. Upon completion of the turn over, Contractor shall be responsible for moving the parts to Owner's storage location for the parts. Additional procedures for delivering spare parts and maintenance materials to Owner, if required, will be developed by Owner's Representative and complied with by Contractor.
- G. Transfer Documentation:
  - 1. Provide on Contractor letterhead a letter of transmittal for spare parts and maintenance materials furnished under each Specification Section. Letter of transmittal shall accompany spare parts and maintenance materials. Do not submit letter of transmittal separate from products.
  - 2. Provide three original, identical, signed letters of transmittal for each Specification Section. Upon delivery of specified quantities and types of products to Owner, designated person from Owner will countersign each original letter of transmittal indicating Owner's receipt of spare parts and maintenance materials. Owner will retain one fully signed original, Contractor will furnish one fully signed original to Owner's Representative, and Contractor will retain one fully signed original for Contractor's file.
  - 3. Letter of transmittal shall include the following:
    - a. Date of letter.
    - b. Project name, and contract name and number.
    - c. Contractor's name and address.
    - d. Transmittal shall list for spare parts and maintenance materials furnished under each Specification Section. List each individual part or product and quantity provided.
    - e. Provide space for countersignature by Owner as follows: space for signature, space for printed name, and date.
- H. Contractor shall be fully responsible for loss or damage to spare parts and maintenance materials until products are received by Owner.
- I. Spare Parts and Special Tools: Contractor shall submit a list of spare parts and special tools for each piece of equipment installed for this Project to be turned over to the Owner to the Owner's Representative. The list shall include all spare parts and special tools mentioned in Contract Documents and those included in the approved O&M Manuals. Each list shall include the name of the part or tool along with the corresponding manufacturer's reference number shown in the parts list of the O&M Manuals. Each and every spare part, including those in any kit to be turned over, shall

be marked with the corresponding spare part number shown on the list. Each kit shall also be marked with the corresponding kit number in addition to each individual part number in the kit. Any discrepancy found at the time of the turnover to the Owner shall be reason to reject the parts, either partially or in total by the Owner at the Owner's discretion. After two (2) attempts by Contractor to turnover the spare parts without achieving compliance, the Contractor will be back charged for the time and effort of the Owner's Representative to participate in the review of any and all lists for the parts and tools as well as the time and effort to participate in the turnover. All spare parts and tools shall be delivered by Contractor to a location designated by Owner once the spare parts and special tools have been accepted, in writing, by Owner.

PART 2 – PRODUCTS - (NOT USED)

PART 3 – EXECUTION - (NOT USED)

END OF SECTION 01830



NO TEXT THIS PAGE

## SECTION 02050 – DEMOLITION, REMOVALS AND MODIFICATIONS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. Contractor shall provide all labor, materials, equipment, tools, and supplies, as necessary for all work required for the demolition and removal of specific parts of the present facilities, as shown in the Contract Documents, as may be required to install new Work and, except those parts as are indicated in the Contract Documents to remain.

#### 1.2 RELATED SECTIONS

- A. Temporary Facilities and Controls: Section 01500
- B. Cutting and Patching: Section 01723

#### 1.3 CONDITIONS

- A. Demolition and removals shall be done at times and methods agreeable to the Owner and/or Owner's Representative. Prior to commencement of any demolition and removals, Contractor shall submit for review a detailed demolition and removal plan outlining the intended demolition, removal and legal transportation and disposal procedures and schedule for conducting same. Demolition and removal plan will not relieve Contractor of complete responsibility for the successful performance of the Work in accordance with all applicable Federal, State, and local codes and restrictions.
- B. Prior to commencement of any demolition and removals, Contractor shall obtain all necessary Federal, State, and local jurisdiction permits and pay all associated fees necessary to perform all phases and operations of the Work.
- C. Contractor shall assume all existing painted surfaces to contain lead based paints. Contractor shall take precautions, as required, to prevent spread of lead containing particles and dust.
- D. Contractor shall recycle demolition debris to the maximum extent possible.
- E. Contractor shall exercise precautions for fire protection. Burning and use of explosives shall be prohibited.
- F. Contractor shall protect all utilities during the Work of this Section.
- G. Contractor shall verify location and status of all utilities within the Contract Limits.
- H. Fluorescent lighting fixtures containing ballasts with PCB's shall be dispose of in compliance with all applicable rules and regulations.
- I. Prior to commencing demolition and removals, Contractor shall verify that all utilities to be demolished and/or removed have been disconnected.
- J. Contractor shall not disrupt utility services to buildings.

- K. Contractor shall execute the demolition and removal Work to prevent damage to structures, existing elements, adjacent features, vehicles and pedestrians which might result from falling debris or other causes, and so as not to interfere with the use, and free and safe passage to and from adjacent structures.
- L. Contractor shall provide interior and exterior shoring, bracing and support to prevent movement, settlement, or collapse of existing structures or facilities. Owner assumes no responsibility for the actual condition of the structures or facilities adjacent to the Work or the structures of facilities designated for removal or modifications.
- M. Closing or obstructing roadways, sidewalks, and passageways adjacent to the Work by the placement or storage of materials will not be permitted, and all operations shall be conducted with minimum interference to vehicular or pedestrian traffic.
- N. Contractor shall erect and maintain barriers, lights, railings, barricades, signs and other required protective devices.
- O. Contractor shall repair damages caused by his operation to facilities to remain, or to any property belonging to the Owner, utilities, residents or others.
- P. All Work shall comply with the applicable provisions and recommendation of OSHA, ANSI A10.2, Safety Code for Building Construction, all governing codes and as hereinafter specified.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01300 – Shop drawing Procedures.
- B. Permits: Submit one (1) copy of each permit.
- C. Demolition Plan: Submit one copy of demolition plan required under Paragraph 1.3 of this Specification.

#### PART 2 - PRODUCTS - (NOT USED)

#### PART 3 - EXECUTION

##### 3.1 GENERAL

- A. Remove all items and materials, as indicated in the Contract Documents and/or as required to accommodate removal of the existing items/materials and installation of new items/materials at the locations as indicated in the Contract Documents.
- B. Contractor shall remove all demolished material on a daily basis and dispose of such materials in an approved and legal manner and in accordance with all applicable laws governing such disposal.
- C. Contractor shall be responsible for obtaining all permits for transportation and disposal of materials, with all costs for permits, transportation and disposal borne by the Contractor. All material shall be legally transported and disposed of off-site in accordance with all local, state and federal regulations.
- D. Any demolished and/or removed materials which is to remain the property of the Owner (i.e.,

salvaged) shall be stored on the site, where designated by the Owner.

- E. Site of the Work shall be left in a neat and clean condition at all times. Contractor shall grade demolition areas to adjacent contours and slope to drain.
- F. Contractor shall perform demolition in a systematic manner, beginning at the top of the structure and proceeding to lowest elevation.
- G. Contractor shall wet down areas demolition, as required to prevent spread of dust and dirt. Contractor shall design, erect, install and maintain temporary partitions and enclosures required to eliminate dust, noise and debris. Contractor shall not utilize water to extent causing flooding, contaminated runoff, or icing.
- H. Remove all asphalt, concrete, masonry, timber, debris, and any other existing material, structures or features, as indicated in the Contract Documents or as required to be removed, to remove existing items/materials and provide for installation of new items/materials.
- I. Any demolished material which is to remain the property of the Owner shall be stored on the site, where directed by the Owner and sufficiently protected from the weather.
- J. The site of the Work shall be left in a neat and clean condition at all times.
- K. All equipment and methods used in the demolition process shall be approved by the Owner and Owner's Representative.
- L. Contractor shall remove concrete and structures to the lines and grade shown, unless otherwise directed by the Owner and Owner's Representative. Where no limits are shown, Contractor shall request a clarification from the Owner and Owner's Representative. Excess removals shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Owner and Owner's Representative at no additional cost to the Owner.
- M. Contractor shall determine thickness of existing concrete to be removed and the extent to which they are reinforced. No additional compensation will be made due to variation from thickness shown or variation in the amount(s) of reinforcement.
- N. All concrete, brick, concrete block, reinforcement, structural or miscellaneous metals, wire mesh and other items contained in or upon the structure shall be removed and taken from the site, unless otherwise approved by the Owner and Owner's Representative. Demolished items shall not be used as backfill.
- O. Modifications shall conform to all applicable Specifications, the Contract Documents, and the directions and approvals of the Owner and Owner's Representative.
- P. Where alterations require cutting or drilling into existing pipes and structures, the damages shall be repaired in an approved manner. Contractor shall repair such openings with the same or matching materials as the existing pipes or structures, or as otherwise approved by the Owner and Owner's Representative. All repairs shall be smoothly finished unless otherwise approved by the Owner and Owner's Representative.
- Q. For all existing structures that are to remain in service, demolish the portions to be removed, repair damages 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 edges 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.

- R. New Work shall be keyed into the existing in an acceptable manner. 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 Owner and Owner's Representative.
- S. Where existing reinforcement is to be exposed and incorporated into new concrete work, this reinforcement shall be sand blasted clean of all rust and concrete residue and painted with a zinc-rich primer paint.

### 3.2 MECHANICAL REMOVALS

- A. Mechanical removals shall consist of dismantling and removing of existing piping, pumps, motors, fans, tanks, process 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 purposed of making connections thereto will be included under Division 15.
- B. Existing process, water, gas, and other piping shall be removed where shown. All removed piping shall be removed to the nearest solid support, capped and left in place. Gas lines shall be purged and made safe prior to removal or capping. Where piping that is to be removed passes through existing walls, it shall be cut off and properly capped on each side of the wall.
- C. When underground piping it 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.
- D. Waste and vent piping shall be removed to points shown or required. Pipe shall be plugged with cleanouts and plugs. Where piping or ducts pass through an existing roof, the hole in the roof shall be properly patched and made watertight.
- E. Any demolition or changes to potable water piping, gas 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.
- F. Refer also to the Drawings for walls, doors, partitions and equipment relocations necessary to complete demolition and removals Work and new facilities.
- G. 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.

### 3.3 ELECTRICAL REMOVALS

- A. Electrical removals shall consist of the removal of existing transformers, distribution switchboards,

control panels, motors, conduits and wires, poles and overhead wiring, panelboards, lighting fixtures, and miscellaneous electrical equipment, all as required to perform the Work.

- B. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to keep the integrity of the grounding systems.
- C. Where shown or otherwise required, wiring and exposed conduits shall be removed. Concealed conduits which are not to be reused shall be plugged and made watertight. All openings in buildings for entrance of abandoned conduit or direct-burial cable to shall be patched and made watertight.
- D. Panelboards where shown shall be removed and disposed of off-site or as directed by the Owner. All cutting and patching necessary for the removal and replacement of panelboards shall be performed.
- E. Lighting fixtures shall be removed where shown or otherwise required.
- F. Switches, receptacles, starters and other miscellaneous electrical equipment shall be removed where shown or otherwise required and disposed of off-site or as directed by the Owner. Care shall be taken in removing all equipment so as to minimize damage to architectural and structural members. Any damage incurred shall be repaired.

#### 3.4 PROTECTION OF ADJACENT STRUCTURES

- A. All necessary precautions shall be taken by the Contractor to guard against any movement or settlement of any existing pavements, foundations, structures, piping, conduits and adjoining properties. Contractor shall provide all sheeting, shoring, bracing as necessary to avoid collapse of any part of the existing facility.
- B. Existing Facility Operations shall be disrupted by the demolition.
- C. All such protection shall remain in place as may be required for the extent of the construction.

#### 3.5 PERSONAL PROTECTION

- A. Access to all parts of the facility shall be maintained in a suitable manner, so as not to disturb the operations of the Owner.
- B. The perimeter of areas under demolition shall be protected by substantial barricades, with warning signs, flashing lights, reflectors, or other warning devices, in accordance with the laws governing such work.
- C. All such protection shall remain in place as may be required for the extent of the construction.
- D. Perimeter areas under demolition shall be protected by substantial barricades, with warning signs, flashing lights, reflectors, or other warning devices, in accordance with the laws governing such work.

- E. Contractor shall be responsible for providing workforce with proper safety equipment. Contractor shall ensure that sub-contractors comply fully with this requirement.

END OF SECTION 02050

## 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 exterior items and surfaces throughout the Project areas included in the Contract and other Contracts described in this Section.
2. Extent of painting includes the Work specified below. Painting shown in schedules may not provide Contractor with complete indication of all painting Work. Refer to Article 2.2 of this Section where all surfaces of generic types specified 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 in the Contract Documents as a surface not to receive specified painting system.
  - a. All new surfaces and 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, except hot dipped galvanized. 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) Accessory items.
    - 3) Hangers, rods, clamps, pipe and conduit supports/restraints, nuts, washers and bolts, kindorf, and all other items where metal contacts metal or metal contacts concrete shall be painted unless they are of stainless-steel construction.
  - c. Surface preparation and painting of all new and specifically identified existing 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. Removal of all substances, topcoats, primers and all intermediate coats of paint and other protective or decorative coatings on those items and surfaces to remain that are identified to receive a painting system under this Section, to provide surfaces acceptable for application of painting specified.

##### B. Coordination:

1. Review installation, removal, and demolition procedures under other Sections and coordinate them with the Work specified in this Section.
3. Notify other contractors in advance of the surface preparation and painting Work included in this Section to provide them sufficient time for installation, removal, demolition and coordination of interrelated items that are included in their contracts and that must be installed, removed or demolished in coordination with the painting Work.
4. Coordinate painting of areas that will become inaccessible once equipment and similar fixed items have been installed.



5. Coordinate primers with finish paint materials to provide primers that are compatible with finish paint materials. Review other Sections and other contracts 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 and in general contract and other contracts.
6. Furnish information to Owner's Representative 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 Owner's Representative 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.
7. Contractor shall take all steps necessary to protect other areas not being painted. Overspray shall be the responsibility of the Contractor to control. Damage resulting from overspray and/or the failure of the Contractor to take sufficient protective measures to control paint splatter and overspray shall be the responsibility of the Contractor. Contractor shall notify all owners of all cars or trucks or other vehicles located within 1,000 feet of the painting area that painting will occur at least 30 minutes prior to commencing of painting activities.
8. Painting shall include application of the primer coat and, at a minimum, two (2) topcoats to all painted surfaces. More topcoats may be needed to provide sufficient cover. Application will be at the direction of the Owner and/or Owner's Representative and shall be considered the Contractor's responsibility to provide a complete coating system.

C. Related Sections:

1. Section 07920, Joint Sealants.

D. Work Not Included: The following Work is not included as painting Work, or are included under other Sections or in other contracts:

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 or in other contracts.
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, such as furred spaces, pipe chases, duct shafts, and elevator shafts.
4. Concrete surfaces below grade, unless otherwise shown or specified.
5. Concrete floors, unless specifically shown as a surface to be painted.
6. Face brick, glazed structural tile, and prefaced, ground-faced or split-faced concrete unit masonry.
7. Exterior face of architectural precast concrete.

8. Collector bearings, shafts and chains, wood flights, wood stop logs, and wood or fiberglass baffles.
9. 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, except hot dipped galvanized surfaces.
10. 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.
11. Structural and miscellaneous metals covered with concrete need to receive primers, but no intermediate, or finish coats of paint.
12. Existing structures, equipment, and other existing surfaces and items unless otherwise shown or specified.

E. Description of Colors and Finishes:

1. Color Selection:
  - a. Owner reserves the right to select non-standard colors for paint systems specified within ability of paint manufacturer to produce such non-standard colors. Provide such colors at no additional expense to Owner.
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.
  - b. For equipment on roofs or exposed to view, such as on exterior building facades and in offices and lobbies, color shall be selected by Owner.

