

## SECTION 01650

### SYSTEM START-UP AND ACCEPTANCE TESTING

#### 1. GENERAL

##### 1.01 Description

- A. The Contractor shall be responsible for demonstrating the proper operation of all equipment, controls, alarms, and appurtenances to the satisfaction of the Owner, Engineer, Virginia Department of Health, and Virginia Department of Environmental Quality. Any temporary power or gas needed for the demonstration shall be the responsibility of the Contractor. The Owner will furnish all water for testing.
- B. Testing includes four discrete testing phases
  - 1. Factory Testing of Equipment
  - 2. Electrical Testing and Placing into Service
  - 3. Operational Testing
  - 4. Acceptance Testing
- C. The contractor shall arrange the services of factory trained equipment representatives to assist in calibrating and testing significant equipment items for Electrical Testing and Placing into Service, Operational Testing and Final Acceptance Testing. If such services are required for electrical testing, these services shall also be provided at no additional cost to the owner.
- D. Additional start-up and testing requirements are as specified throughout the technical specifications and as recommended by the equipment manufacturer are also required.

##### 1.02 Submittals

Submit the following in accordance with Section 01300 "Submittals".

- A. Factory testing and quality assurance reports
  - 1. Pumping Equipment
- B. Testing equipment product data and calibration certificates.
- C. Field Test Plans
  - 1. Operational Testing
  - 2. Acceptance Testing
- D. Testing and Adjustment Reports
  - 1. Electrical Testing and Placing into Service
  - 2. Operational Testing
  - 3. Acceptance Testing

E. Certifications

1. Electrical Testing and Placing into Service
2. Operational Testing
3. Acceptance Testing

2. PRODUCTS

2.01 Testing Devices

The Contractor shall employ all testing devices and personnel trained in their use, required for testing as specified herein. Testing devices shall have valid calibrations performed by qualified independent calibration and testing agencies certified by the testing equipment manufacturer.

3. EXECUTION

3.01 Factory Testing

- A. Perform factory testing of equipment in accordance with manufacturer standard practices and these specifications.
- B. As a minimum, the following equipment shall be tested in accordance with the reference specification:
  1. Pumping Equipment, Section 15100
- C. Submit quality assurance reports of factory testing for approval before equipment is shipped to the site in accordance with Section 01300 "Submittals".

3.02 Electrical Testing

- A. The contractor shall perform electrical testing in accordance with Division 16 - Electrical.
- B. Results of testing shall be fully documented including dates of testing, equipment utilized, person performing tests, tests made, comparative acceptable test results and reference standards, actual test results, corrections made and results of retesting for each piece of equipment or component tested.
- C. The contractor shall provide a written certification that the electrical testing was completed successfully, all deficiencies corrected, and initially deficient equipment and or components were retested successfully.

3.03 Piping System Testing

- A. Pressure test all interior and exterior pressure piping in accordance with HRPDC Regional Standards and City of Newport News Standards.

### 3.04 Operational Testing

- A. The contractor shall perform Operational Testing of all installed equipment, controls, alarms and appurtenances prior to the Final Acceptance Testing. Operational testing shall be for a minimum of seventy-two (72) hours.
- B. Manufacturer's representatives. The Contractor shall contract with and pay for the services of the following manufacturer's representatives to be present for Operational Testing, to assist with equipment and control adjustments and bringing the system into service, and to furnish final equipment adjustment and testing reports:
  - 1. Sewage Pumps
  - 2. Pump Station Control Center
- C. Operational Testing shall be performed by the Contractor in the presence of the Owner. Contractor shall provide at his expense all equipment, utilities, expendables and labor required to perform the initial field testing.
- D. Operational Testing of pumping and control equipment components will be performed with potable water as required to demonstrate the proper operation of individual items of equipment, components and processes.
- E. The Contractor shall prepare and submit for approval a field test plan prior to scheduling the Operational Testing. The field test plan shall fully document all proposed procedures, testing, and testing equipment to be utilized to demonstrate proper installation, operational and control of the station and its equipment. The field test plan shall clearly document testing of all control systems in manual and automatic operational modes, including alarm functions, control signals and any signal simulation required.
- F. Schedule Operational Testing of individual components, groups of components or systems with the Owner at least seven days in advance of such testing. To the maximum extent possible, all Operational Testing shall be performed on the same date.

- G. As a minimum, Operational Testing shall include demonstration of proper installation, operation and control of the following:
1. Sitework – Driveway, Grading, Drainage, Landscaping
  2. Exterior – Masonry, Roof, Trim, Paint, Louvers, Doors, Concrete, Fixtures
  3. Interior – Masonry, Ceiling, Floors, Concrete Walls, Coatings, Linings, Equipment Anchorage
  4. Space Heaters – Manual and Auto
  5. Lighting Systems – Exterior, Control/Equipment Rooms, and Generator Room
  6. Supply Fans
  7. Exhaust Fans – Manual and Auto
  8. Louvers and Dampers
  9. Plumbing Fixtures – Hose bibs and drains.
  10. Doors and Door Hardware
  11. Influent and Discharge Piping
  12. Gate Valves (Interior and Exterior)
  13. Valve Actuators
  14. Check Valves
  15. Sewage Pumps
  16. Station Control System
  17. Bubbler System
  18. Alarm and Telemetry Systems
  19. Stairs and Platforms
  20. Verification that permanent by-pass pump has not been adversely affected by rehabilitation procedures.
- H. Results of Operational Testing shall be fully documented in an Operational Testing and Final Adjustment Report. The report shall include dates of testing, test equipment utilized, person performing tests and Owner witness, tests made, specified or manufacturer provided comparative acceptable test results, actual test results, corrections made and results of retesting for each piece of equipment of component tested.
- I. Upon completion of Operational Tests, the Contractor shall make all final adjustments, repairs and replacements as required to comply with the Project Documents and retest all components to demonstrate such.
- J. The Contractor shall provide written certification that the Operational Testing was satisfactorily completed, all deficiencies were corrected, initially deficient components were successfully retested and that the Station is ready for Final Acceptance Testing.