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 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. AWWA C652, Disinfection of Water-Storage Facilities.
16. AWWA D102, Coating Steel Water-Storage Tanks.
17. Green Seal, Inc. Paint, (GS-11).
18. Great Lakes Upper Mississippi River Board of Public Health and Environmental Managers (GLUMRB), Recommended Standards for Water Works.
19. GLUMRB, Recommended Standards for Wastewater Facilities.
20. 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.
21. Ozone Transport Commission, (OTC), OTC Model Rule for Architectural and Industrial Maintenance Coatings.
22. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
23. SSPC SP 1, Solvent Cleaning.
24. SSPC SP 3, Power Tool Cleaning.
25. SSPC SP 6, Commercial Blast Cleaning.
26. SSPC SP 10, Near-White Blast Cleaning.
27. SSPC SP 11, Power Tool Cleaning To Bare Metal.
28. SSPC VIS 1, Visual Standard for Abrasive Blast Cleaned Steel.
29. SSPC VIS 2, Method of Evaluating Degree of Rusting/Painted Steel Surfaces.
30. SSPC Volume 2, Systems and Specifications.
31. U.S. Green Building Council, "LEED Reference Guide," Version 2.2, Credit 4.2.
32. Recommended Standards for Wastewater Facilities ("Ten States Standards"), latest edition.

### 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, convector 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.

#### 1.4QUALITY 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 Owner's Representative along with following information for at least three (3) 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 Owner's Representative 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. When requested, submit documentation demonstrating to satisfaction of Owner's Representative, 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 Owner's Representative on acceptability of completed Work and during the course of the Work as may be requested by Owner's Representative.
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 acceptable.
4. Owner's Representative 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, coverages 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. Submit "or equal" products in accordance with the General and Supplementary Conditions.
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: No lead and chromate content.
  - b. All areas at the Site are subject to some level of hydrogen sulfide fume exposure. Through Contractor, paint manufacturer shall notify Owner's Representative of colors that are not suitable for long-term color retention to hydrogen sulfide fume exposure.
  - 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 Owner's Representative that painting materials have been manufactured within six (6) 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.

E Pre-painting Conference:

1. Prior to installing painting systems, arrange a meeting at Site with painting applicator and its foreman, paint manufacturer's technical representative, installers of other work in and around painting that must follow painting Work, Owner's Representative, Owner, and other representatives directly concerned with performance of painting Work. Record discussions of conference and decisions and agreements and disagreements and furnish a copy of

record to each party attending. Review foreseeable methods and procedures relating to painting Work including:

- a. Review Project requirements including Contract Documents, approved Shop Drawings, pending and approved Change Orders, requests for information that submitted by Contractor to Owner's Representative, and other pertinent documents.
  - b. Review required samples and submittals, both completed and to be completed.
  - c. Review status of surfaces including drying, surface preparations, and similar considerations.
  - d. Review availability of materials, tradesmen, equipment, and facilities required for progress, to avoid delays, and to protect Work from damage.
  - e. Review required inspection, testing, certifying, and quality control procedures.
  - f. Review weather and forecasted weather conditions, and procedures for coping with unfavorable conditions. Supplemental heating sources required for working in low-temperature conditions, shall be operating and acceptable to paint applicator and Owner's Representative.
  - g. Review methods for complying with regulations of authorities having jurisdiction at Site, such as compliance with environmental protection, health, safety, fire, and similar regulations.
  - h. Review laws and procedures covering removal and disposal of blast debris.
  - i. Review painting schedule with respect to the overall Project CPM in order to identify potential delays or to address deviations. Where possible, identify means, methods and procedures to eliminate delays and/or reduce any deviations, even if project delays have occurred as a result of other construction activities.
2. Reconvene meeting at earliest opportunity if additional information must be developed to conclude the required topics of the meeting.
  3. Record revisions or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

## 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 Contact 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 Owner's Representative for that system, proof of additional material purchase shall be provided to Owner's Representative. 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. 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.
  - e. Contractor shall take all steps necessary to protect other areas not being painted. Overspray shall be the responsibility of the Contractor to control. Damage resulting from overspray and/or the failure of the Contractor to take sufficient protective measures to control paint splatter and overspray shall be the responsibility of the Contractor. Contractor shall notify all owners of all cars or trucks or other vehicles located within 1,000 feet of the painting area that painting will occur at least 30 minutes prior to commencing of painting activities. Contractor shall take into account current and daily projections for wind strength and direction as well as all other environment factors that could affect application, transport and curing of the coating systems. Procedures outlining protection from overspray and weather/environmental related affects shall be submitted to Owner's Representative.
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 Owner's Representative five (5) copies of detailed maintenance manual along with a CD copy/version of the manual for each hard copy and to include 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 Owner's Representative 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 manufacturer's recommended preparatory work has been completed 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, temporary enclosures, 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. 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.
2. 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.
3. Do not paint tanks or pipelines containing fluid without specific permission of Owner's Representative and only under conditions where "sweating" of outside surface of vessel being painted is not likely to occur within 24 hours of paint application.
4. Do not apply epoxy paints if ambient temperature is expected to go below 50 degrees F within twelve (12) hours of application. Follow manufacturer's instructions when manufacturer's published recommendations require a higher minimum ambient temperature.
5. 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.
6. 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.
7. Moisture content of surfaces shall be verified to Owner's Representative as acceptable prior to commencement of painting using methods recommended by paint manufacturer.
8. 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.
9. 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. When working with flammable materials, provide fire extinguishers and post temporary 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. Sherwin-Williams Company (SWC).
  4. Benjamin Moore & Company (BMC).
  5. ICI Paints (ICI).
  6. Duron Inc. (DI).

## 2.2PAINTING SYSTEMS

- A 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 1.5.A.2., 3.2.A., 3.2.C.1., 3.2.C.2.
  2. Shop Primer:
    - a. Generic Components:
      - 1) Minimum 67 percent volume solids, build, two-component, cycloaliphatic amine-catalyzed epoxy or polyamido-amine epoxy coating; 250 grams per liter VOC, maximum.
    - b. Products and Manufacturers: Provide one of the following:
      - 1) Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Macropoxy HS Epoxy (SWC): 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) Series 165 Epoxoline 100 (TCI); Carboguard 954 HB (TCC); Cor-Cote HP (SWC): One coat, 8.0 to 12.0 dry mils.
  4. Finish: High-Gloss:
    - a. Generic Components:
      - 1) Minimum 67 percent volume solids, build, two-component, cycloaliphatic amine-catalyzed epoxy or polyamido-amine epoxy coating; 250 grams per liter VOC, maximum.
    - b. Products and Manufacturers: Provide one of the following:

- 1) Series N69 Hi-Build Epoxoline (TCI); Carboguard 954 HB (TCC); Macropoxy HS Epoxy (SWC): One coat, 4.0 to 6.0 dry mils.

## 2.3 INSTRUMENTS

### A. Instruments:

1. Contractor shall provide three (3) new infra red thermometer guns. Contractor shall provide one (1) each to Owner, Owner's Representative and Contractor Site superintendent so all can agree to surface temperature of the substrate to be painted prior to painting should environmental conditions be in question. Temperature measurement shall indicate appropriate temperatures based on at least two (2) consecutive acceptable temperature readings taken 10 minutes apart by Owner, Owner's Representative and Contractor. All three (3) simultaneous temperature readings shall be average in order to determine the temperature of the substrate's surface. All temperature readings shall be taken from the substrate from a portion that is not in direct sunlight or exposure to any temporary heat source.
2. Provide two (2) new dry-film thickness gauges for checking film thickness, two (2) holiday detectors to detect holidays or holes in the coating, and two (2) sets of visual standards to check surface preparation. Calibrate dry film thickness gauge at Site using Bureau of Standards standard shim blocks. After performing testing, furnish instruments and standards to Owner.
3. 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.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine areas and conditions under which painting Work is to be performed and notify Owner's Representative 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 Owner's Representative.
- 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.
- C. Do not paint over existing paint where there is no assurance that existing paint will provide an acceptable surface for long-term adherence and durability of painting systems specified or where paint manufacturer requires removal of all existing paint to recommend use of specified painting system.

### 3.2 SURFACE PREPARATION

#### A. General:

1. Test for surface temperature of the substrate by Owner, Owner's Representative and Contractor Site superintendent so all can agree to surface temperature of the substrate to be painted prior to painting should environmental conditions be in question. Temperature measurement shall indicate appropriate temperatures based on at least two (2) consecutive acceptable temperature readings taken 10 minutes apart by Owner, Owner's Representative and Contractor. All three (3) simultaneous temperature readings shall be average in order to determine the temperature of the substrate's surface. All temperature readings shall be taken from the substrate from a portion that is not in direct sunlight or exposure to any temporary heat source.
2. Test for moisture content of surfaces before commencement of painting Work. Test for moisture in concrete in compliance with ASTM D4263. Report results to Owner's Representative before commencing Work.
3. Perform preparation and cleaning procedures as specified herein and in strict accordance with paint manufacturers approved instructions for each surface and atmospheric condition.
4. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items already in place that do not require field painting, or provide effective surface-applied protection prior to surface preparation and painting.
5. 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. Masonry Surfaces:

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. Perform tests per ASTM D4262 and ASTM D4263 to verify alkalinity and moisture content of surfaces to be painted, and report findings to Owner's Representative. If, in Owner's Representative'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.
4. 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 Owner's Representative 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.
- h. Remove all rust and contamination on existing ferrous metals to sound surfaces by power tool-cleaning complying with SSPC SP 11 to provide a surface profile of not less than one mil.

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 requirement 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.
- e. 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.
- f. Remove all contamination on existing ductile and cast iron to sound surfaces by power tool cleaning complying with NAPF 500-03-03.

- 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.

### 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.

### 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 Owner's Representative 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 printed 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 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 and manufacturer
  2. Limit roller applications 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 samples for color, texture, and coverage. Remove, refinish, or repaint Work not in compliance with specified requirements as required by Owner's Representative.

### 3.6 FIELD QUALITY CONTROL

- A. Owner's Representative may invoke the following material testing procedure at any time for a maximum of five times during field painting Work:
1. Contractor shall engage service of an independent testing laboratory to sample paints used, as designated by Owner's Representative. Samples of products delivered to Site shall be obtained, identified, sealed, and certified as to being products actually applied to surfaces in each area, in 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 test results show that products being used do not comply with specified requirements, Contractor may be directed to stop painting Work and remove non-complying paint, and shall prepare and repaint surfaces coated with rejected paint with material complying with the Contract Documents.

B. Notify Owner's Representative after completing each coat of paint. Provide testing instruments specified in Article 2.4 of this Section for testing by Contractor. Testing instruments shall become property of Owner.

- 1. Owner's Representative and Owner shall observe all testing and shall be notified of scheduled testing at least three (3) working days 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 Owner's Representative.

### 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 Owner's Representative.

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 Owner's Representative.

3.9SCHEDULE

- A. Extent of painting includes the Work specified below. Painting shown in schedule may not provide Contractor with complete indication of all painting Work.

<b>Location</b>	<b>Surface</b>
Mechanical/Process Items	Surface of aboveground piping, unless stainless steel Surface of pipe insulation Surface of pipe hangers, supports, unless stainless steel

END OF SECTION 09900

## SECTION 11290 – ELECTRIC VALVE ACTUATORS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

##### A. Scope:

1. Contractor shall provide all labor, materials, tools, equipment, and appurtenances, as required and to provide for complete and fully operational electric valve actuators for plug valve operation as indicated in the Contract Documents, as specified herein, and as designated by the Owner's Representative. Contractor shall be responsible for complete and fully operational electric valve actuator system and all items shall be fully compatible as to fit, form and function with existing valves, actuators, and control panels as previously purchased by plant.

##### 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 electric valve actuator work.
2. Notify other contractors in advance of the installation of the electric valve actuators and valves to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the electric plug valve actuators work.

##### C. Related Sections:

1. Section 15111 – Plug Valves
2. Division 16 - Electrical.

#### 1.2 REFERENCES

##### A. Standards referenced in this Section are listed below:

1. American Gear Manufacturers Association, (AGMA).
2. American Water Works Association, (AWWA).
3. National Electrical Code, (NEC).
4. National Electrical Manufacturers Association, (NEMA).

#### 1.3 QUALITY ASSURANCE

##### A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of ten (10) years experience producing substantially similar equipment and shall be able to show evidence of at least ten (10) installations in satisfactory operation for at least ten (10) years.

##### B. Component Supply and Compatibility:

1. Obtain all actuators and valves, as well as field services and accessories from a single source supplier who will have the responsibility of final performance of new and previously supplied equipment.
2. The equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.

## 1.4 SUBMITTALS

- A. Shop Drawings: Submit the following:
  - 1. Fabrication, assembly and installation diagrams.
  - 2. Manufacturer's literature, illustrations, specifications and engineering data.
  - 3. Wiring diagrams for electric motor operators.
- B. Shop Test Results:
  - 1. Submit results of required shop tests. Each valve and actuator shall be shop tested prior to shipping.
- C. Field Test Results:
  - 1. Submit a written report giving the results of required field tests.
- D. Operation and Maintenance Manuals:
  - 1. Submit complete Installation, Operation and Maintenance Manuals, including, test reports, maintenance data and schedules, description of operation, spare parts information, actuator catalog, specification summary, technical information, electrical & mechanical drawings, parts lists, factory test results, torque profiles for each actuator, and a warranty statement.
  - 2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01830 - Startup, Training and Operation and Maintenance Manuals.
- E. Lubricant Specification: Furnish a lubricant specification for the type and grade necessary to meet the requirements of the equipment, as 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.
- 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 Owner's Representative, 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 EQUIPMENT

- A. Description:
  - 1. Electric actuators, along with all Plug Valves, Control Panels and Field Services for the natural gas plug valve, digester gas plug valve, and fuel oil plug valves shall be supplied by a single supplier for single source responsibility. Electric actuators shall be Auma Motor, or approved equal.

2. Machining of actuator drives as well as required mounting hardware shall be supplied by the supplier. Valve stem details shall be verified in the field and confirmed prior to machining.

B. Actuators:

1. Actuators shall be high torque, with sufficient power to operate the plug valves through one complete cycle, open-close-open or close-open-close under the maximum unbalanced head when voltage to terminals is within ten percent of specified voltage.
2. Actuator shall have a NEMA 4 and 6 enclosure that is watertight and be submersible to IP68 and shall have an oil filled gearcase,
3. The voltage shall be 120/1//60, and actuators shall also contain integral motor starters and contactors. An integral Local/Off/Remote switch as well as an Open/Close selector switch shall be provided on the actuator cover. These switches shall not penetrate the front cover but should operate by means of magnets and reed switches.
4. Actuators shall also have an LCD back-lit digital valve position display showing 0 to 100% of valve position as well as two sets of red, green, and amber LED lights shall also be included on the main display to indicate open, close and intermediate travel positions. Instantaneous actuator torque shall also be accessible from this display. This local position indication as well as remote actuator position status shall be maintained by an integral 9-volt lithium battery.
5. A De-Clutchable Manual Override shall also be provided. This override shall engage the actuator output drive in a 1:1 ratio and shall have a hammer blow feature, and handwheel diameters shall not be less than 16”.
6. Each Actuator shall include an integral Modbus card for single channel, half duplex, Modbus RTU (slave) communications. Actuator interface shall be EIA-485 suitable for 2-wire connection and fully isolated from other actuator circuits.
7. Four (4) programmable auxiliary contacts shall be provided for status or diagnostic feedback to the local control panels in addition to a Monitor Relay. Wiring diagram number shall be 100M000.

## 2.2 LUBRICANTS

- A. Furnish lubricant and oil and grease as required for initial operation and supply a year’s supply of all manufacturer’s recommended grease, oils and lubrications. At the minimum a case for solid or semi-solid lubricants/grease of each type called for by the manufacturer shall be supplied to Owner as part of this contract. At the minimum 2 gallons of each type of oil called for by the manufacturer shall be supplied to Owner as part of this contract. Two (2) sets of any and all tools recommended by the manufacturer for the installation and/or application of any grease, oil or lubricant recommended by the manufacturer shall be supplied to Owner as part of this Contract. Use products recommended by the manufacturer.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Make adjustments required to place system in proper operating condition.

### 3.2 INSTALLATION

- A. All actuators and appurtenances shall be installed as per manufacturer's instructions at the locations as indicated in the Contract Documents, true to alignment and rigidly supported. Any damage to existing valves and appurtenances shall be repaired to the satisfaction of the Owner's Representative.

- B. Because of space and orientation limitations, the actuators shall be field mounted to the valves after the valves have been mounted in the piping, with field supervision by a manufacturer's representative. Orientation of actuators shall be such as to provide the best line of sight to the actuator LED display.
- C. If there are difficulties in the operation of any valve and actuator due to the manufacturer's fabrication and/or Contractor's installation, corrective measures shall be taken and the gate valve and actuator shall be retested to assure compliance with these specifications. All costs associated with any required corrective action, shall be borne by the Contractor.
- D. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Gates and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.
- E. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Section.
- F. Contractor shall bear any additional engineering costs associated with substitutions or deviation from specifications.

### 3.3 ELECTRIC VALVE ACTUATOR SCHEDULE

- A. Contractor shall furnish and install the electric valve actuators indicated on the schedule on the contract drawings. Refer to Contract Drawings for valve/actuator locations.

### 3.4 FIELD QUALITY CONTROL

- A. All equipment will be given running tests by Contractor at the Site following installation of the equipment in the presence of the actuator supplier. Should the tests indicate any malfunction, Contractor shall make any necessary repairs and adjustments. Such tests and adjustments including re-setting of actuator torques and limits shall be repeated until, in the opinion of the Owner's Representative, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.
- B. Field Tests:
  1. Functional Tests: Each valve with actuator shall be field-tested. Tests shall demonstrate that each part and all parts together function in the manner intended. Contractor shall provide all necessary testing equipment, power, incidentals, material and labor required for the tests at his expense. All valves gates shall be operated through at least two complete open/close cycles. Complete torque switch test shall be performed. Limit switches shall be adjusted following the manufacturer's instructions. Submit report of test results.
  2. In the event that the manufacturer is unable to demonstrate to Owner's Representative that the equipment meets the requirements of the tests, the deficient equipment will be rejected and Contractor shall adjust and 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.

- C. An authorized Motor factory representative shall be provided for installation supervision, to set actuator limits and outputs, to confirm torque data and stroke times, and to check and approve the installation prior to operation. In addition, Modbus communication cards shall be installed and actuator firmware updated in the 4 actuators. Up to five (5) days of on-site field services shall be included. The authorized factory representative shall witness the test and operation of the system in the presence of the Owner's Representative and verify that the equipment conforms to the requirements. The authorized factory representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

### 3.5 WARRANTY

- A. Equipment furnished under this Section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, for a period of twelve (12) months from date of final start-up. Any defective equipment shall be repaired or replaced by the Contractor at no additional cost to the Owner. All travel expenses, accommodation, etc. for a service visit shall be included in the warranty.

END OF SECTION 11290



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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.
  - 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.
3. Notify other contractors in advance of installation of exposed piping to provide them with sufficient time for installation of items included in their contracts that must be installed with or before exposed piping Work.

##### C. Related Sections:

1. Section 09900 - Painting
2. Valves, mechanical piping and appurtenances and pipe hangers and supports are included in Division 15.

#### 1.2 REFERENCES

##### A. Standards referenced in this Section are:

1. ASME B31.3, Process Piping.

2. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
3. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
5. ANSI/AWWA C606, Grooved and Shouldered Joints.
6. AWWA M41, Ductile-Iron Pipe and Fittings.
7. AWWA M23, PVC Piping
8. ASTM D2464, Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
9. ASTM D2467, Socket-type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
10. ASTM D2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings.
11. ASTM D2855, Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings.

### 1.3 QUALITY ASSURANCE

#### A. Regulatory Requirements:

1. Comply with requirements and recommendations of authorities having jurisdiction over the Work

### 1.4 SUBMITTALS

#### A. Action Submittals: Submit the following Shop Drawings:

1. Detailed drawings in plan and, as applicable, section.
2. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.
3. Submit description of proposed testing methods, procedures, and apparatus, and obtain Owner's Representative's approval no less than forty-eight (48) hours prior to testing.

#### B. Test Reports:

1. Submit copies of testing report for each test.

#### C. Certificates:

1. Submit a certificate signed by manufacturer of each product certifying:
  - a. That product conforms to applicable referenced standards.

#### D. Record Documents:

1. 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 directed by Owner's Representative.
2. 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.
3. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
4. Conform to Section 01710 - Record Drawings and Closeout Procedures.

## 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.
3. Conform to requirements of Section 01661 - Storage and Protection of Products.

### 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.

#### A. 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 on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.

##### 2. Pipe Identification Markers and Arrows: Provide products of one of the following:

- a. Brady Corporation.
- b. Seton Identification Products.

#### B. Appurtenances: Provide products that conform to:

1. Valves, mechanical piping and appurtenances and pipe hangers and supports included in Division 15.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine conditions under which the Work is to be installed and notify Owner's Representative 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 Owner's Representative 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 Owner's Representative.

#### C. Piping Installation:

1. Conform to manufacturer's instructions and requirements of standards and manuals.
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 otherwise directed by the Owner's Representative.
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 directed by Owner's Representative 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 Owner's Representative.
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. Additional Requirements for Thermoplastic Piping:

- a. Support all valves independently of the piping system.
- b. Utilize wide band supports as recommended by manufacturer and approved by Engineer to minimize localized stresses.
- c. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.
- d. When anchors are required at locations other than equipment or tanks they shall be placed at elbows, valve locations and at bends in pipeline.
- e. Spacing of supports shall be in accordance with the manufacturer's published values at the maximum design operating temperature of the pipe.
- f. Use "U" clamps with wide band circumferential contact. Avoid all pressure contact with piping.
- g. Use guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by manufacturer.
- h. Use bellows with low axial force to take up pipe expansion. Provide anchors to restrain the expansion joint. Use of bellows joints shall be kept to a minimum. Flexible connectors may be used to absorb thermal movement when approved by Engineer.
- i. Provide air chambers with shut off and drain valve on all pump discharge lines to reduce hydraulic hammer and flexible connectors to absorb vibration. Submit details for Engineer to review.
- j. Do not install pipe when temperature is less than 60F.

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 and Steel 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 directed by Owner's Representative 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.

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 - Piping Specialties and Accessories, 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.

3.3 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:

1. Locations of existing piping shown in the Contract Documents should be considered approximate. Contractor shall satisfy himself by actual examination of the site of the Work, as no claim shall be made by the Contractor for additional compensation by reasons of the fact that existing conditions are other than as shown in the Contract Documents.
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. Do not take pipelines or facilities out of service unless otherwise directed by Owner's Representative. Taking existing pipelines and facilities out of service may only be performed following submittal and approval of a MOPO Plan and shall require no less than 72 hours in advance written notice to Owner and Owner's Representative. Contractor shall coordinate with Owner's operations no less than 72 hours in advance written notice to reschedule as necessary, if Owner's operations is unable to accommodate Contractor's request and at no additional cost to Owner.

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 01723, Cutting and Patching.

3.4 PAINTING

- A. Field painting shall conform to Section 09900 - Painting.

3.5 FIELD QUALITY CONTROL

A. Testing, General:

1. Test all piping, except as exempted in the Exposed Piping Schedule. All piping must be clean prior to any work described in this section. They shall be free from dirt, debris, sand, stones, etc. and accumulated water must be removed.
2. Notify Owner's Representative and authorities having jurisdiction in writing at least 48 hours in advance of testing.
3. Conduct all testing in presence of Owner's Representative.
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 system that fails to meet acceptance criteria. Retest after repair. All tests and repairs shall be repeated as many times as necessary, at no additional cost to the Owner, until the specified requirements have been met.
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 will be paid as extra work except for the connection joint of new and existing old pipe or unless otherwise specified.

B. 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.
3. 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 Owner's Representative 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.

C. Hydrostatic Testing:

1. Preparation for Testing:
  - a. 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 Owner's Representative 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. For HDPE pipe, after three-hour expansion phase, reduce test pressure by ten psig and do not add liquid. The test pressure shall then remain steady for one hour, indicating no leakage.
  - 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 and fiberglass 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.

D. 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 acceptable to Owner's Representative, prior to placing in service.

3.7 EXPOSED PIPING SCHEDULE

- A. New piping used to modify the existing piping to install the new valves shall be of the same specification as the existing piping.

END OF SECTION 15052

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## 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.

##### 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.
2. Contractor shall coordinate the location and placement of any concrete inserts, and any cutting or drilling of structural members required.

##### C. Related Sections:

1. Section 09900 - Painting.
2. Division 15 - Sections on Piping, Valves and Appurtenances.

#### 1.2 REFERENCES

##### A. Standards referenced in this Section are listed below:

1. American Society for Testing and Materials, (ASTM).
  - a. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
2. Federal Specification, (FS).
  - a. FS A-A-1192, Hangers, Pipe.
3. Manufacturers Standardization Society of the Valve and Fittings Industry, (MSS).
  - a. MSS SP 58, Pipe Hangers and Supports-Materials, Design and Manufacture.
  - b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.
4. Underwriters' Laboratories, Inc., (UL).
  - a. UL 203, Pipe Hanger Equipment for Fire Protection Service.

#### 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 hanger 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. Shop Drawings: Submit the following for review:
  1. 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. Each pipe system shall be analyzed for all loads and forces on the hangers and supports, and their reaction forces to the structure to which they are fastened.
  2. Submit and coordinate these with Shop Drawings required for all piping systems.
  3. Contractor is responsible for designing all pipe hangers and supports. Submit design calculations for all supports, signed and sealed by a registered Professional Engineer licensed in the State of New York for review.
- B. Product Information: 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.
  2. All materials be inspected for size, quality, and quantity against approved Shop Drawings.
- 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 Owner's Representative, 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. 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 shall be as follows:

Pipe Size (inches)	Maximum Pipe Span <sup>1</sup> (feet)	
	Steel	Cast/Ductile Iron <sup>2</sup>
2-1/2	10	-
3	10	-
4	12	12 feet for pressure pipe  10 feet for soil pipe
6	12	
8	12	
10	-	
12	-	
14	-	
16	-	
18	-	
20	-	
24	-	

<sup>1</sup>Pipe 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.

<sup>2</sup>Pipe hanger and support selection shall be as shown and/or as specified in this Section.

10. 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.
11. Supports and hangers shall be of a material that is compatible with the fluid being conveyed in such pipe being supported.
12. 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.  $\Delta L = L \times \Delta T \times \alpha$ 
  - a. Where  $\Delta L$  = pipe length change (inches).
  - b.  $L$  = pipe length between anchors (inches).
  - c.  $\Delta T = 100$  (F).
  - d.  $\alpha$  = coefficient of thermal expansion (inches/inches/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 - Piping Specialties and Accessories.

## 2.2 HANGERS AND SUPPORTS

- A. Hangers and supports where required shall be in accordance with MSS SP 58.
- B. Products and Manufacturers: Provide one of the following:
  1. Anvil International, Inc.
  2. Elcer.
  3. B-Line.
  4. Unistrut Corporation.
  5. Or equal.

## 2.3 ACCESSORIES

- A. Hanger rods shall be Type 316 stainless steel, with square head nut on top and running thread on bottom end.
- B. Concrete Inserts:
  1. Concrete inserts shall be Type 316 stainless steel and conform to MSS SP 58.
  2. Manufacturers: Provide products of one of the following:
    - a. Unistrut Corporation
    - b. Elcan Metal Products
    - c. B-Line.
    - d. Anvil International, Inc.
    - e. Or equal.
- C. Steel Beam Clamps:
  1. Steel beam clamps shall be Type 316 stainless steel and conform to MSS SP 58.
- 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. Inserts shall be Type 316 stainless steel and conform to MSS SP 58.

E. Brackets:

1. Brackets for wall mounting shall conform to MSS SP 58.

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 hangers and supports to prevent vibration or swaying and to provide for expansion and contraction.
  1. Temperature differential as specified in this Section.
  2. Support piping independently so that equipment is not stressed by piping weight or expansion.
  3. Uncoated Hangers, Rods and Supports: Dip in zinc chromate primer before installation.
  4. Provide additional supports at:
    - a. Changes in direction.
    - b. Branch piping and runouts over five (5) feet.
    - c. Concentrated loads due to valves, strainers or other similar items.
  5. 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) Connection to Structure for Piping to 2-Inches: Concrete inserts, or expansion shields in shear into sides of beams.
    - 3) Connection to Structure for Piping 2-1/2-Inch or Larger: Concrete inserts, beam clamps or suitable bridging.
6. 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.
- 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 15055

## SECTION 15111 – PLUG VALVES

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. Contractor shall provide all labor, materials, tools, equipment, and accessories as required and provide complete and ready for operation and test, as may be required, all valves including, but not necessarily limited to plug valves, as indicated in the Contract Documents, as specified herein, and as designated by the Director's Representative.

#### 1.2 SUBMITTALS

- A. Contractor shall submit to Director's Representative, in accordance with Section 013300, materials required to establish compliance with this Section. Submittals shall include at least the following:
  - 1. Certified drawings showing all important details of construction and dimensions.
  - 2. Descriptive literature, bulletins and/or catalogs of the equipment.
  - 3. Total weight of each item.
  - 4. Complete bill of materials.
  - 5. Additional submittal data, where noted with individual pieces of equipment.
- B. Test Reports
  - 1. Contractor shall provide certified hydrostatic test data, per manufacturer's standard procedure for all valves.
- C. Certificates
  - 1. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, Contractor shall submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.
- D. Operating and Maintenance Data
  - 1. Contractor shall provide operating and maintenance (O&M) instructions. The O&M instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

#### 1.3 QUALITY ASSURANCE

- A. Qualifications
  - 1. Valves and appurtenances shall be products of well-established firms who are fully experienced, minimum ten (10) years, reputable and qualified in the manufacture of the particular equipment to be furnished.
  - 2. Equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with this Specification as applicable.
  - 3. All units of the same type shall be the product of one manufacturer.

B. Certifications

1. Contractor shall provide manufacturer's affidavit of compliance with Standards referred to herein as specified in Paragraph 1.02 of this Specification.

C. Contractor shall provide the services of a qualified and factory-trained service representative of the manufacturer to provide operational and maintenance instruction, for a 1-day, 8-hour period.

D. Inspection of the units may also be made by the Director's Representative or other representative of the Owner after delivery. Equipment shall be subject to rejection due to failure to meet any of the specified requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be immediately removed from the Project Site.

1.4 SYSTEM DESCRIPTION

A. All equipment and materials specified herein is intended to be standard for use in controlling the flow of natural gas, digester gas, and fuel oil as noted in the Contract Documents.

B. Valves, appurtenances and miscellaneous items shall be installed at the locations as indicated in the Contract Documents and as specified, so as to provide for complete and fully operational systems.

C. Unless otherwise noted, all powered valve operators shall have:

1. Valves: electric operators, 120 Volt, 1 Phase, 60 Hz.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping

1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves and appurtenances, and/or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired to the satisfaction of the Director's Representative and at no additional cost to the Owner.

2. Prior to shipping, the ends of all valves shall be covered to prevent entry of foreign material. Covers shall remain in place until after installation and connecting piping is completed.

a. 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 and covered to prevent exposure to the elements.

b. Valves smaller than 3-in shall be shipped and stored on-site until time of use with heavy cardboard covers on the openings and covered to prevent exposure to the elements.

c. Rising stems and exposed stem valves shall be coated with a protective oil film, which shall be maintained until the valve is installed and put into service.

d. Any corrosion in evidence at the time of acceptance by the Owner shall be removed, or the valve shall be removed and replaced.

B. Storage and Protection

1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation.

## 1.6 MAINTENANCE

- A. Special tools and the manufacturer's standard spare parts, as required for normal operation and maintenance, shall be supplied with the equipment.
- B. Provide all special tools required for normal maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.
- C. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than 1 year after start-up and final acceptance.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT - GENERAL

- A. Reference is made to Division 1 for additional requirements, including nameplates, provisions for temporary pressure gauges, protection against electrolysis and anchor bolts.
- B. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- C. Valves and appurtenances shall be of the size shown in the Contract Documents or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.
- D. Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or indelibly marked upon some appropriate part of the body.
- E. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.
- F. Joints, size and material - unless otherwise noted or required by the Director's representative:
  1. Except where noted, all joints referred to herein shall be of the same type, nominal diameter, material and with a minimum rating equal to the pipe or fittings they are connected to.
  2. Valves and appurtenances shall be of the same nominal diameter as the pipe or fittings they are connected to.
  3. Unless otherwise noted, all valves exposed to view, or in vaults.
    - a. Flanged ends.
- G. Provide all special adaptors as required to ensure compatibility between valves, appurtenances and adjacent pipe.