### 3.05 Final Acceptance Testing

- A The contractor shall perform Final Acceptance Testing of all installed equipment, controls, alarms and appurtenances. During Final Acceptance Testing, the contractor shall demonstrate proper repair of any items found deficient during the initial operational testing.

- B. Manufacturer's representatives. The Contractor shall contract with and pay for the services of the following manufacturer's representatives to be present for Final Acceptance Testing, to assist with equipment and control adjustments and bringing the system into service, and to furnish final equipment adjustment and test reports:
1. Sewage Pumps
  2. Pump Station Control Center
- C. Final Acceptance Testing shall be performed by the Contractor in the presence of the Owner. Contractor shall provide at his expense all equipment, utilities, expendables and labor required to perform the testing.
- D. Final Acceptance Testing of pumping and control equipment will be performed with raw water to simulate operation as a system.
- E. The Contractor shall prepare and submit for approval a field test plan prior to scheduling the Final Acceptance Testing. The field test plan shall fully document all proposed procedures, testing, and testing equipment to be utilized to demonstrate proper installation, operational and control of the pump station and its equipment. The field test plan shall clearly document testing of all control systems in manual and automatic operational modes, including alarm functions, control signals and any signal simulation required.
- F. Schedule Final Acceptance Testing with the Owner at least seven days in advance.
- G. As a minimum, testing shall include demonstration of proper operation and control of the following:
1. Influent and Discharge Piping
  2. Gate Valves (Interior and Exterior) including Air Release Assemblies
  3. Valve Actuators
  4. Check Valves
  5. Bubbler System
  6. Sewage Pumps
  7. Station Control System
  8. Alarm and Telemetry Systems
- H. Results of testing shall be fully documented in a Final Acceptance Testing and Final Adjustment Report. The report shall include dates of testing, test equipment utilized, person performing tests, tests made, specified or manufacturer provided comparative acceptable test results, actual test results, corrections made and results of retesting for each piece of equipment of component tested.
- I. Upon completion of Final Acceptance Testing the Contractor shall make all final adjustments, repairs and replacements as required to comply with the Project Documents and the Owner provided punch list of any remaining items to be corrected by the Contractor and retest all components to demonstrate such, prior to final acceptance by the Owner.

- J. The Contractor shall provide written certification that the Final Acceptance Testing was satisfactorily completed, all deficiencies were corrected, initially deficient components were corrected and successfully retested and that the Station is ready for operation, prior to final acceptance by the Owner.

END OF SECTION 01650

**SECTION 01501**

**FLOW CONTROL**

1. GENERAL

1.01 Description of Work

- A. The Contractor shall furnish all labor, materials, equipment and supplies, and shall perform all work related to the control of sewage flow. Flow control and routing methods shall be submitted to the Owner for review and approval prior to commencing work on the pump station.
- B. Bypass pumping system shall be capable of operating at the following design points.

Flow (gpm)	TDH (ft)		HRSD Policy Head
	Avg Daily	Peak Daily	
3,000	51	69	103
4,385	71	89	123
5,885	85	103	137

1.02 Submittals

- 1. Flow Control and Sewage Bypassing Arrangement Plan
- 1. Sewage Bypassing Equipment Product Data

2. PRODUCTS

Not applicable

3. EXECUTION

3.01 Flow control

- A. The Contractor shall submit a flow control and sewage bypassing arrangement plan to the Owner for review and approval at least two weeks (14 calendar days) prior to commencing work. Flow control includes, but is not limited to, plugging and bypass pumping. The plan must be specific and complete, include all layouts of the bypass piping, and shall include, but not be limited to, the following details:
  - 1. Site Plan with Equipment Layout.
  - 2. Monitoring Plan.
  - 3. Listing of Equipment.
  - 4. Equipment Capacity (Including but not limited to pump curves verifying the bypass pump is capable of meeting the peak flow and head requirements as indicated on the drawings).
  - 5. Description of Equipment Operational Controls.
  - 6. Traffic control plans.
  - 7. Spill Contingency Plans and Protection against pipe breaks.