- H. Valves and actuators located outdoors but not within a building; within maximum 2-ft above liquid; in vaults; or where otherwise noted, shall be especially designed for submerged service where water may completely submerge the valve and operator. All other units shall be as a minimum weather tight.

## 2.2 VALVE ACTUATORS - GENERAL

- A. The valve manufacturer shall supply and integrally, rigidly mount all actuators, including any type of manual or powered actuators, on valves at the factory. The valves and their individual actuators shall be shipped as a unit.
- B. Unless otherwise noted, valves shall be manually actuated; nonburied valves shall have an operating wheel, handle or lever mounted on the operator; buried valves and those with operating nuts shall have a non-rising stem with an AWWA 2-in nut. At least two tee handles shall be provided for all operating nuts.
- C. All actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.
- D. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.
- E. Floor boxes for operating nuts recessed in concrete shall be standard cast iron type, cast-in-place, with fastening top, as manufactured by Clow Corp., or approved equal.
- F. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10-ft, as manufactured by Clow; Rodney Hunt, or approved equal. Extended operating nuts and/or stems shall have universal joints and pin couplings, if longer than 10-ft and a rating of at least five times the maximum operating torque. Stem adaptors shall be provided.
- G. Where required by the installation, or as specified, provide the following: extended stem; floor stand and handwheel; position indicator and etched or cast arrow to show direction of rotation to open the valve; resilient, moisture-resistant seal around stem penetration of slab.
- H. Gear Actuators
  - 1. Unless otherwise noted, gear actuators shall be provided for the following: all valves of larger than 8-in nominal diameter; all buried valves with operating shaft mounted horizontally (butterfly, plug, etc); where specified and/or indicated in the Contract Documents; where manual operator effort is greater than 80 ft-lbs rim pull.
  - 2. Gear actuators shall be of the worm or helical gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Unless noted they shall conform to AWWA C504, but except with butterfly valves, need not be certified.
  - 3. Actuators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.
  - 4. Gearing shall be machine-cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and seals and to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant and be of the same material as the valve body.

5. Manual operator input effort to the handwheel shall be a maximum of 40 ft-lbs for operating the valve from full open to full close, under any conditions. Gear actuators shall indicate valve position and have adjustable stops. Maximum handwheel size shall be 24-in diameter.

I. All position indication and direction of opening arrows shall be embossed, stamped, engraved, etched or raised decals.

J. Unless otherwise noted, all valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.

### 2.3 VALVE ACTUATORS – POWERED

A. Electrical actuators provided as part of this Section shall comply with AWWA C540.

B. Unless otherwise noted, all electric or other powered actuators shall utilize worm gear or helical gearing for all size valves.

C. Motorized actuators shall consist of motor, reduction gearing, detachable drive bushing, thrust bearing and emergency hand wheel local position indicator, together with torque and position limit switches, thermostatically controlled space heater, terminals and integral controls. The actuator shall be a self-contained, totally enclosed unit with position lights, push buttons and position and status contacts.

D. Electrical control indicated in the Contract Documents and this Section is based on utilizing Limitorque actuators. Equal products may be utilized, but any modifications required to the control and/or wiring indicated in the Contract Documents, in order to utilize other equipment, shall be the Contractor's responsibility.

E. Handwheel drive shall permit manual operation in a reasonable time, related to valve size. Failure of motor drive or gearing should not prevent manual operation. Handwheel shall not operate when motor operates. Motor shall be unable to operate when handwheel is operating.

F. Continuous mechanical dial indication of valve end positions shall be incorporated.

G. Open and close torque and/or position limit switches to suit the valve type shall be provided for travel control, with means to prevent unwanted tripping on torque during initial unseating.

H. Where required in the Contract Documents, Contractor shall provide position indicating switches on valves. Switches shall be single pole, double throw, at either limit of open or close or both limits as shown. Switches shall be enclosed in a NEMA 4 enclosure and contacts shall be rated 10 Amps at 230/460 VAC.

### 2.4 ECCENTRIC PLUG VALVES

A. Plug valves shall be model PEC as manufactured by DeZURIK, Inc., or approved equal.

B. Plug valves shall be rectangular port eccentric (AWWA C517), resilient seated and body and bonnet shall be of the same material.

C. Valves shall meet the American Iron and Steel Act.

- D. Valves shall be manufactured in the United States.
- E. Port area shall be 100% of nominal pipe area at all points of the valve.
- F. General:
  - 1. All plug valves shall be of rectangular port, eccentric type unless otherwise specified.
  - 2. Port area shall be 100% of the pipe area.
  - 3. Exposed valves shall have flanged ends. Buried valves shall have Mechanical Joint ends.
  - 4. Design Working Pressures:
    - a. Valves 12 inch and Smaller: 175 psig.
  - 5. Maximum Fluid Temperature: 180 deg F.
  - 6. Valves shall provide drip tight bi-directional shut off at the design working pressure, operating pressures and test pressures.
  - 7. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat until at least 90% closed:
    - a. The interface between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure.
  - 8. Round Ports are not acceptable.
  - 9. Spherical Plugs are not acceptable.
  - 10. All Actuators shall be mounted, adjusted and tested at the valve manufacturer's facility. This shall be evidenced by witness test of the entire assembly, at the Director's Representative's discretion, at the manufacturer's facility.
- G. Materials of Construction:
  - 1. See valve schedule on contract drawings.
- H. Actuators:
  - 1. For buried applications actuators shall be fully sealed, buried/submerged rated worm gear type. Gear shall terminate in a 2" nut.
    - a. Extension stems, floor box and valve box shall be by Contractor.
  - 2. For non-buried applications actuators shall be manual with worm gear sized for 80lb rim pull maximum.
- I. Shop Testing:
  - 1. Performance Tests:

- a. To demonstrate that the complete assembly is workable, each valve (with the actuator mounted directly on the valve or as required) shall be shop operated three times from the fully closed to the fully opened position and the reverse under a no-flow condition.
2. Leakage tests:
    - a. Each valve shall be shop tested for leaks in the closed position
    - b. Valves shall be given a leakage test at the design working and operating pressures. During the test, the valves shall be drip tight. The test duration shall be at least 5 minutes for valves up to 20 inches and 10 minutes for valves 20 inches and larger. The tests shall be repeated with pressure in the opposite direction.
  3. Hydrostatic Test:
    - a. All valve bodies shall be subjected to an internal hydrostatic pressure equivalent to twice the rated pressure.
    - b. During the hydrostatic test, there shall be no leakage through the metal, end joints, or shaft seal, nor shall any part be permanently deformed.
    - c. The duration of the hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least 1 min. for valves 8 in. and smaller, 3 min. for valves 10 in. through 20 in. and 10 min. for valves 20 in. and larger.
  4. Customer/Engineer witness test:
    - a. To verify quality standards any or equal substitutions will require witness tests at no cost to Director's Representative or Owner of:
      - 1) Casting Pour
      - 2) Hydrostatic and Seat test
      - 3) Plug resilient facing manufacturing process
      - 4) Plug lining process

J. Installation:

1. In applications of liquids with suspended solids or dirty gasses:
  - a. For valves installed in a vertical pipeline, or where the possibility of overhead drain-back exists, install the valve with the seat at the top to prevent drain-back solids from settling into the valve body.
  - b. For valves installed in a horizontal pipeline, install the valve so the plug rotates up when opened. Where drain-back does not exist, install the valve with the higher pressure, when closed, against the end opposite the seat.
  - c. In applications of clean liquids and gasses for eccentric plug valves installed in a horizontal or vertical pipeline, it is recommended that the valve be installed with the higher pressure against the end opposite the seat.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL



- A. All valves and appurtenances shall be installed as per manufacturer's instructions at the locations as indicated in the Contract Documents, true to alignment and rigidly supported. Any damage to valves and appurtenances shall be repaired to the satisfaction of the Director's Representative before they are installed.
- B. If there are difficulties in the operation of any valves and appurtenances due to the manufacturer's fabrication or Contractor's installation, corrective measures shall be taken and the valves and appurtenances shall be retested to assure compliance with these specifications. All costs associated with any required corrective action, shall be borne by the Contractor.
- C. Install all brackets, extension rods, guides and various types of operators and appurtenances as indicated in the Contract Documents, or otherwise required. Before setting these items, check all Contract Documents which have a direct bearing on their location. Contractor shall be responsible for the proper location of all valves and appurtenances during construction of the Work.
- D. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.
- E. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Section.
- F. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying manufacturers' torquing requirements for all valves.

### 3.2 CLEANING

- A. All items (including valve interiors) shall be cleaned prior to installation, testing and final acceptance.

### 3.3 INSTALLATION OF MANUAL OPERATIONAL DEVICES

- A. Unless otherwise noted, all operational devices shall be installed with the units of the factory, as indicated in the Contract Documents or as acceptable to the Director's Representative to allow accessibility to operate and maintain the item and to prevent interference with other piping, valves and appurtenances.
- A. For manually operated valves 3-in in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.
- B. Unless otherwise noted, floor stands, valve boxes and extension stems shall be installed vertically centered over the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform with the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete pouring to maintain vertical alignment.

### 3.4 INSPECTION, TESTING AND CORRECTION OF DEFICIENCIES

- A. Contractor shall take care not to over pressure valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the Director's Representative and at no additional cost to the Owner.
- B. Prior to startup, all items shall be inspected for proper alignment, quite operation, proper connection and satisfactory performance. All units shall be operated continuously while connected to the attached piping for at least 2 hours, without vibration, jamming, leakage, or overheating and perform the specified function.
- C. Various pipe lines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests, any defective valve or appurtenance shall be adjusted, removed and/or replaced, or otherwise made acceptable to the Director's Representative and at no additional cost to the Owner.
- D. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected or the device replaced or otherwise made acceptable to the Director's Representative and at no additional cost to the Owner.

### 3.5 INSTALLATION OF PLUG VALVES

- A. Plug valves shall be provided at the locations as indicated in the Contract Documents and/or as directed by the Director's Representative. Plug valves shall be installed in accordance with the manufacturer's recommendations.
- B. All plug valves shall be handled and stored in such a manner as to prevent shock and damage. Storage shall be in accordance with the manufacturer's recommendations and as such to avoid foreign matter from entering the valves.
- C. During construction, the surfaces of the plug valves shall be covered or otherwise protected from concrete spillage, paint, oil and debris. Any damage that occurs to the valve in storage or handling shall be corrected prior to installation of the valve or operation and testing of the valve.
- D. Following the completion of each plug valve installation, the plug valves shall be operated through at least two (2) complete open/close cycles. If an electric or hydraulic operator is used, limit switches shall be adjusted following the manufacturer's instructions. Contractor shall check plug valves for leakage.
- E. Plug valves found to be defective, damaged or not meeting the standards required in this Specification, shall be rejected and immediately removed from the Project Site. Contractor shall replace or repair to the satisfaction of the Director's Representative plug valves found to be defective, damaged or not meeting the standards required in this Specification and at no additional cost to the Owner.

### 3.6 WARRANTY

- A. Equipment furnished under this Section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, for a period of twelve (12) months from date of start-up or twenty-four (24) months after shipment, whichever comes first. Any defective equipment shall be repaired or replaced by the Contractor at no additional cost to the Owner. All travel expenses, accommodation, etc. for a service visit shall be included in the warranty.

END OF SECTION 15111

## SECTION 15120 - PIPING SPECIALTIES AND 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 all piping specialties and accessories.

##### B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before piping specialties and accessories Work.

##### C. Related Sections:

1. Section 09900, Painting.
2. Section 15051, Buried Piping Installation
3. Section 15052, Exposed Piping Installation.
4. Section 15061, Ductile Iron Pipe.

#### 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 (5) years of experience producing substantially similar products to those specified and shall be able to provide documentation of at least five (5) installations in satisfactory operation for at least five (5) years each.

##### B. Component Supply and Compatibility:

1. Obtain each type of piping specialty and accessory product included in this Section, regardless of component manufacturer, from a single piping specialty and accessories 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: Submit piping layout Shop Drawings in accordance with Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
2. Product Data: 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: When requested by Owner's Representative submit certificate attesting to compliance with standards referenced in this Section, signed by manufacturer.
2. Manufacturer's Instructions: Provide instructions for handling, storing, installing, and adjusting of products.
3. Source Quality Control: When requested by Owner's Representative, submit results of source quality control tests.
4. Qualifications Statements: Submit qualifications of manufacturer when requested by Owner's Representative.

#### 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:
  - a. Style 253/38, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
  - b. No. 441/411/413, as manufactured by Smith Blair, Inc.
  - c. Style FC Series, as manufactured by Ford.
  - b. 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 nitride 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 for pipe size, wall thickness, and test pressure required. Provide minimum 5/8-inch diameter bolts.
7. Remove pipe stop(s) if used, unless otherwise shown or specified.

B. Flanged Coupling Adapters:

- 1. Description: One end of adapter shall be flanged and opposite end shall have sleeve-type flexible coupling.
- 2. Products and Manufacturers:
  - a. Style 227, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
  - b. Style 912, as manufactured by Smith Blair, Inc.
  - c. Or equal.
- 3. Pressure and Service: Same as connected piping.
- 4. Material: Ductile iron.
- 5. Gasket: Recommended by the manufacturer.
- 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.
- 7. Harnessing:
  - a. Harness adaptors to restrain pressure piping. For pressure pipelines, test pressures are included in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
  - b. For flanged adapters 12-inch diameter and smaller, provide 1/2-inch diameter (minimum) Type 316 stainless steel anchor studs installed in pressure-tight anchor boss. 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. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by flanged adapter manufacturer. Provide the following minimum anchor studs unless otherwise directed by Owner's Representative:
    - 1) Six-inch Diameter and Smaller: Two
    - 2) Eight-inch Diameter and Smaller: Four
    - 3) Ten-inch Diameter and Smaller: Six
    - 4) Twelve-inch Diameter and Smaller: Eight
  - c. For adapters larger than 12-inch diameter, provide split-ring harness clamps with minimum of four corrosion-resistant alloy steel bolts. 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. Harness assembly shall be as designed and recommended by flanged adapter manufacturer. Dimensions, sizes, spacing and materials shall be suitable for service and conditions encountered.

C. Split type Grooved or Shouldered End Couplings:

1. Pressure and Service: Same as connected piping. Use shouldered end where required by pressure rating.
2. Products and Manufacturers:
  - a. Coupling cast-iron or ductile iron pipe:
    - 1) Style 31, as manufactured by Victaulic Company.
    - 2) Series 500, as manufactured by Tyler Pipe, Gustin Bacon Division.
    - 3) Gruvlok Figure 705, as manufactured by Grinnell Mechanical Products, division of Tyco.
    - 4) Or equal.
  - b. Coupling of standard steel pipe, where joint deflection is desired or allowed:
    - 1) Style 77, as manufactured by Victaulic Company.
    - 2) Series 1000, as manufactured by Tyler Pipe, Gustin Bacon Division.
    - 3) Or equal.
  - c. Coupling of standard steel pipe, where joint deflection is not desired or allowed:
    - 1) Style HP-70, as manufactured by Victaulic Company.
    - 2) Series 110, as manufactured Tyler Pipe, Gustin Bacon Division.
    - 3) Or equal.
  - d. Coupling of stainless-steel pipe:
    - 1) Style 77S, as manufactured by Victaulic Company.
    - 2) Or equal.
  - e. Coupling of thermoplastic pipe:
    - 1) Style 357, as manufactured by Victaulic Company.
    - 2) Or equal.
3. Couplings shall conform to applicable requirements of AWWA C606.
4. Housing Material:
  - a. Coupling of cast-iron pipe, ductile iron pipe, steel pipe, and thermoplastic pipe: Malleable iron or ductile iron.
  - b. Coupling of stainless-steel pipe: Type 304 stainless steel, or equal.
  - c. Coupling of aluminum pipe: Aluminum alloy 356-T6.
5. Gaskets: As recommended by manufacturer.

6. Bolts and Nuts: Heat-treated carbon steel track bolts, plated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and with nitrided stainless nuts.

## 2.2 EXPANSION COUPLINGS

### A. Rubber-type Expansion Couplings:

1. General: Use rubber-type expansion couplings at all locations, except where other types are shown or specified.
2. Manufacturers:
  - a. Mercer Rubber Company.
  - b. U.S. Rubber Supply Company, USA
  - c. Or equal.
3. Liquid Service:
  - a. Construct expansion couplings of neoprene or Buna-N suitable for temperatures up to 180 degrees F.
  - b. Expansion couplings shall be filled arch type. Provide backup or retaining rings as recommended by manufacturer.
  - c. Expansion couplings shall be yoked in manner to provide transmission of tension loading to which expansion coupling may be subjected during system operation. Compressive or lateral movement of expansion coupling shall not be impaired by yoking system. Submit yoking details when requested by Owner's Representative.
4. Harnessing:
  - a. Harness each expansion coupling against thrust for test pressure in piping, as specified in piping schedules in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.
  - b. Harnessing shall be by control units consisting of two or more tie rods connected between flanges, set for maximum allowable elongation of expansion coupling.
  - c. Provide epoxy-coated triangular plates to connect tie rods to flanges. Tie rods shall be Series 300 stainless steel. Rubber washers shall be used between triangular plates and tie rods.
  - d. Provide control units in accordance with recommendations of manufacturer.

## 2.3 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:
  - 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.
- B. Pressure Isolation Ring: Red Valve Series 48 Type 316 Stainless Steel, BUNA-N sleeve and vegetable oil fill fluid.

## 2.4 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. Contractor shall coordinate coating compatibility with top/finish coat.
  - 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 written 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 15120

## SECTION 16050 - GENERAL PROVISIONS

### PART 1 – GENERAL

#### 1.1 DESCRIPTION

##### A. Scope:

1. Contractor shall provide all labor, materials, equipment, incidentals, testing, troubleshooting, and training as shown, specified, and required to provide complete and operable electrical work.

##### B. Coordination:

1. Review installation procedures and schedules under other Sections and coordinate with other trades the installation of electrical items that must be installed with or within formwork, walls, partitions, ceilings, and panels.

##### C. General:

##### 1. Interpretation of Drawings:

- a. Dimensions shown on the Drawings that are related to equipment are based on the equipment of one manufacturer. Conform the dimensions of the equipment furnished to the space allocated for that equipment.
- b. The Drawings show the principal elements of the electrical work. They are not intended as detailed working drawings for the electrical work, but as a complement to the specifications to clarify the principal features of the electrical systems.
- c. It is the intent of the Drawings and Specifications that all equipment and devices, furnished and installed under this contract, be properly connected, and interconnected with other equipment and devices 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 Drawings.
- d. It also is the intent of the Drawings and Specifications that similar products be by the same manufacturer for uniformity on the Project.

#### 1.2 QUALITY ASSURANCE

##### A. Permits: Refer to the Instructions to Bidders for responsibilities for obtaining and paying for Contractor's permits, licenses, and inspection fees.

##### B. Testing Laboratory Labels: Electrical material and equipment shall be new and shall bear the label of the Underwriters' Laboratories, Inc., or other nationally-recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.

- C. Area Classifications: Materials and equipment shall conform to the area classification(s) shown, specified, and required.
1. Dry Locations: Materials, equipment, and incidentals in these locations shall meet NEC and NEMA requirements for dry locations. Conduit systems shall be as specified in Section 16130, Raceways and Boxes for Electrical Systems. Enclosures, pullboxes, and terminal boxes installed in dry locations shall be NEMA 12, unless noted otherwise on the Contract Drawings.
  2. Damp/Wet Locations: Materials, equipment, and incidentals in these locations shall meet NEC and NEMA requirements for damp/wet locations. Conduit systems shall be as specified in Section 16130, Raceways and Boxes for Electrical Systems. Enclosures, pullboxes, and terminal boxes installed in damp/wet locations shall be NEMA 4X Type 316 Stainless Steel, unless noted otherwise on the Contract Drawings.
  3. Corrosive Locations: Materials, equipment and incidentals in corrosive locations shall meet NEC and NEMA requirements for wet locations. Conduit systems shall be as specified in Section 16130, Raceways and Boxes for Electrical Systems. Enclosures pullboxes, and terminal boxes installed in corrosive locations shall be NEMA 4X Type 316 Stainless Steel, unless specified otherwise on the Contract Drawings.

D. Area Classification Table:

<b>DRY LOCATIONS:</b>
Electrical Room
<b>DAMP/WET LOCATIONS:</b>
Exterior Locations
<b>CORROSIVE LOCATIONS:</b>
All locations outside of the Electrical Room above and below grade (except those listed as Class I, Division 2 or Class I, Division 1 locations).
<b>CLASS I, DIVISION 2 LOCATIONS:</b>
Not applicable. (Class I, Division 2 extents shall be defined as extending horizontally to 3 ft beyond the outer surface of the exterior walls and vertically above and below grade for each of the facilities listed in this classification.)
<b>CLASS I, DIVISION 1 LOCATIONS:</b>
Not applicable (Class I, Division 1 extents shall be defined as extending horizontally to 3 ft beyond the outer surface of the exterior walls and vertically above and below grade for each of the facilities listed in this classification.)

E. Utilities:

1. Power Company: Perform work in strict conformance with the requirements of the electric utility service serving the facility, PSEG Long Island.

- F. Material, equipment, and work shall be installed in accordance with the current standards and recommendations of the following publications at a minimum. Where discrepancies arise between codes, the most restrictive regulation shall apply.
1. 2017 National Electrical Code (NFPA 70).
  2. 2013 National Fire Alarm Code (NFPA 72).
  3. Standard for Emergency and Standby Power Systems (NFPA 110) latest edition.
  4. 2017 International Code Council Electrical Code.
  5. 2017 National Electrical Safety Code.

### 1.3 SUBMITTALS

- A. Refer to Section 01300, Shop Drawing Procedures.
- B. Submit details of equipment identification as specified under Part 2.
- C. Submit shop drawings for each specification section individually under a unique Submittal Number. Submittal shall include shop drawings specific to the specification section that the submittal number references. Any submittal that includes shop drawings for materials and equipment that are specified in more than one specification section shall be returned to Contractor without review.

### 1.4 PROJECT CLOSEOUT

- A. Operation and Maintenance Data:
1. Refer to Section 01830, Startup, Training and Operation and Maintenance Manuals.
  2. a separate O&M Manual for each Division 26 specification section for which an O&M Manual is required in accordance with Section 01830, Startup, Training and Operation and Maintenance Manuals. Any O&M Manual submitted that covers more than one specification section shall be returned to Contractor without review.
- B. Record Drawings:
1. Furnish record drawings in accordance with Section 01710, Record Drawings and Closeout Procedures, including:
    - a. System Record Drawings: Include the following:
      - 1) One line wiring diagram of the power distribution system and grounding system.
      - 2) Actual in place conduit and cable layouts with schedule of conduit sizes and number and size of conductors.
      - 3) Layouts of the power and lighting arrangements and the grounding system.
      - 4) Control schematic diagrams, with terminal numbers and all control devices identified, for all equipment.
      - 5) Duct bank layouts, including installed locations of handholes and manholes, and interior elevations of each side of each handhole and each manhole which clearly indicates the conduit number and its location.

- b. Point-to-Point Interconnection Wiring Diagram Drawings: Include the following:
  - 1) External wiring for each piece of equipment, panel, instrument, and other devices and wiring to control stations, lighting panels and motor controllers.
  - 2) Numbered terminal block identification for each wire termination.
  - 3) Identification of the assigned wire numbers 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 all equipment and the Shop Drawing transmittal number for equipment from which the wiring requirements and termination information was obtained.

2. The record drawings shall reflect final equipment and field installation information.

## 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of Materials: Advise manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the Site.

## PART 2 - PRODUCTS

### 2.1 NAMEPLATES

- A. Material: For indoor locations, provide laminated phenolic, engraved with one-inch-high white letters on a black background. For outdoor locations, provide photo-metallic type nameplates with one-inch-high black letters.
- B. Border: Minimum 1/8-inch around engraved print with extra length for fastening devices.
- C. Fasteners: 3/16-inch diameter, roundhead, stainless steel, and self-tapping screws.

### 2.2 WIRE MARKERS

- A. Refer to Section 16411, Low-Voltage Electrical Power Conductors and Cables.

### 2.3 CONDUIT TAGS

- A. Refer to Section 16130, Raceways and Boxes for Electrical Systems.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT IDENTIFICATION

- A. Provide identification of each electrical item, in addition to the manufacturer's nameplates, to identify the item's function and the equipment or system which it serves or controls.

- B. Identify equipment by means of nameplates. Relabel existing equipment whose designation has been changed.
- C. Color code and identify wires and cables by means of wire markers. Identify power conductors by circuit number and phase. Identify each control, signal, and status wire by a unique number. Numbering system shall reflect the actual designations used in the Work and shall be documented on the point-to-point wiring diagrams. Coil spare wiring neatly. Tag each spare wire and note its origin.
- D. Identify raceways by means of brass tags.
- E. Identify pull, junction, and terminal boxes with nameplates. Identify each box by a unique number. Numbering system shall reflect the actual designations used in the field and as documented on wiring diagrams.

END OF SECTION 16050

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## **SECTION 16054 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:

- 1. Round sleeves.
- 2. Rectangular sleeves.
- 3. Sleeve seal systems.
- 4. Grout.
- 5. Pourable sealants.
- 6. Foam sealants.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.

### **PART 2 - PRODUCTS**

#### **2.1 ROUND SLEEVES**

- A. Wall Sleeves, Steel:

- 1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

- B. Wall Sleeves, Cast Iron:

- 1. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.



C. Pipe Sleeves, PVC:

1. Description: ASTM D1785, Schedule 40.

D. Molded Sleeves, PVC:

1. Description: With nailing flange for attaching to wooden forms.

E. Molded Sleeves, PE or PP:

1. Description: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sheet Metal Sleeves, Galvanized Steel, Round:

1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch (0.6-mm); round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

## 2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:
  - a. Material: Galvanized sheet steel.
  - b. Minimum Metal Thickness:
    - 1) For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness must be 0.052 inch (1.3 mm).
    - 2) For sleeve cross-section rectangle perimeter not less than 50 inches (1270 mm) or with one or more sides larger than 16 inches (400 mm), thickness must be 0.138 inch (3.5 mm).

## 2.3 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
  2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.5 POURABLE SEALANTS

- A. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.
1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

## 2.6 FOAM SEALANTS

- A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
    - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
  2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed or seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations:
1. Install steel or cast-iron pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
  2. Install steel pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

### 3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

### 3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 16054

NO TEXT THIS PAGE

## SECTION 16060 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Transformer Grounding.
  - 3. Switchgear Grounding.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agencies field supervisor.
- C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Spare Parts and Maintenance Materials: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01783 "Spare Parts and Maintenance Materials," include the following:

- a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1) Test wells.
  - 2) Ground rods.
  - 3) Ground rings.
  - 4) Grounding arrangements and connections for separately derived systems.
- b. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NETA MTS.
  - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
  - 2) Include recommended testing intervals.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Burndy; Part of Hubbell Electrical Systems.
  - 2. Dossert; AFL Telecommunications LLC.
  - 3. ERICO International Corporation.
  - 4. Fushi Copperweld Inc.
  - 5. ILSCO.
  - 6. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 7. Siemens Power Transmission & Distribution, Inc.
  - 8. Thomas & Betts Corporation, A Member of the ABB Group.

### 2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

- B. Bare Copper Conductors:
  1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Tinned Conductors: ASTM B 33.
  4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
  6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

## 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- K. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- L. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- M. Straps: Solid copper, cast-bronze clamp or copper lugs. Rated for 600 A.
- N. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- O. Water Pipe Clamps:



1. Mechanical type, two pieces with stainless-steel bolts.
  - a. Material: Die-cast zinc alloy.
  - b. Listed for direct burial.
2. U-bolt type with malleable-iron clamp and copper ground connector.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m).

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  1. Bury at least 24 inches (600 mm) below grade.
  2. Duct-Bank Grounding Conductor: See duct bank details for location of ground conductor.
- C. Conductor Terminations and Connections:
  1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  3. Connections to Ground Rods at Test Wells: Bolted connectors.
  4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Receptacle circuits.
  - 3. Single-phase motor and appliance branch circuits.
  - 4. Three-phase motor and appliance branch circuits.
  - 5. Armored and metal-clad cable runs.
  - 6. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 16138 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
  2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections.
- D. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  - 2. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
  - 3. Substations and Pad-Mounted Equipment: 5 ohms.
  - 4. Manhole Grounds: 10 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

NO TEXT THIS PAGE

## SECTION 16072 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Ladder cable tray.
2. Fiberglass cable tray.
3. Cable tray accessories.
4. Warning signs.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

- B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
  - a. Vertical and horizontal offsets and transitions.
  - b. Clearances for access above and to sides of cable trays.
  - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
  - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

- C. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer who is licensed in the state where Project is located and who is responsible for their preparation.
2. Design Calculations: Calculate requirements for selecting seismic restraints.
3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
  - 2. Vertical and horizontal offsets and transitions.
  - 3. Clearances for access above and to side of cable trays.
  - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.
- B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
  - 2. Component Importance Factor: 1.5.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient.

### 2.2 GENERAL REQUIREMENTS FOR CABLE TRAY

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
  - 1. Source Limitations: Obtain cable trays and components from single manufacturer.

- B. Sizes and Configurations: See the Cable information on Drawings for specific requirements, sizes, and configurations.
- C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:
  1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
  2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
  3. Load and Safety Factors: Applicable to both side rails and rung capacities.

### 2.3 LADDER CABLE TRAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. B-line, an Eaton business.
  2. Chalfant Manufacturing Company.
  3. MP Husky USA Cable Tray & Cable Bus.
  4. Thomas & Betts Corporation; a Member of the ABB Group.
- B. Description:
  1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
  2. Width: 18 inches (450 mm) or 24 inches (600 mm) unless otherwise indicated on Drawings.
  3. Minimum Usable Load Depth: 4 inches (100 mm).
  4. Straight Section Lengths: 10 feet except where shorter lengths are required to facilitate tray assembly.
  5. Rung Spacing: 12 inches (300 mm) o.c.
  6. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
  7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
  8. No portion of the rungs shall protrude below the bottom plane of side rails.
  9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
  10. Fitting Minimum Radius: 12 inches (300 mm).
  11. Class Designation: Comply with NEMA VE 1, to support 83 lbs/ft on a 12 ft span.
  12. Splicing Assemblies: Bolted type using serrated flange locknuts.
  13. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.



## 2.4 FIBERGLASS CABLE TRAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; part of Atkore International.
2. B-line, an Eaton business.
3. Endure Composites Inc.
4. Legrand US.
5. MP Husky USA Cable Tray & Cable Bus.

B. Description:

1. Configuration: Two longitudinal members with rounded edges and smooth surfaces, supporting a bearing surface, complying with NEMA FG 1.
2. Materials: Straight section structural elements; side rails, rungs, and splice plates shall be pultruded from glass-fiber-reinforced vinyl ester resin, complying with NEMA FG 1 and UL 568.
3. Width: 24 inches (600 mm) unless otherwise indicated on Drawings.
4. Minimum Usable Load Depth: 5 inches (125 mm) according to NEMA FG 1.
5. Straight Section Lengths: 10 feet (3.0 m).
6. Class Designation: Comply with NEMA VE 1, to carry 60 lbs/ft with supports.
7. Temperature Rating: Reduce the load rating of trays exposed to temperatures above 75 deg F (24 deg C) according to Table 4-3, "Working Loads," in NEMA FG 1.
8. Fitting Minimum Radius: 12 inches (300 mm).
9. Splicing Assemblies: Minimum four nuts and bolts per plate. Splice plates shall be furnished with straight sections and fittings.
10. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
11. Fasteners: Fiberglass-encapsulated, ASTM F593 and ASTM F594 stainless steel, Type 316. Design fasteners so that no metal is visible when fully assembled and tightened. Fastener encapsulation shall not be damaged when torqued to manufacturer's recommended value.