8. Sewer plugging methods.  
Method of connecting to discharge force main including evacuation of force main and control of sewage.
  9. Size, length, material, and method of installation for suction and discharge piping.
  10. Method of noise control for each pump and/or generator.
  11. Construction sequence.
  12. Bypass time duration for the pump station to be rehabilitated.
  13. Repair and restoration plans for damaged infrastructure including, but not limited to, pavement, sidewalks, curb, gutter and sewer system.
- B. Bypassed flow must be discharged to the sanitary sewer system and shall be continuous and uninterrupted.
- C. The Contractor shall supply the necessary pumps, conduits, engines, controls and other equipment to divert the flow of sewage in accordance with the approved plan. The Contractor shall have backup equipment available. The pumping/bypass system shall be adequate in size to handle the existing peak use flows and additional flows that may occur with rainstorms. The Contractor shall select pumping/bypassing equipment that will not have excessive noise levels and shall be restricted to a maximum of sixty decibels (60 dB) at a distance of fifty-feet (50'). If pumping/bypassing equipment exceeds the noise level, noise control equipment such as a sound insulating structure shall be required. Equipment shall be the critically silenced unit as supplied by Godwin Pumps of America, Inc., or approved equal.
- D. The Contractor shall also furnish the labor and supervision to set up, operate and maintain, and continuously monitor the pumping/bypass system from the time the pump station is taken out of service until it is returned to service.
- E. The Contractor shall provide a sewage bypassing system as depicted on the Contract Drawings. The bypass system shall be designed to provide bypass pumping operations throughout the duration of the construction activity with the capability of rerouting the suction lines with a minimal amount of disturbance to the bypassing operations. The Contractor shall coordinate with the Owner for additional traffic control and bypass pumping requirements.
- F. 24-Hour Bypass Pump Test
- The Contractor shall operate the bypass pumping system installed to bypass the pump station for a 24 hour test period prior to taking the pump station off-line.
- G. Infrastructure restoration shall be in accordance with City of Newport News Standards and these specifications. All restoration work shall be approved by the Owner. Materials left in place shall comply with the material and installation requirements of these specifications.

### 3.02 Flow Control Precautions

- A. When flow is bypassed by the Contractor, he shall take precautions to protect the public health and to protect the sewer lines from damage that might result from sewer surcharging. The Contractor shall take precautions to insure that sewer flow control operations do not



cause flooding or damage to public or private property being served by the sewers involved and he shall be responsible for any damage resulting from his flow control operations.

- B. When flow in a sewer line is plugged or blocked by the Contractor, he shall monitor the conditions upstream of the plug and shall be prepared to immediately start bypass pumping, if needed. Any liquid or solid matter which is bypass pumped from the sewer collection system shall be discharged to another sewer manhole or appropriate vehicle or container only. No such liquid or solid matter shall be allowed to be discharged, stored or deposited on the ground, swale, road, stormwater drainage system or open environment. The Contractor shall protect all pumps, conduit and other equipment used for bypass from traffic.
- C. During the bypass pumping period no liquid or solid matter shall be allowed to be discharged on to the ground, swale, road, stormwater drainage system or open environment. The Contractor shall protect all pumps, conduit and other equipment used for bypass pumping from traffic damage and potential vandalism.
- D. Should any liquid or solid matter from the sewer collection system be spilled, discharged, leaked or otherwise deposited to the open environment as a result of the Contractor's flow control operations, he shall immediately cleanup and disinfect the affected area and assume all costs associated with same. The Contractor shall also notify the sewer system operating personnel and appropriate regulatory agencies and perform required cleanup operations at no additional cost to the Owner.

END OF SECTION

## SECTION 01781 - OPERATION AND MAINTENANCE DATA/MANUAL

### PART 1 - GENERAL

#### 1.01 SUBMISSION OF OPERATION AND MAINTENANCE DATA/MANUAL

- A. Submit Operation and Maintenance (O&M) Data/Manuals which are specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01330 "Submittal Procedures."

#### 1.02 QUANTITY

- A. Submit five (3) sets of the supplier/manufacturers' O&M information specified herein for the components, assemblies, subassemblies, attachments, and accessories. The items for which O&M Data/Manuals are required are listed in the technical sections which specifies those particular items.

#### 1.03 PACKAGE QUALITY

- A. Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

#### 1.04 PACKAGE CONTENT

- A. Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." For each product, system, or component piece of equipment requiring submission of O&M Data, submit the Data Package specified in the individual technical section.

#### 1.05 DELIVERY

- A. Submit O&M Data Manuals to the Owner for review and acceptance.

#### 1.06 CHANGES TO SUBMITTALS

- A. Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M data.

## PART 2 - TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

### 2.01 OPERATING INSTRUCTIONS

- A. Include specific instructions, procedures, and illustrations for the following phases of operation:
1. Safety Precautions: List personnel hazards and equipment or product safety precautions for all operating conditions.
  2. Operator Prestart: Include procedures required to set up and prepare each system for use.
  3. Startup, Shutdown, and Post-shutdown Procedures: Provide narrative description for each operating procedure including control sequence for each.
  4. Normal Operations: Provide narrative description of normal operating procedures. Include control diagrams with data to explain operation and control of systems and specific equipment.
  5. Emergency Operations: Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies.
  6. Operator Service Requirements: Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and gage reading recording.
  7. Environmental Conditions: Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.
- B. Preventive Maintenance: Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.
1. Lubrication Data: Include lubrication data, other than instructions for lubrication in accordance with paragraph titled "Operator Service Requirements":
    - a. A table showing recommended lubricants for specific temperature ranges and applications;
    - b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
    - c. A lubrication schedule showing service interval frequency.
  2. Preventive Maintenance Plan and Schedule: Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.
  3. Corrective Maintenance (Repair): Include manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.