## 2.5 CABLE TRAY ACCESSORIES

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
- C. Splice phase plates shall be stainless steel with 316 stainless steel hardware.

## 2.6 WARNING SIGNS

- A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background, with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

- B. Comply with Section 260553 "Identification for Electrical Systems."
- C. Provide markings on cable tray reading "DANGER - HIGH VOLTAGE – KEEP AWAY".

## 2.7 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect cable trays according to NEMA VE 1.

## PART 3 - EXECUTION

### 3.1 CABLE TRAY INSTALLATION

- A. Install cable tray and support systems according to NEMA VE 2.
- B. Install cable tray as a complete system, including fasteners, hold-down clips, support systems, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, bonding, box connectors, etc.
- C. Install cable tray, so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure and install seismic restraints.
- G. Design fasteners and supports to carry cable tray, cables, and a concentrated load of 200 lb (90 kg). Comply with requirements in "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to "Seismic Controls for Electrical Systems."
- H. Place supports, so that spans do not exceed maximum spans on schedules, and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support assembly to prevent twisting from eccentric loading.
- K. Do not install more than one cable tray splice between supports.
- L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

- M. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed recommended dimensions. Space connectors and set gaps according to applicable standard.
- N. Make changes in direction and elevation using manufacturer's recommended fittings.
- O. Make cable tray connections using manufacturer's recommended fittings.
- P. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."
- Q. Install cable trays with enough workspace to permit access for installing cables.
- R. Install warning signs in visible locations on or near cable trays after cable tray installation.
- S. Provide seismic bracing as required under Paragraph 1.4 of this Specification.

### 3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems." Provide insulated ground conductor in tray.

### 3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

### 3.4 CONNECTIONS

- A. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.

2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70.
4. Verify that there are no intruding items, such as pipes, hangers, or other equipment, in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

### 3.6 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 16072

NO TEXT THIS PAGE

## SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

- B. Related Requirements:

- 1. Section 16074 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

- a. Hangers.
    - b. Steel slotted support systems.
    - c. Nonmetallic support systems.
    - d. Trapeze hangers.
    - e. Clamps.
    - f. Turnbuckles.
    - g. Sockets.
    - h. Eye nuts.
    - i. Saddles.
    - j. Brackets.

- 2. Include rated capacities and furnished specialties and accessories.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

- 1. Trapeze hangers. Include product data for components.
  - 2. Steel slotted-channel systems.
  - 3. Equipment supports.

4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of trapeze hangers.
  2. Include design calculations for seismic restraints.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
- B. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M.
  2. AWS D1.2/D1.2M.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."

2. Component Importance Factor: 1.5.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
  2. Self-extinguishing according to ASTM D 635.

## 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. Flex-Strut Inc.
    - e. G-Strut.
    - f. Thomas & Betts Corporation; a member of the ABB Group.
    - g. Unistrut; an Atkore International company.
    - h. Wesanco, Inc.
  2. Material: Galvanized steel.
  3. Channel Width: 1-5/8 inches (41.25 mm).
  4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  8. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported. Provide support for IAC and MI cables as recommended by the manufacturer.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.



- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti, Inc.
      - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti, Inc.
      - 4) ITW Ramset/Res Head; Illinois Tool Works Inc.
      - 5) MKT Fastening, LLC.
  3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  5. Toggle Bolts: Stainless-steel springhead type.
  6. Hanger Rods: Threaded steel.

## 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 16130 "Raceways and Boxes for Electrical Systems."

- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits. Non-metallic slotted supports shall be used in corrosive atmospheres.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, RMCs may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  - 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are indicated on drawings.
- C. Anchor equipment to concrete base as follows:
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 16073

## SECTION 16074 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

- B. Related Requirements:

1. Section 16073 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
  - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
  - b. Annotate to indicate application of each product submitted and compliance with requirements.

- B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
  - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

3. Seismic-Restraint Details:

- a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

#### A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
  - a. Component Importance Factor: 1.5.
  - b. Component Response Modification Factor: 2.5.
  - c. Component Amplification Factor: 2.5.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second)
4. Design Spectral Response Acceleration at 1.0-Second Period.

### 2.2 RESTRAINT CHANNEL BRACINGS

#### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-Line, an Eaton business
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut; Atkore International.

#### B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

### 2.3 RESTRAINT CABLES

#### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.; a Division of Cooper Industries.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut; Atkore International.

#### B. Restraint Cables: ASTM A 603 galvanized steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

## 2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.; a Division of Cooper Industries.
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.
  - 4. TOLCO; a brand of NIBCO INC.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.5 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.' a Division of Cooper Industries.
  - 2. Hilti, Inc.
  - 3. Kinetics Noise Control, Inc.
  - 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.6 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hilti, Inc.
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.

- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
  - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
  - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- B. Install cables so they do not bend across edges of adjacent equipment or building structure.
- C. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.



E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
3. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
4. Set anchors to manufacturer's recommended torque using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  5. Test to 90 percent of rated proof load of device.
- C. Seismic controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 16074

## SECTION 16075 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Tapes and stencils.
  - 5. Tags.
  - 6. Signs.
  - 7. Cable ties.
  - 8. Paint for identification.
  - 9. Fasteners for labels and signs.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- C. Delegated-Design Submittal: For arc-flash hazard study.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 16575 requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; material surfaces.

## 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase-and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
  - 3. Colors for 240-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
  - 4. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  - 5. Color for Neutral: White or gray.
  - 6. Color for Equipment Grounds: Green.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Champion America.
    - c. Emedco.
    - d. Grafoplast Wire Markers.
    - e. Hellermann Tyron.
    - f. LEM Products Inc.
    - g. Marking Services, Inc.
    - h. Panduit Corp.
    - i. Seton Identification Products.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Hellerman Tyton.
    - c. Marking Services, Inc.
    - d. Panduit Corp.
    - e. Seton Identification Products.
- C. Self-Adhesive Wraparound Labels: Preprinted or Write-on, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. Emedco.

- e. Grafoplast Wire Markers.
  - f. Ideal Industries, Inc.
  - g. LEM Products Inc.
  - h. Marking Services, Inc.
  - i. Panduit Corp.
  - j. Seton Identification Products.
2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. emedco.
    - e. Grafoplast Wire Markers.
    - f. Hellerman Tyton.
    - g. Ideal Industries, Inc.
    - h. LEM Products Inc.
    - i. Marking Services, Inc.
    - j. Panduit Corp.
    - k. Seton Identification Products.
  2. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches (37 by 150 mm)for raceway and conductors.
    - b. 3-1/2 by 5 inches (76 by 127 mm)for equipment.
    - c. As required by authorities having jurisdiction.

## 2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation,

- b. Marking Services, Inc.
  - c. Panduit Corp.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Panduit Corp.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlton Industries, LP.
    - b. Champion America.
    - c. Ideal Industries, Inc.
    - d. Marking Services, Inc.
    - e. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
  - 1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Marking Services, Inc.
- C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and is 12 inches (300 mm) wide. Stop stripes at legends.
  - 1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
    - a. LEM Products Inc.
    - b. Marking Services, Inc.
    - c. Seton Identification Products.
- D. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

- a. Carlton Industries, LP.
- b. Seton Identification Products.

E. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

- a. Brady Corporation.
- b. Ideal Industries, Inc.
- c. LEM Products Inc.
- d. Marking Services, Inc.
- e. Reef Industries, Inc.
- f. Seton Identification Products.

2. Tape:

- a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
- b. Printing on tape shall be permanent and shall not be damaged by burial operations.
- c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

- a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
- b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE". Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

4. Tag: Type I:

- a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
- b. Width: 3 inches (75 mm).
- c. Thickness: 4 mils (0.1 mm).
- d. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
- e. Tensile according to ASTM D 882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).

5. Tag: Type II:

- a. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  - b. Width: 3 inches (75 mm).
  - c. Thickness: 12 mils (0.3 mm).
  - d. Weight: 36.1 lb/1000 sq. ft. (17.6 kg/100 sq. m).
  - e. Tensile according to ASTM D 882: 400 lbf (1780 N) and 11,500 psi (79.2 MPa).
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be inch (25 mm).

## 2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Marking Services, Inc.
    - e. Seton Identification Products.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) to 0.023 inch (0.58 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Grafoplast Wire Markers.
    - e. LEM Products Inc.
    - f. Marking Services, Inc.
    - g. Panduit Corp.
    - h. Seton Identification Products.
- C. Write-on Tags:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlton Industries, LP.
    - b. LEM Products Inc.
    - c. Seton Identification Products.



2. Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## 2.7 SIGNS

### A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Carlton Industries, LP.
  - b. Champion America.
  - c. emedco.
  - d. Marking Services, Inc.
2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches (180 by 250 mm).

### B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Champion America.
  - c. emedco.
  - d. Marking Services, Inc.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch (1-mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch (6.4-mm) grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches (250 by 360 mm).

### C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Carlton Industries LP.
  - c. emedco.
  - d. Marking Services, Inc.

2. Engraved legend.
3. Thickness:
  - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick).
  - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
  - c. Engraved legend with white letters on a dark gray background.
  - d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
  - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 CABLE TIES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ideal Industries, Inc.
  - b. Marking Services, Inc.
  - c. Panduit Corp.
  
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  4. Color: Black, except where used for color-coding.
  
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
  3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  4. Color: Black.
  
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
  1. Minimum Width: 3/16 inch (5 mm).
  2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
  3. UL 94 Flame Rating: 94V-0.
  4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
  5. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer, load shedding, key interlocks and as directed.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
  - 3. "UPS."
- M. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- N. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- W. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- X. Metal Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using UV-stabilized cable ties.
- Y. Nonmetallic Preprinted Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using UV-stabilized cable ties.
- Z. Write-on Tags:
  - 1. Place in a location with high visibility and accessibility.
  - 2. Secure using UV-stabilized cable ties.
- AA. Baked-Enamel Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.
- BB. Metal-Backed Butyrate Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.
- CC. Laminated Acrylic or Melamine Plastic Signs:
  - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

DD. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch- (75-mm-) high, black letters on 20-inch (500-mm) centers.
  1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot (3-m) maximum intervals.
- D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Snap-around labels and Snap-around color-coding bands for raceway and cables.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive raceway labels.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
  1. "EMERGENCY POWER."
  2. "POWER."
  3. "UPS."
- G. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use snap-around labels to identify the phase.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

- H. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- K. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- L. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- N. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
  - 1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
  - 2. Wall surfaces directly external to raceways concealed within wall.
  - 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- O. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- P. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- Q. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  - 1. Apply to exterior of door, cover, or other access.
  - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- R. Arc Flash Warning Labeling: Self-adhesive labels.

- S. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- T. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer, load shedding, key interlocks, etc.
- U. Equipment Identification Labels:
  - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
  - 2. Outdoor Equipment: Laminated acrylic or melamine sign or Stenciled legend 4 inches (100 mm) high.
  - 3. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Switchboards.
    - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - g. Substations.
    - h. Emergency system boxes and enclosures.
    - i. Motor-control centers.
    - j. Enclosed switches.
    - k. Enclosed circuit breakers.
    - l. Enclosed controllers.
    - m. Variable-speed controllers.
    - n. Push-button stations.
    - o. Power-transfer equipment.
    - p. Contactors.
    - q. Remote-controlled switches, dimmer modules, and control devices.
    - r. Battery-inverter units.
    - s. Battery racks.
    - t. Power-generating units.
    - u. Monitoring and control equipment.
    - v. UPS equipment.

END OF SECTION 16075



NO TEXT THIS PAGE

## SECTION 16130 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

1. Section 16138 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

#### 1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Allied Tube & Conduit; a part of Atkore International.
  - 3. Anamet Electrical, Inc.
  - 4. Electric-Flex Company.
  - 5. FSR Inc.
  - 6. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 7. Picoma Industries, Inc.
  - 8. Republic Conduit.
  - 9. Robroy Industries.
  - 10. Southwest Company.
  - 11. Thomas & Betts Corporation, A Member of the ABB Group.
  - 12. Western Tube and Conduit Corporation.
  - 13. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch (1 mm), minimum.
- E. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Expansion Fittings: Steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper. Provide expansion fitting where crossing existing expansion joints.
- H. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
  2. Anamet Electrical, Inc.
  3. Arco Corporation.
  4. CANTEX INC.
  5. CertainTeed Corporation.
  6. Condux Interantional, Inc.
  7. Electri-Flex Company.
  8. Kraloy.
  9. Lamson & Sessions.
  10. Niedax Inc.
  11. RACO; Hubbell.
  12. Thomas & Betts Corporation, A Member of the ABB Group.
- B. Listing and Labeling: Nonmetallic conduits and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Rigid HDPE: Comply with UL 651A.
- F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- G. Fittings for LFNC: Comply with UL 514B.
- H. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
  2. Hoffman; a brand of Pentair Equipment Protection.
  3. MonoSystems, Inc.
  4. Square D.

- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R, Type 4 or Type 12 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type or Flanged-and-gasketed type where installed in areas subject to moisture. .
- E. Finish: Manufacturer's standard enamel finish.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Adalet.
  - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. FSR Inc.
  - 6. Hoffman.
  - 7. Hubbell Incorporated.
  - 8. Kraloy.
  - 9. Milbank Manufacturing Co.
  - 10. Mono-Systems, Inc.
  - 11. O-Z/Gedney.
  - 12. RACO; Hubbell.
  - 13. Robroy Industries.
  - 14. Spring Non-Metallic Enclosures.
  - 15. Stahlin Non-Metallic Enclosures.
  - 16. Thomas & Betts Corporation.
  - 17. Wiremold/Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- I. Gangable boxes are allowed.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R, Type 4 or Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Fiberglass.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
  - 1. NEMA 250, Type 3R or Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: GRC.
  - 3. Underground Conduit: RNC, Type EPC-80-PVC.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4, Type 4X, Type 12.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed: GRC.
  - 2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 3. Damp or Wet Locations: GRC.
  - 4. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 or Type 4X stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 16073 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- G. Support conduit within 12 inches ((300 mm)) of enclosures to which attached.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- N. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- P. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- Q. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- R. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
  - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
  - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.00078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
  - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.



- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- T. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

### 3.3 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

### 3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements for Electrical Raceways and Cabling."

### 3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

### 3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130

NO TEXT THIS PAGE

## SECTION 16241 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Load centers.

#### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. HID: High-intensity discharge.
- D. MCCB: Molded-case circuit breaker.
- E. SPD: Surge protective device.
- F. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:
  1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock.
  2. Circuit Breakers Including GFCI: Two spares for each panelboard.
  3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

#### 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407

1.10 FIELD CONDITIONS

A. Environmental Limitations:

- 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Altitude: Noa

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

- 1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of electric service.
- 2. Do not proceed with interruption of electric service without Construction Manager or Owner written permission.
- 3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

- 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

- 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1
    - b. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
    - c. Other Wet or Damp Indoor Locations: NEMA 250, [Type 4X]
    - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  - 2. Height: 84 inches (2.13 m) maximum.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Finishes:
    - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Same finish as panels and trim.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- F. Incoming Mains:
  - 1. Location: Convertible between top and bottom.
  - 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
    - a. Plating shall run entire length of bus.
    - b. Bus shall be fully rated the entire length.
  - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

- H. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Terminations shall allow use of 75 deg C rated conductors without derating.
  - 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  - 4. Main and Neutral Lugs: Compression or Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  - 5. Ground Lugs and Bus-Configured Terminators: Compression or Mechanical type, with a lug on the bar for each pole in the panelboard.
  - 6. Feed-Through Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 7. Subfeed (Double) Lugs: Compression or Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  
- I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
  
- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
  - 1. Percentage of Future Space Capacity: 10 percent.
  