4. **Troubleshooting Guides and Diagnostic Techniques:** Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
  5. **Wiring Diagrams and Control Diagrams:** Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specified wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.
  6. **Maintenance and Repair Procedures:** Include instructions and list tools required to restore product or equipment to proper condition or operating standards.
  7. **Removal and Replacement Instructions:** Includes step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.
  8. **Spare Parts and Supply Lists:** Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.
- C. **Appendices:** Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following.
1. **Parts Identification:** Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall be grouped by components, assemblies and subassemblies. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.
  2. **Warranty Information:** List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.
  3. **Personnel Training and Requirements:** Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
  4. **Testing Equipment and Special Tool Requirement:** Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

5. Contractor Information: Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

### PART 3 - SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

#### 3.01 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall furnish five (5) copies of a 3-ring binder type manual that contains complete operation, maintenance and repair instructions for each of the following equipment:
  1. Sewage Pumps, including certified Pump Curves
  2. Electric Motors
  3. Generator Set
  4. Automatic Transfer Switch
  5. Alarm Systems
  6. Ventilation Systems
  7. Pump Control Systems: To include as-built wiring diagrams and software ladder diagrams
  8. Shingles
  9. Louvers and Dampers
  10. Check Valves
  11. Gate Valves
  12. Lighting
  13. Heaters
  14. Backflow Preventer
- B. The manual shall contain adequate information to be in conformance with the Commonwealth of Virginia, Department of Health "Sewerage Regulations" and the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended.

#### PART 4 - PRODUCTS

Not used.

**END OF SECTION**

## SECTION 02000 - EARTHWORK

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. General: Applicable provisions of the contract drawings and general conditions govern work under this section.
- B. Scope of Work: Furnish all labor, materials, and equipment for the clearing and grubbing, excavation, backfilling, site grading, and cleanup and restoration, for the pumping station, the force main, gravity sewers, manholes, vaults and miscellaneous structures and all related appurtenances. All material and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.
- C. Work Specified Elsewhere but is not limited to:
  - Section 01330 - Submittal Procedures
  - Section 02485 - Seeding
  - Section 02650 - Gravity Sewer Force Main, Pumping Station Piping, Water Service and Accessories
  - Section 03300 - Cast-In-Place Concrete

#### 1.02 ENVIRONMENTAL PROTECTION

- A. Environmental protection measures specified or indicated shall be considered minimum requirements, and the Contractor shall fully comply with the intent of these specifications which is to cause the least change in the natural state of the area.
- B. The Contractor shall limit the size equipment utilized on the project to the smallest possible consistent with the nature of the work to be accomplished. All equipment used on the project shall be subject to approval of the Engineer.
- C. All grading and excavations shall be accomplished in a manner to prevent erosion and siltation of adjacent streams. Areas affected by construction shall be held to absolute minimum. Rainfall run off or other water carrying silt or debris shall be passed through some type of basin or device to remove the silt and debris.
- D. The work shall be scheduled so that each stage of construction promptly follows the proceedings, thereby reducing the time that earth areas will be subject to erosion. The Contractor shall restore all areas promptly to pre-existing grades and shall seed and mulch finished areas as the work progresses.
- E. Upon completion of all site work, the erosion control devices shall be removed, accumulated silt and debris removed from the site, and all disturbed areas topsoiled and seeded.

#### 1.03 CLEARING AND GRUBBING

- A. The Contractor shall clear only the area indicated for the pump station and that area which is absolutely necessary for proper installation of the pipe. Brush, refuse, stumps and roots, shall be disposed of by the Contractor off of the project site and adjacent private property in spoil areas obtained by him. All trees, shrubs, and bushes that are to remain shall be carefully protected from damage.

- B. Burning will not be permitted.

#### 1.04 EXCAVATION AND GRADING FOR STRUCTURES

- A. Stripping Topsoil: Strip topsoil to its entire depth from areas to be graded or covered by the structures and affected by construction activities, and pile in locations which will not interfere with the building or utility operations. Strip and pile topsoil before any excavation is started. Stripping topsoil shall be free from clay, large stone and debris.
- B. Soil Borings: Subsurface soils investigations have not been made at the site. The Contractor shall be responsible to conduct subsurface investigations that he deems necessary.
- C. Excavations: The locations of the building and the elevations of footings, foundations, existing, and finished grades are indicated on the drawings. The grades shown on the drawings will establish the volume of excavation, filling and backfilling to be performed. The Contractor shall perform all excavation to the dimensions and elevations indicated on the drawings and for all incidental work thereto. Should unsuitable bearing be encountered above or below indicated elevations, excavation shall be carried to such elevations as are approved by the Engineer.

After completion of excavation and prior to commencement of the foundation footings, and setting of precast structures, the excavation will be inspected and approved to ensure that suitable bearing was achieved. Care should be taken not to excavate below the depth indicated or directed. Where excavation is made below indicated elevation, or as directed through the fault of the Contractor, the excavation shall be restored to the proper elevation in accordance with the procedure described for backfill or the heights of walls or footings shall be increased as may be directed by the Engineer. Excavation shall extend a sufficient distance from walls and footings to allow for forms, installation of services and for inspections except where the grade for walls and footings is specifically authorized to be deposited directly against excavated surfaces. Excavated material which is suitable for use as fill shall be stockpiled as directed. Material to be excavated shall be unclassified and shall include all material encountered.

The Contractor shall keep adequate pumps on the site to prevent accumulation of water in the excavation. Adequate suction and discharge lines shall be provided to prevent direct discharge of any water carrying silt or debris into natural drainage ways. Appropriate measures shall be taken to prevent damage and erosive conditions created by the dewatering discharge and to prevent silting the natural drainage ways.

Excavations in unstable material shall be shored to prevent injury to persons, damage to structures and utility lines, injurious caving or erosion.

The Contractor shall control the grading in the vicinity of the affected work so that the ground surface is properly pitched to prevent water running into the excavated areas of the work. Water which has accumulated in any excavation shall be removed by the Contractor at his own expense. All areas outside the building in which grades are changed are to be excavated below the finished grades indicated as required for top-soiling.

Remove from the site all excess excavated material and any other material unsuitable for fill or backfill.

- D. Backfill: Before placing backfill, remove all forms of debris. Place material in 8 inch layers and compact with power tamper equipment suitable for the type of material involved. No backfill shall be placed against structure until they have adequate strength.

Fill and backfill when required on both sides of walls, piers or free standing structures shall be deposited on both sides to approximately same elevations. Proper provisions shall be made to prevent wedging action against walls or structures.

- E. Compaction: Compact each layer of backfill under structures and roadways to not less than 95 percent maximum density based on ASTM. Compaction shall extend not less than 5 feet beyond structures and edges or roads. Where fill is required and no immediate or future construction is indicated, scarify subgrade and compact each layer of fill to not less than 85 percent maximum density base on AASHO T-99. Perform all compaction using compacting rollers, pneumatic or vibrating compactors, or other equipment and methods approved by the Engineer.

#### 1.05 BACKFILLING:

Backfilling shall be in accordance with the following:

- A. The Contractor shall refill all excavations as rapidly as practicable after inspection of the pipe. Backfill shall be carefully placed around and over the pipe and structures and shall not be permitted to fall directly on the pipe structures from a height which would cause damage or disturb the pipe or structures.
- B. Backfill material shall be placed in layers of not more than six (6) inches and simultaneously compact on both sides of the pipe to a point one (1) foot above the pipe. Special care shall be taken to thoroughly compact the material under the haunches of the pipe having a tamping face of not more than 25 square inches. The backfill shall then be continued in two foot lifts and machine compacted at optimum moisture content with rollers or tampers within a tolerance of plus or minus 2.0 percent of optimum to a minimum density of not less than 95 percent as compared to the theoretical maximum density determined in accordance with VTM-1
- C. No ashes, putrescible refuse, large stones, or other material of an unsatisfactory character shall be used as embankment or backfill. The Contractor shall not permit excavations to be used as a dumping ground for refuse.
- D. After completion of backfilling all material not used therein including such earth as the Owner shall decide cannot be properly used to refill the excavation, shall be removed and disposed of in such a manner and at such point or points as shall be approved or directed. All roads, sidewalks, and other places on the line of the work shall be left free, clean and in good order, said cleaning up shall be done by the Contractor without extra compensation, and if he shall fail to do such work within reasonable time after receipt of notice, it will be performed by the Owner and the cost shall be retained out of the monies due or to become due to the Contractor under the Contract.

**END OF SECTION**



## **SECTION 02220**

### **DEMOLITION**

#### **PART 1 - GENERAL**

##### **1.01 DESCRIPTION OF WORK**

The work includes demolition, salvage of identified items and materials, removal of resulting rubbish and debris. Rubbish and debris shall be removed from City property daily, unless otherwise directed, to avoid accumulation at the demolition site. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

##### **1.02 SUBMITTALS**

Work Plan:

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operation.

##### **1.03 PROTECTION**

A. During the demolition work the contractor shall continuously evaluate the condition of the pump station structure while work is underway. Immediate action to protect all personnel working in and around the demolition work shall be taken as conditions warrant. Pump station structural elements to be left in place shall have sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

B. Protection of Structures

The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

C. Protection of Existing property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Owner; any damaged items shall be repaired or replaced as approved by the Owner. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and

shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

D. Protection From the Weather

The interior of buildings and equipment to remain; salvageable materials and equipment shall be protected from the weather at all times.

E. Protection of Trees

Trees within the project site which might be damaged during demolition, shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Owner.

F. Use of Explosives

Use of explosives will not be permitted.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 EXISTING STRUCTURES

Existing structures shall be removed to the extent indicated on the plans.

3.02 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Owner salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Owner will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.03 SALVAGEABLE ITEMS AND MATERIAL

Contractor shall salvage items and material to the maximum extent possible.

3.04 MATERIAL SALVAGED FOR THE CONTRACTOR

Material salvaged for the Contractor shall be removed from Owners property on a daily basis. Material salvaged for the Contractor shall not be sold on the site.

3.05 ITEMS SALVAGED FOR THE OWNER

The City of Newport News Department of Public Works will tag all items to be salvaged. These items shall be delivered by the Contractor to the City of Newport News Department of Public Works representative. Notify the City Inspector, 48 hours prior to delivery.

3.06 UNSALVAGEABLE MATERIAL

Concrete, masonry, and other material, shall be disposed of in a sanitary landfill at no additional cost to the Owner.