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
  - 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  - 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
  
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.3 PANELBOARDS

- A. Available 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. Square D; by Schneider Electric
  - 2. Eaton
  - 3. General Electric Company
- B. Panelboards: NEMA PB 1
  - 1. Distribution type
  - 2. Lighting and appliance branch-circuit type.
- C. Doors:
  - 1. Secured with vault-type latch with tumbler lock; keyed alike.
    - a. For doors more than 36 inches high, provide two latches, keyed alike.
  - 2. Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.
- D. Mains: As indicated on drawings.
- E. Branch Devices (3-phase, 125A – 800A): Molded case circuit breakers with LSI trip function
- F. Branch Devices (3-phase, 110A and below): Molded case circuit breakers with adjustable instantaneous trip
- G. Other Branch Overcurrent Protective Devices: Bolt-on circuit breakers

## 2.4 LOAD CENTERS

- A. Available 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. Square D; by Schneider Electric
  - 2. Eaton
  - 3. General Electric Company
- B. Load Centers: Comply with UL 67.
- C. Mains: As indicated on drawings.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.



- E. Doors: Concealed hinges secured with flush latch with tumbler lock; keyed alike.
- F. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

## 2.5 ELECTRONIC-GRADE PANELBOARDS

- A. Available 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. Square D; by Schneider Electric
  - 2. Eaton
  - 3. General Electric Company
- B. Panelboards: NEMA PB 1; with factory-installed, integral SPD; labeled by an NRTL for compliance with UL 67 and UL 1449 after installing SPD.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. SPD.
  - 1. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
  - 2. Protection modes and UL 1449 VPR for grounded wye circuits with three-phase, four-wire circuits shall not exceed the following:
    - a. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
    - b. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
    - c. Neutral to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
    - d. Line to Line: 2000 V for 480Y/277 V and 1200 V for 208Y/120 V.
  - 3. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
    - a. Line to Neutral: 700 V.
    - b. Line to Ground: 700 V.
    - c. Neutral to Ground: 700 V.
    - d. Line to Line: 1200 V.
  - 4. SCCR: Equal to the SCCR of the panelboard in which installed or exceed 100 kA.
  - 5. Inominal Rating: 20 kA.

## 2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Available 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. Square D; by Schneider Electric
  2. Eaton
  3. General Electric Company
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.
      - 3) Long and short time adjustments.
      - 4) Ground-fault pickup level, time delay, and I squared T response.
  4. MCCB Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.
    - b. Breaker handle indicates tripped status.
    - c. UL listed for reverse connection without restrictive line or load ratings.
    - d. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    - f. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    - g. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.

- h. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- i. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.7 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## 2.8 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
  - 1. Install panelboards on cast-in-place concrete equipment base(s) as required.
  - 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Comply with mounting and anchoring requirements.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 1-1/4 inch in depth. Orient steel slotted supports vertically.
- J. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.
- M. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 16075 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 16075 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 16075 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 16075 "Identification for Electrical Systems" identifying source of remote circuit.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Perform optional tests. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 16241

## SECTION 16272 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Standard-grade receptacles, 125 V, 20A.
  - 2. USB receptacles.
  - 3. GFCI receptacles, 125 V, 20 A.
  - 4. Hospital-grade receptacles, 125 V, 20 A.
  - 5. Cord and plug sets.
  - 6. Toggle switches, 120/277 V, 20 A.
  - 7. Decorator-style devices, 20 A.
  - 8. Wall plates.

#### 1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Service/Power Poles: One for every 10, but no fewer than one.
  - 2. Floor Service-Outlet Assemblies: One for every 10 but no fewer than one.
  - 3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

## PART 2 - PRODUCTS

### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  - 2. Devices shall comply with requirements in this Section.
- F. Devices for Owner-Furnished Equipment:
  - 1. Receptacles: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.
- G. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: Gray as approved by Architect and Owner, unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Essential Electrical System: Red.



- H. Wall Plate Color: For plastic covers, match device color.
- I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

### A. Duplex Receptacles, 125 V, 20 A

1. Description: Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

### B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

### C. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

### D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

## 2.3 USB RECEPTACLES

### A. USB Charging Receptacles:

1. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual and quad, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.

B. Tamper-Resistant Duplex and USB Charging Receptacles:

1. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
2. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
3. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.5 HOSPITAL-GRADE RECEPTACLES, 125 V, 20 A

A. Hospital-Grade, Single Receptacles, 125 V, 20 A:

1. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498 Supplement sd and FS W-C-596.
  4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.
- B. Hospital-Grade, Duplex Receptacles, 125 V, 20 A:
1. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Two pole, three wire, and self-grounding.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498 Supplement sd and FS W-C-596.
  4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.
- C. Hospital-Grade, Isolated-Ground, Duplex Receptacles, 125 V, 20 A:
1. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498 Supplement sd and FS W-C-596.
  4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.
- D. Hospital-Grade, Tamper-Resistant, Duplex Receptacles, 125 V, 20 A:
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, and FS W-C-596.
  4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.
- E. Hospital-Grade, Tamper-Resistant, Duplex (125 V, 20 A) and USB Charging Receptacles:
1. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
  2. Line Voltage Receptacles: Two pole, three wire, and self-grounding, NEMA Configuration 5-20R.
  3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
  4. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1310, and FS W-C-596.
  5. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.
- F. Hospital-Grade, Duplex GFCI Receptacles, 125 V, 20 A:
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Single-piece, rivetless, nickel-plated, all-brass grounding system.

2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498 supplement sd, UL 943 Class A, and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

G. Hospital-Grade, Tamper-Resistant, Duplex GFCI Receptacles, 125 V, 20A :

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Single piece, rivetless, nickel-plated, all-brass grounding system.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498 supplement sd, UL 943 Class A, and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

2.6 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
  1. Standards: Comply with UL 20 and FS W-S-896.
- B. Antimicrobial, Single-Pole Switches, 120/277 V, 20 A:
  1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
  2. Standards: Comply with UL 20 and FS W-S-896.
- C. Two-Pole Switches, 120/277 V, 20 A:
  1. Comply with UL 20 and FS W-S-896.
- D. Antimicrobial, Double-Pole Switches, 120/277 V, 20 A:
  1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.

2. Standards: Comply with UL 20 and FS W-S-896.
- E. Three-Way Switches, 120/277 V, 20 A
1. Comply with UL 20 and FS W-S-896.
- F. Antimicrobial, Three-Way Switches, 120/277 V, 20A:
1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
  2. Standards: Comply with UL 20 and FS W-S-896.
- G. Four-Way Switches, 120/277 V, 20 A:
1. Standards: Comply with UL 20 and FS W-S-896.
- 2.8 DECORATOR-STYLE DEVICES, 20 A
- A. Decorator Duplex Receptacles, 125 V, 20 A:
1. Description: Two pole, three wire, and self-grounding. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
- B. Decorator Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
  4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- C. Decorator, Tamper- and Weather-Resistant, Duplex Receptacles, 125 V, 20 A:
1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
  4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.
- D. Decorator Single-Pole Switches, 120/277 V, 20 A:
1. Comply with UL 20.
- E. Decorator Single-Pole Lighted Switches, 120/277 V, 20A :
1. Description: Square face illuminated when circuit is switched off.
  2. Standards: Comply with UL 20.

- F. Decorator, Antimicrobial, Single-Pole Switches, 120/277 V, 20 A:
  - 1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
  - 2. Standards: Comply with UL 20 and FS W-S-896.

## 2.9 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.
- D. Antimicrobial Cover Plates:
  - 1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
  - 2. Tarnish resistant.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 16075 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
- C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

### 3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
  - 1. In healthcare facilities, prepare reports that comply with NFPA 99.
  - 2. Test Instruments: Use instruments that comply with UL 1436.
  - 3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Test straight-blade convenience outlets in patient-care areas and hospital-grade outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).
- F. Wiring device will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.



END OF SECTION 16272

NO TEXT THIS PAGE

## SECTION 16411 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including *General* and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

##### A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.
4. Mineral insulated cables (MI) 600 V and less.

##### B. Related Requirements:

1. Section 16124 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.

#### 1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
  1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

## PART 2 - PRODUCTS

### 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Alpha Wire Company.
  - 2. American Bare Conductor.
  - 3. Belden Inc.
  - 4. Cerro Wire LLC.
  - 5. Encore Wire Corporation.
  - 6. General Cable Technologies Corporation.
  - 7. Service Wire Co.
  - 8. Southwire Company.
  - 9. WESCO.
- C. Where MI cable is indicated, it shall be Pyrotenax.
- D. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Conductor Insulation:
  - 1. Type USE-2 and Type SE: Comply with UL 854.
  - 2. Type THHN and Type THWN-2: Comply with UL 83.
  - 3. Type UF: Comply with UL 83 and UL 493.
  - 4. Type XHHW-2: Comply with UL 44.

### 2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Alpha Wire Company.
  - 2. American Bare Conductor.
  - 3. Belden Inc.
  - 4. Cerro Wire LLC.
  - 5. Encore Wire Corporation.
  - 6. General Cable Technologies Corporation.
  - 7. Service Wire Co.
  - 8. Southwire Company.
  - 9. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Bare.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Aluminum, interlocked.

I. Jacket: PVC applied over armor.

## 2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.
5. Ideal Industries, Inc.
6. ILSCO.
7. NSi Industries LLC.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Service Wire Co.
10. TE Connectivity Ltd.
11. Thomas & Betts Corporation, A Member of the ABB Group.

## 2.4 MINERAL INSULATED CABLE

- A. The contractor shall furnish and install MI cable as noted on the drawings.
- B. MI cable shall be Pyrotenax System 500. Cable shall have a seamless metal sheath that allows the cable to withstand bending, twisting, pulling and mechanical abrasion whole remaining functional.
- C. Insulation shall be highly compressed magnesium oxide over copper conductor. Insulation rating shall be 600 volts.
- D. Cables smaller or equal to  $\frac{3}{4}$ " shall have a bending radius of 5 times the cable diameter. Cables larger than  $\frac{3}{4}$ " shall have a bending radius of 10 times the cable diameter.
- E. MI cable shall be insulated per manufacturer's recommendations. Where the runs are longer than what a standard spool holds, provide field installed splice kits complete with glands.
- F. Where multiple single conductor cables are used for a single feeder, provide stainless steel banding kits as recommended by the manufacturer.
- G. Where MI cable terminates at equipment, provide brass plates to avoid induction heating of ferrous metal enclosures.
- H. Where MI cable is cut, use epoxy resin sealing component.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

### 3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 16130 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 16073 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation prior to installing conductors and cables.
- H. Install MI cables per manufacturer's recommendations.

### 3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

### 3.4 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 16075 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

### 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### 3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
  3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each bolted connection and splice 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 16411



## SECTION 16419 - MOTOR-CONTROL CENTERS

### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Coordinate with the facility most percent electrical system studies for required PPE to work or energize equipment.

### 1.2 SUMMARY

- A. Contractor shall coordinate with manufacturer local GEXPRO distributor to provide a new 100A circuit breaker bucket to be furnished and installed into existing MCC-GE available space within section #3. This work shall be done without deenergizing the MCC line up.
- B. Contractor shall field verify and survey the existing MCC-GE to provide all additional copper bus details, accessories, or components necessary for the proposed scope of work.
- C. Section includes MCCs for use with ac circuits rated 600 V and less, with combination controllers and having the following factory-installed components:
  - 1. Automatic power transfer.
  - 2. Feeder-tap units.
  - 3. Measurement and control.
  - 4. Auxiliary devices.
  - 5. Panelboards.
  - 6. Transformers.

### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCC: Motor-control center.
- C. MCCB: Molded-case circuit breaker.
- D. MCP: Motor-circuit protector.
- E. OCPD: Overcurrent protective device.
- F. PID: Control action; proportional plus integral plus derivative.
- G. PT: Potential transformer.
- H. SPD: Surge protective device.
- I. SCR: Silicon-controlled rectifier.
- J. VFC: Variable-frequency controller.

- K. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for MCCs.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each cell of the MCC.
- B. Shop Drawings: For each MCC or bucket components, manufacturer's approval and production drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
  - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Enclosure types and details.
    - d. Nameplate legends.
    - e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.
    - f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device and installed devices.
    - g. Specified optional features and accessories.
  - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring for each installed controller.
  - 3. Nameplate legends.
  - 4. Vertical and horizontal bus capacities, if applicable.
  - 5. Features, characteristics, ratings, and factory settings of each installed unit.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Standard Drawings: For each MCC or bucket components, as defined in UL 845.
- B. Production Drawings: For each MCC or bucket components, as defined in UL 845.
- C. Coordination and phasing Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around MCCs where work is proposed. Show MCC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support or internal component. Indicate field measurements.
- D. Qualification Data: For testing agency.

- E. Seismic Qualification Data: Certificates, for MCCs, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Product Certificates: For each MCC or bucket components.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.
- J. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01830 "Startup Training and Operation and Maintenance Manuals," include the following:
  - 2. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer, Contractor, or both.
  - 3. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
  - 4. Manufacturer's written instructions for setting field-adjustable overload relays.
  - 5. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage, solid-state controllers.
  - 6. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  - 7. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

## 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
  1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended use.
- D. UL Compliance: MCCs shall comply with UL 845 and shall be listed and labeled by a qualified testing agency.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver MCCs in shipping splits of lengths that can be moved past obstructions in delivery paths.
- B. Handle MCCs according to the following:
  1. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."
  2. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."
- C. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside MCCs.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace MCC that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. General Electric
- B. ABB

### 2.2 SYSTEM DESCRIPTION

- A. NEMA Compliance: Fabricate and label MCCs to comply with NEMA ICS 18.
- B. Ambient Environment Ratings:
  - 1. Ambient Temperature Rating: Not less than 0 deg F (minus 18 deg C) and not exceeding 104 deg F (40 deg C), with an average value not exceeding 95 deg F (35 deg C) over a 24-hour period.
  - 2. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)
  - 3. Humidity Rating: Less than 95 percent (noncondensing).
  - 4. Altitude Rating: Not exceeding 6600 feet (2000 m), or 3300 feet (1000 m) if MCC includes solid-state devices.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: MCCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
  - 2. Component Importance Factor: 1.0.
  - 3. Component Amplification Factor: 2.5.
  - 4. Component Response Modification Factor: 6.0.
- B. Capacities and Characteristics:
  - 1. MCC Enclosure and Assembly:
    - a. Nominal System Voltage: 277/480-V ac.
    - b. Service Equipment Rated: No.
    - c. Enclosure: NEMA 250, Type 12
  - 2. Integrated Short-Circuit Rating for MCC:
    - a. Fully rated; 65 kA.
  - 3. Integrated Short-Circuit Rating for Each Unit:

- a. Fully rated; 65 kA.
- 4. Wiring Class: I-BD
- 5. Bus:N/A
- 6. Main Disconnect Device:N/A
- 7. Automatic Power Transfer: N/A
- 8. Magnetic Controllers: N/A
- 9. Reduced-Voltage Solid-State Controllers: N/A
- 10. VFCs: N/A
- 11. Controller-Mounted Auxiliary Devices:
  - a. Push Buttons and Selector Switches: Heavy-duty, oiltight type.
  - b. Feeder Tap Units: Main Disconnect: MCCB, UL 489 three pole. Manually operated, electrically tripped.
- 12. Panelboards: N/A
- 13. Transformer(s): N/A
- 14. Transfer Switch: N/A

#### 2.4 MOTOR CONTROL CENTER ENCLOSURES

- A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, to match existing MCC rating unless otherwise indicated to comply with environmental conditions at installed location.
- B. Space Heaters: N/A
- C. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- D. Outdoor Enclosures: N/A

#### 2.5 ASSEMBLY

- A. Structure:
  - 1. Comply with UL requirements for service entrance equipment.
  - 2. Units up to and including Size 3 shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
  - 3. Units in Type B and Type C MCCs shall have pull-apart terminal strips for external control connections.
  - 4. Pull Boxes:
    - a. Include provisions for ventilation to maintain temperature in pull box within same limits as the MCC.
    - b. Set the box back from front to clear circuit-breaker removal mechanism.
    - c. Covers: Removable covers forming top, front, and sides.
    - d. Insulated bottom of fire-resistive material with separate holes for cable drops into MCC.