3.07 CLEAN UP

Debris and rubbish shall be removed from the site. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION

## SECTION 02485 - SEEDING

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. General: Applicable provisions of the contract drawings and general conditions govern work under this section.
- B. Scope of Work: Furnish all labor, materials and equipment to restore disturbed areas. The work includes seedbed preparation, liming, fertilizing, seeding and mulching of all areas graded under this Contract. The work also includes those areas within or outside the limits of construction that are disturbed by the Contractor's operation. All material and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.
- C. Work specified elsewhere but is not limited to:
  - Section 02000 - Earthwork
  - Section 02650 - Gravity Sewer Force Main, Pumping Station Piping, Water Service and Accessories

#### 1.02 MATERIALS

- A. Agriculture Lime - shall be agriculture grade ground limestone of which 90 percent shall pass the No. 10 mesh screen and at least 40 percent shall pass the No. 100 mesh screen; and shall have a calcium and magnesium carbonate content of not less than 85 percent.
- B. Fertilizer - shall be standard commercial product of 10-20-10 analysis. All fertilizer shall be delivered in bags bearing the manufacturer's name, the chemical analysis of the product, the weight, and warranty. If not used immediately after delivery, fertilizer shall be stored in a manner that will not allow it to harden or destroy its effectiveness.
- C. Seed - shall be certified seed or equivalent based on Virginia Seed Improvement Association requirements for certification. If the seed is not grown in the state where it is to be used, it shall meet the certification requirements of the Seed Improvement Association for the state which is grown.
- D. Mulching Material - shall conform to the following requirements unless otherwise approved in writing by the Owner.
  - 1. Vegetable mulch shall consist of dry straw or hay, free of noxious weeds. The mulch shall be reasonably bright in color and shall not be musty, moldy, caked, decayed or very dusty.
  - 2. Wood cellulose fiber mulch for seeding shall consist of a specially prepared wood fiber processed to contain no growth or germination inhibiting factors. The fiber mulch shall be manufactured and processed in such manner that the wood cellulose fibers will remain in uniform suspension in water under agitation and will blend with grass seed, fertilizer and other additives to form a homogeneous slurry. The processed mulch material shall have characteristics to form a blotter-like ground cover on application, having moisture absorption and percolation properties and the ability to cover and hold grass seed in contact with the soil.
- E. Topsoil - may be stockpiled topsoil which has been salvaged as specified under Section 02000 - "Earthwork" or furnished from sources outside project limits. It shall consist of natural, friable,

loamy soil without admixture of subsoil or other foreign materials. It shall be reasonably free of stumps, roots, hard lumps, stiff clay, stones, noxious weeds, brush or other litter.

## PART 2 - EXECUTION

### 2.01 SEED BED PREPARATION

- A. Areas to be topsoiled shall be scarified or tilled to a depth of approximately 2 inches (50 millimeters) after having been graded and shaped in reasonably close conformity to the grade and cross-section shown on the plans or established by the Owner. Such loosening of the subsoil shall be done by discing, harrowing, or other approved methods. Topsoil shall be applied only when the subsoil is in a loose friable condition. If the subsoil has become compacted or a surface crust has formed subsequent to the initial loosening, it shall again be loosened immediately prior to placing and spreading of the topsoil. Subsoil shall not be loosened on slopes on which horizontal grooves have been cut to key the topsoil.
- B. Topsoil shall be spread on the designated areas to a depth of 3 inches (80 millimeters) unless otherwise directed. The loose depth of topsoil shall be sufficient to allow the area to conform to the elevations shown on the plans after natural settlement has taken place. If, during the topsoiling operation, either the weather or topsoil become unsuitable for spreading, operations shall cease and shall only be resumed when authorized by the Owner. All large clods shall be removed from the topsoiled area. When the operation is completed, the area shall be in condition for planting without further soil preparation.
- (1) The Contractor shall plan his operations so that seeding of the topsoil has been done within fifteen (15) days after the topsoil has been spread; however, when permitted by the Owner. The Contractor may control erosion and siltation of topsoiled areas by other approved methods, in lieu of seeding within fifteen (15) days.
- (2) The Contractor shall restore or replace any portion of the topsoil which erodes or is otherwise damaged before final acceptance of the project.
- C. After placing the topsoil, lime shall be uniformly spread at the rate of 2 tons per acre and fertilizer uniformly spread at the rate of 1500 pounds per acre. The lime and fertilizer shall be incorporated into the topsoil by discing, harrowing or raking. If liquid fertilizer is used, it shall be kept agitated during application and shall be applied in amounts sufficient to provide the same value of nutrients per acre as that specified for dry fertilizer.

Should the Contractor elect to use liquid fertilizer in a hydroseeder, the material shall be applied on a poundage basis, mixed with the same volume of water that would be used with dry fertilizer.

### 2.02 LIMING

- A. Limestone shall be uniformly applied at the rate of 1,000 pounds per acre (1,100 kilograms per hectare) to all areas to be vegetated. Limestone may be applied to the area prior to the preparation of the seedbed, but in all cases, it shall be applied before seeding and thoroughly incorporated into the entire depth of prepared seedbed. The incorporation of the lime may form a part of the tillage operation specified above.

### 2.03 FERTILIZING

- A. The fertilizer shall be uniformly applied at the rate of 1,000 pounds per acre (1,100 kilograms per hectare) to all areas to be vegetated. The fertilizer shall be incorporated into the upper three or four inches of prepared seedbed. This can be done just prior to the last tillage operation or just prior to seeding, but in no case will it be applied more than 3 days before seeding or before the lime is applied. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

2.04 SEEDING

Seed shall be uniformly sown as soon as practical following incorporation of the lime and fertilizer with the seed bed in a loose friable condition. Seeding shall be done from February 1 to November 15 using the seed varieties and mixtures noted below dependent upon the date:

<u>From</u>	<u>To</u>	<u>Mixture</u>	<u>Pounds/Acres</u>
February 1 and August 2	May 1  November 15	Ky. 31 Fescue	55
		Red Top	1
		Bermuda	<u>25</u>
		Total	81
May 2	August 1	Ky. 31 Fescue	15
		Red Top	1
		Bermuda	45
		Weeping Lovegrass	5
		Foxtail Millet	<u>10</u>
		Total	76

2.05 MULCHING:

- A. Mulch of hay or straw shall be spread over all seeded areas at the rate of approximately 2 tons per acre. Mulch shall be applied to a uniform depth by an approved method and in such a manner that not more than 10 percent of the soil surface is exposed. The use of wet hay or straw will not be permitted. Mulch shall be applied within 48 hours after the seeding operation. Mulch shall be anchored to the seeded surface by spraying with asphalt, discing or punching the mulch partially into the soil, by the use of approved netting or other materials or methods approved by the Owner. The Contractor may use more than one method on the same project. In the event asphalt is used it shall be applied in such a manner that uniform distribution is obtained and at a rate of not less than 60 gallons per ton of mulch.
- B. Wood cellulose fiber shall be applied at a rate of approximately 1500 pounds (dry weight) per acre and in such a manner that uniform distribution is obtained.

2.07 MAINTENANCE

- A. The Contractor shall maintain all seeded areas until final acceptance of the project and shall restore or replace any portion of the seeding work that is found defective or which becomes damaged prior to final acceptance. Restoration or replacement work shall include the re-establishment of the grade or profiles of the area, replacement of topsoil, refertilization, reseeding and remulching as directed by the Owner. When damage consists only of the displacement of mulch, the mulch shall be replaced within 7 days.

- B. Excess mulching material that may inhibit growth of young plants shall be removed during the period of turf establishment. Planted areas shall be sprinkled when necessary with fine water hose spray during establishment to assure a continuously moist soil surface.
- C. The Contractor shall mow and maintain grassed areas at an approximate height of 4 inches. When the amount of cut grass is heavy, it shall be removed to prevent destruction of the underlying turf.

2.08 CLEAN-UP AND RESTORATION

- A. Clean-up: The Contractor shall clean up all areas affected by his work, remove surplus materials from the site, and leave all areas affected by construction of the sewer lines in condition acceptable to the Owner ready for seeding.
- B. Restoration: All fences, guardrails, driveways, culverts, signs and other improvements affected by the work shall be fully restored to their original condition or better.

**END OF SECTION**

## SECTION 02500-PLANT MATERIALS AND PLANTING

### PART 1 GENERAL

#### 1.1 DESCRIPTION

The specified work includes the furnishing of all materials, equipment, labor and supervision required for the planting of trees, shrubs and ground cover. Complete the work shown on the drawings and as herein specified.

#### 1.2 QUALITY ASSURANCE

- A. Nomenclature. The names of the plants required under this contract conform with Standardized Plant Names as adopted by the latest edition of the American Joint Committee of Horticulture/Nomenclature. Varieties not included therein conform generally with names accepted in the nursery trade.
- B. Comply with sizing and grading standards of the latest edition of American Standard for Nursery Stock by the American Association of Nurserymen.
- C. The Contractor performing work specified in this section must have a minimum of three (3) years experience in installation of similar projects.
- D. The Contractor performing work specified in this section must be a member of the Tidewater Virginia Nurseryman's Association or the Virginia Nurseryman's Association.

#### 1.3 SUBMITTALS

Submit the following to the Project Engineer/Architect if checked.

- \_\_\_\_\_ Soil analysis of planting soil at site.
- \_\_\_\_\_ Sample of mulch to be used on project.
- \_\_\_\_\_ Three (3) day's notice of installation date (by phone).

#### 1.4 PROJECT CONDITIONS

- A. Planting operation shall be conducted under favorable weather conditions which are normal for such work as determined by accepted practice in the locality of the project. At the option of, and



on the full responsibility of the Contractor awarded the contact, planting operations may be conducted under unseasonable conditions without additional compensation.

- B. The Contractor shall be familiar with the alignment of existing or new utility lines, ducts and buried cables. He shall field check the location of utilities before any installation of material or plants. The Contractor shall be responsible for all damage resulting from neglect or failure to comply with this requirement. If discrepancies occur, consult the Project Engineer/Architect. Changes in the location of plant materials should only be made with the approval of the Project Engineer/Architect. Contractor shall notify MISS UTILITIES prior to any digging or excavation.
- C. Protect existing utilities, paving and other facilities from damage caused by landscape operations.
- D. A complete list of plants, including a schedule of sizes, quantities and other requirements is shown on the project plans. In the event quantity discrepancies or material omissions occur in the plant materials list, the planting plans shall govern.
- E. All work shall be accomplished under the direction of a competent, experienced foreman.

#### 1.5 PLANT GUARANTEE AND REPLACEMENT

- A. Guarantee. The General Contractor shall guarantee all plants for a period of two years from date of acceptance by the owner or his authorized representative, and that plants shall be alive and in satisfactory growth at the end of the guarantee period. Since the Contractor must guarantee all plant material, it is the responsibility of the Contractor to submit a schedule to the Project Engineer/Architect to monitor all plant material, along with Contractors intentions to ensure plant material will remain in healthy condition during the guarantee period (e.g. watering, pruning, etc.)
- B. Replacement. At the conclusion of the guarantee period, inspection will be made by the Project Engineer/Architect. A written notice requesting such inspection shall be submitted by the Contractor at least ten days before the anticipated date. Any plant required under this contract that is dead, is in an unhealthy, unsightly, or badly impaired condition, as determined by the Project Engineer/Architect, shall be removed from the site. These plants shall be replaced as soon as it is reasonably possible, as

determined by the Project Engineer/Architect at no extra cost to the City of Newport News. No replacement shall be made in any season definitely unfavorable for planting (June 1-October 1).