- e. Cable Supports: Arranged to facilitate cabling and adequate to support cables, including supports for future cables.
  - f. When equipped with barriers, supply with access to check bus bolt tightness.
- B. Compartments: Modular; individual lift-off doors with concealed hinges and quick-captive screw fasteners.
  - 1. Interlock compartment door to require that the disconnecting means is "off" before door can be opened or closed, except by operating a concealed release device.
  - 2. Compartment construction shall allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC.
  - 3. The same-size compartments shall be interchangeable to allow rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- C. Bus Transition and Incoming Pull Sections: N/A
- D. Utility Metering Compartment: N/A
- E. Owner's Metering Compartment: N/A
- F. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same-size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
- G. Wiring Spaces: N/A
- H. Provisions for Future: N/A
- I. Integrated Short-Circuit Rating:
  - 1. Short-Circuit Current Rating for Each Unit: Fully rated 65kA.
  - 2. Short-Circuit Current Rating of MCC: Fully rated with its main overcurrent device; 65kA.
- J. Control Power:
  - 1. 120-V ac, supplied centrally from a CPT.
  - 2. 120-V ac; obtained from CPT integral with controller; with primary and secondary fuses. The CPT shall be of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. CPT Spare Capacity: 200VA.
  - 3. Control Circuits: 24-V dc, supplied centrally from two redundant, automatically switched power supplies.

4. CPT Spare Capacity: 200VA. Factory-Installed Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
5. Wiring Class: NEMA ICS 18, Class I, Type B-D,
6. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

K. Bus: N/A

2.6 MAIN DISCONNECT AND OVERCURRENT PROTECTIVE DEVICE(S) - N/A

2.7 AUTOMATIC POWER TRANSFER- N/A

2.8 MAGNETIC CONTROLLERS- N/A

2.9 REDUCED-VOLTAGE SOLID-STATE CONTROLLERS - N/A

2.10 VFC- N/A

2.11 CONTROLLER-MOUNTED AUXILIARY DEVICES

A. Control-Circuit and Pilot Devices: Factory installed in controller enclosure cover unless otherwise indicated. Comply with NEMA ICS 5.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

B. degree scale and plus or minus 2 percent accuracy, with selector switches having an off position.

C. Auxiliary Dry Contacts: NC, NO.

2.12 MEASUREMENT AND CONTROL DEVICES- N/A

2.13 FEEDER TAP UNITS

A. MCCBs (to 1200 A): Fixed mounted, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. Comply with UL 489, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

1. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.



2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - a. Instantaneous trip.
  - b. Long- and short-time pickup levels.
  - c. Long- and short-time time adjustments.
  - d. Ground-fault pickup level, time delay, and I<sup>2</sup>t response.
3. Communication Capability: Circuit-breaker-mounted or integral communication module with functions and features compatible with power monitoring and control system specified in contract documents.
4. With built-in digital ammeter and a digital display, showing tripping cause.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
8. Electrical Operator: Remote control for on, off, and reset operations.

2.14 PANELBOARDS- N/A

2.15 TRANSFORMERS- N/A

2.16 TRANSFER SWITCHES- N/A

2.17 SOURCE QUALITY CONTROL

- A. MCC Testing: Test and inspect MCCs according to requirements in NEMA ICS 18.
- B. MCCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. NEMA Industrial Control and Systems Standards: Comply with parts of NEMA ICS 2.3 for installation and startup of MCCs.
- B. Floor Mounting: Install MCCs on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in specifications.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible switch.
- F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- H. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 16075 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.
  - 1. Identify field-installed conductors, interconnecting wiring, and components.
  - 2. Install required warning signs.
  - 3. Label MCC and each cubicle with engraved nameplate.
  - 4. Label each enclosure-mounted control and pilot device.
  - 5. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.
- B. Operating Instructions: Frame printed operating instructions for MCCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of MCCs.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between master terminal boards and remote devices. Comply with requirements in specification.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
  - 2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.5 CONNECTIONS

- A. Comply with requirements for installation of conduit in Section 16130 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Comply with requirements in Section 16060 "Grounding and Bonding for Electrical Systems."

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- E. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 4. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

- a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multipole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
  - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multipole enclosed controller 11 months after date of Substantial Completion.
  - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Submit calibration record for device.
- 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
  - 6. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.
- F. MCCs will be considered defective if they do not pass tests and inspections.
  - G. Prepare test and inspection reports.

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to NETA Acceptance Testing Specification and manufacturer's written instructions.

### 3.8 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload relay pickup and trip ranges.
- B. Adjust overload relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required).
- D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid-state controllers.
- E. Program microprocessors in VFCs for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- F. Set field-adjustable circuit-breaker trip ranges as specified in specifications.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 16419

NO TEXT THIS PAGE

## SECTION 16420 - ENCLOSED CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
  - 1. Full-voltage manual.
  - 2. Full-voltage magnetic.
  - 3. Reduced-voltage magnetic.
  - 4. Reduced-voltage solid state.
  - 5. Multispeed.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Show tabulations of the following:
    - a. Each installed unit's type and details.
    - b. Factory-installed devices.
    - c. Nameplate legends.
    - d. Short-circuit current rating of integrated unit.
    - e. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
  - 2. Wiring Diagrams: For power, signal, and control wiring.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.
- D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

## 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition, include the following:
  - 1. Routine maintenance requirements for enclosed controllers and installed components.
  - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.



3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

#### 1.8 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  3. Indicating Lights: Two of each type and color installed.
  4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
  5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

#### 1.9 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.
- D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 16074 "Seismic Controls for Electrical Systems."

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

## 1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
  - 2. Altitude: Not exceeding 6600 feet (2010 m).
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
  - 1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of electrical systems.
  - 2. Indicate method of providing temporary utilities.
  - 3. Do not proceed with interruption of electrical systems without Construction Manager's and Owner's written permission.
  - 4. Comply with NFPA 70E.

## 1.12 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

## PART 2 - PRODUCTS

### 2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D: a brand of Schneider Electric.

2. Configuration: Nonreversing, Reversing, Two speed or as noted on contract documents.
  3. Surface mounting.
  4. Provide Pilot lights as noted on control diagrams.
  5. Additional Nameplates: FORWARD and REVERSE for reversing switches HIGH and LOW for two-speed switches.
- C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    - c. Rockwell Automation, Inc.
    - d. Square D; a brand of Schneider Electric.
  2. Configuration: Nonreversing or Two speed as noted.
  3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
  4. Surface mounting.
  5. Pilot lights as noted.
  6. Additional Nameplates: HIGH and LOW for two-speed controllers.
- D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Configuration: Nonreversing, Reversing and Two speed as noted on Schedules.
  3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
  4. Green pilot light.
  5. Additional Nameplates: FORWARD and REVERSE for reversing controllers, HIGH and LOW for two-speed controllers.
  6. N.O. and N.C. auxiliary contact.

- E. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
    - c. Rockwell Automation Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Configuration: Nonreversing or Reversing as noted on drawings.
  3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
  5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. CPT Spare Capacity: 100 VA.
  6. Melting Alloy Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  7. Bimetallic Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - d. Ambient compensated.
    - e. Automatic resetting.
  8. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor running overload protection.
    - b. Sensors in each phase.
    - c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    - e. Analog communication module.

9. N.C. and N.O., isolated overload alarm contact.
  10. External overload reset push button.
- F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  2. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  4. Nonfusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  5. MCP Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    - d. N.C. and N.O. alarm contact that operates only when MCP has tripped.
    - e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.
  6. MCCB Disconnecting Means:
    - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
    - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

- c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
- e. N.C. and N.O. alarm contact that operates only when MCCB has tripped.

## 2.2 REDUCED-VOLTAGE MAGNETIC CONTROLLERS

- A. General Requirements for Reduced-Voltage Magnetic Controllers: Comply with NEMA ICS 2, general purpose, Class A; closed-transition; adjustable time delay on transition.
- B. Reduced-Voltage Magnetic Controllers: Reduced voltage, electrically held.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
    - c. Siemens Energy & Automation, Inc.
    - d. Square D; a brand of Schneider Electric.
  - 2. Configuration as noted on the documents:
    - a. Wye-Delta Controller: Four contactors, with a three-phase starting resistor/reactor bank.
    - b. Part-Winding Controller: Separate START and RUN contactors, field-selectable for 1/2- or 2/3-winding start mode, with either six- or nine-lead motors; with separate overload relays for starting and running sequences.
    - c. Autotransformer Reduced-Voltage Controller: Medium-duty service, with integral overtemperature protection; taps for starting at 50, 65, and 80 percent of line voltage; two START and one RUN contactors.
  - 3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
  - 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
  - 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
    - a. CPT Spare Capacity: 100 VA.
  - 6. Melting Alloy Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

7. Bimetallic Overload Relays:
  - a. Inverse-time-current characteristic.
  - b. Class 10 tripping characteristic.
  - c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
  - d. Ambient compensated.
  - e. Automatic resetting.
  
8. Solid-State Overload Relay:
  - a. Switch or dial selectable for motor running overload protection.
  - b. Sensors in each phase.
  - c. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
  - d. Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
  - e. Analog communication module.
  
9. N.C. and N.O., isolated overload alarm contact.
10. External overload reset push button.
  
- C. Combination Reduced-Voltage Magnetic Controller: Factory-assembled combination of reduced-voltage magnetic controller, OCPD, and disconnecting means.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
    - c. Siemens Energy & Automation, Inc.
    - d. Square D; a brand of Schneider Electric.
  
  2. Fusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R indicated fuses.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.
  
  3. Nonfusible Disconnecting Means:
    - a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
    - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    - c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

4. MCP Disconnecting Means:
  - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
  - d. N.C. and N.O. alarm contact that operates only when MCP has tripped.
  
5. MCCB Disconnecting Means:
  - a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
  - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
  - e. N.C. and N.O. alarm contact that operates only when MCCB has tripped.

### 2.3 REDUCED-VOLTAGE SOLID-STATE CONTROLLERS

- A. General Requirements for Reduced-Voltage Solid-State Controllers: Comply with UL 508.
  
- B. Reduced-Voltage Solid-State Controllers: An integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and keypad, bypass contactor, and overload relay; suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
  1. Manufacturers: Subject to compliance with requirements, provide by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  
  2. Configuration: Severe duty as noted on drawings.
  3. Starting Mode: field selectable.
  4. Stopping Mode: Coast to stop.
  5. Shorting (Bypass) Contactor: Operates automatically when full voltage is applied to motor and bypasses the SCRs. Solid-state controller protective features shall remain active when the shorting contactor is in the bypass mode.



6. Shorting and Input Isolation Contactor Coils: Pressure-encapsulated type; manufacturer's standard operating voltage, matching control power or line voltage, depending on contactor size and line-voltage rating. Provide coil transient suppressors.
7. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.
8. Control Circuits: 120 V ac; obtained from integral CPT, with primary and secondary fuses, of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 100 VA.
9. Adjustable acceleration-rate control using voltage or current ramp, and adjustable starting torque control with up to 400 percent current limitation for 20 seconds.
10. SCR bridge shall consist of at least two SCRs per phase, providing stable and smooth acceleration with or without external feedback from the motor or driven equipment.
11. Keypad, front accessible; for programming the controller parameters, functions, and features; shall be manufacturer's standard and include not less than the following functions:
  - a. Adjusting motor full-load amperes, as a percentage of the controller's rating.
  - b. Adjusting current limitation on starting, as a percentage of the motor full-load current rating.
  - c. Adjusting linear acceleration and deceleration ramps, in seconds.
  - d. Initial torque, as a percentage of the nominal motor torque.
  - e. Adjusting torque limit, as a percentage of the nominal motor torque.
  - f. Adjusting maximum start time, in seconds.
  - g. Adjusting voltage boost, as a percentage of the nominal supply voltage.
  - h. Selecting stopping mode and adjusting parameters.
  - i. Selecting motor thermal overload protection class between 5 and 30.
  - j. Activating and de-activating protection modes.
  - k. Selecting or activating communication modes.
12. Digital display, front accessible; for showing motor, controller, and fault status; shall be manufacturer's standard and include not less than the following:
  - a. Controller Condition: Ready, starting, running, stopping.
  - b. Motor Condition: Amperes, voltage, power factor, power, and thermal state.
  - c. Fault Conditions: Controller thermal fault, motor overload alarm and trip, motor underload, overcurrent, shorted SCRs, line or phase loss, phase reversal, and line frequency over or under normal.
13. Controller Diagnostics and Protection:
  - a. Microprocessor-based thermal protection system for monitoring SCR and motor thermal characteristics and providing controller overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
  - b. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and underload conditions; and line frequency over or under normal.
  - c. Input isolation contactor that opens when the controller diagnostics detect a faulted solid-state component or when the motor is stopped.

- d. Shunt trip that opens the disconnecting means when the controller diagnostics detect a faulted solid-state component.
14. Remote Output Features:
- a. All outputs prewired to terminal blocks.
  - b. Form C status contacts that change state when controller is running.
  - c. Form C alarm contacts that change state when a fault condition occurs.
15. Optional Features:
- a. Full-voltage bypass contactor operating manually, with NORMAL/BYPASS selector switch. Power contacts shall be totally enclosed, double break, and silver-cadmium oxide; and assembled to allow inspection and replacement without disturbing line or load wiring.
  - b. Bimetallic Overload Relays:
    - 1) Inverse-time-current characteristic.
    - 2) Class 10 tripping characteristic.
    - 3) Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - 4) Ambient compensated.
    - 5) Automatic resetting.
  - c. Solid-State Overload Relay:
    - 1) Switch or dial selectable for motor running overload protection.
    - 2) Sensors in each phase.
    - 3) Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - 4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    - 5) Analog communication module.
  - d. N.C. and N.O., isolated overload alarm contact.
  - e. External overload reset push button.
- C. Combination Reduced-Voltage Solid-State Controller: Factory-assembled combination of reduced-voltage solid-state controller, OCPD, and disconnecting means.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    - b. General Electric Company; GE Consumer & Industrial – Electrical Distribution.
    - c. Rockwell Automation, Inc.; Allen-Bradley brand.
    - d. Siemens Energy & Automation, Inc.
    - e. Square D; a brand of Schneider Electric.
  - 2. MCCB Disconnecting Means:

- a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
  - b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
  - e. N.C. and N.O. alarm contact that operates only when MCCB has tripped.
3. Molded-Case Switch Disconnecting Means:
- a. UL 489, NEMA AB 1, and NEMA AB 3, with in-line fuse block for Class J or L power fuses (depending on ampere rating), providing an interrupting capacity to comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.
  - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
  - c. Auxiliary contacts "a" and "b" arranged to activate with molded-case switch handle.
  - d. N.C. and N.O. alarm contact that operates only when molded-case switch has tripped.

## 2.4 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
- 1. Dry and Clean Indoor Locations: Type 1.
  - 2. Outdoor Locations: Type 3R or Type 4X as noted.
  - 3. Other Wet or Damp Indoor Locations: Type 4.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

## 2.5 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
- 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
    - a. Push Buttons: Shrouded types; as indicated.
    - b. Pilot Lights: LED types; colors as indicated; push to test.
    - c. Selector Switches: Rotary type.
  - 2. Elapsed Time Meters: Heavy duty with digital readout in hours; nonresettable.
- B. N.C. and N.O. auxiliary contact(s).

- C. Control Relays: Auxiliary and adjustable pneumatic solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4 Type 4X Type 7 Type 9 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R Type 4X Type 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- H. Cover gaskets for Type 1 enclosures.
- I. Terminals for connecting power factor correction capacitors to the line load side of overload relays.
- J. Spare control wiring terminal blocks, quantity as indicated; unwired; wired.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 16073 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch (100-mm) nominal-thickness concrete base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Seismic Bracing: Comply with requirements specified in Section 16074 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in each fusible-switch enclosed controller.
- F. Install fuses in control circuits if not factory installed.
- G. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- I. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 16075 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved nameplate.
  3. Label each enclosure-mounted control and pilot device.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices and facility's central control system.
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.

2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
  1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- E. Tests and Inspections:
  1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
  3. Test continuity of each circuit.
  4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager and Owner before starting the motor(s).
  5. Test each motor for proper phase rotation.
  6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.

- c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- 9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.6 ADJUSTING

- A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager and Owner before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers at 65 percent.
- E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.
- F. Set field-adjustable circuit-breaker trip ranges.

### 3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

END OF SECTION 16420