- C. Materials and Operations. All replacements shall be plants of the same kind and size as specified on the project plans. They shall be furnished and planted as specified in planting details D-1 and D-2 and under Section 3.2 Installation.
- D. At the conclusion of the guarantee period, the Contractor shall remove all stakes, wires, nylon strap and protective fencing from trees and remove them from the site.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

#### Plants

- A. Quality and Size. Plants shall be nursery grown, have a habit of growth that is normal for species and shall be sound, healthy, vigorous, and free from insect pests, plant diseases, and injuries. All plants shall equal or exceed the measurements found on the project plans, which are minimum acceptable sizes. They shall be measured before pruning, with branches in normal position. Any necessary pruning shall be done at time of planting and will be consistent with the natural growth habit of each species. Requirements for the measurements, branching, grading, quality balling and burlapping of plants on the project plans shall follow the Code of Standards currently recommended by the American Association of Nurserymen, Inc. in the American Standard for Nursery Stock.
- B. Substitutions will not be accepted unless the Contractor notifies the Project Engineer/Architect by phone before contracts are signed. Unless the Contractor notifies the Project Engineer/Architect in writing, no substitutions will be approved. Proposed substitutes shall be of the nearest equivalent size or variety as the plant actually specified, having the same essential characteristics. Proposed substitutes of a lesser cost shall have an equitable adjustment of contract price. Plants of a greater value may be provided without additional cost to the City of Newport News.
- C. Balled and Burlapped Plants. Plants designated "B&B" on the project plans shall be balled and burlapped. They shall be dug with a sufficient diameter and depth to encompass the fibrous and

feeding root system necessary for full recovery of the plant. Balls shall be firmly wrapped with burlap or similar material and bound with twine or cord. Where necessary to prevent breaking or cracking of the ball during the process of planting, the ball may be secured to a platform or wire basket.

- D. Container Grown Plant. Plants designated "Cont." in the Plant List shall be container grown plants well established in container size indicated, conforming to American Association of Nurserymen Standards.
- E. Protection After Delivery. The balls of B&B plants which cannot be planted immediately on delivery shall be covered with moist soil (2" depth) or mulch (3" depth). All plants shall be watered as necessary until planted.

## 2.2 ACCESSORIES

- A. Topsoil shall be furnished by the Contractor at his expense. The Contractor shall furnish sufficient topsoil to properly install all work specified herein, and as shown on the drawings. Topsoil furnished shall be a natural, fertile, friable soil, possessing characteristics of representative productive soils in the vicinity. It shall be obtained from natural well-drained areas. It shall have a pH of between 6.0 and 6.8 and be free of toxic substances which may be harmful to plant growth. Topsoil shall be without admixture of subsoil and shall be cleaned and reasonably free from clay lumps, stones, stumps, roots, and similar substances one inch or more in diameter, debris, or other objects which might be a hindrance to planting operations. The mechanical analysis of the soil shall be as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch mesh	99-100 percent
½ inch mesh	97-99 percent
No. 100 mesh	40-60 percent
No. 200 mesh	20-40 percent

- B. Commercial Fertilizer shall be 18-6-12 slow release formula, or as noted on project plans, and shall conform to the applicable state fertilizer laws. It shall be uniform in composition, dry, and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis and trademark. Any fertilizer which becomes or otherwise is damaged, making it unsuitable for use, will not be accepted.

- C. Peat or Peat Moss shall be delivered to the site in unopened original containers. Peat shall be shredded or granulated having an acid reaction of 4-5 pH and shall have a natural moisture content of 30 percent, with a water absorption capacity of 1100 to 2000 percent.
- D. Water shall be free from oil, acid, alkali, salt and other substances harmful to plant growth. The contractor shall make, at his expense, whatever arrangements may be necessary to ensure an adequate supply of water to meet the needs of this contract. He shall furnish all hose, equipment, attachments, and accessories necessary for adequate irrigation of planted areas as may be required to complete the work as specified.
- E. Mulch shall be "Shredded Hardwood Bark". Hardwood mulch shall be of disease free hardwood, one or more years old. The shredded hardwood mulch shall be of uniform brown color with a nominal thickness not to exceed 1/8". All mulch shall be free of twigs, leaves and materials injurious to plant growth. The use of shredded bark from the American Elm (*Ulmus Americana*) will not be permitted.
- F. Perlite shall be delivered to site in unopened original containers and free of any foreign material.
- G. Materials for Staking
1. Tree stakes shall be rough and sawn straight grain oak, white or red cedar, or pressure treated pine, or as noted on "Plant List." Stakes up to 10 feet long shall have a minimum diameter of 2 to 2 ½ inches. Stakes over 10 feet long shall have a diameter of 3 inches. The maximum diameter of stakes shall not exceed approximately 4 inches. Stakes shall be pointed at one end and shall have a maximum allowable deflection of ½ inch for every foot of length. All stakes shall be sound and free of bark, splints, insects and fungi.
  2. Wire for fastening trees to stakes shall be No. 12 gauge pliable solid strand galvanized steel.
  3. Nylon strap shall be used to attach to wires used for fastening trees to stakes. All nylon straps shall be black.

4. Hose shall not be used to attach wire to trees due to possible injury to the tree.

## **PART 3 EXECUTION**

### **3.1 EXECUTION**

- A. Layout. The Contractor is responsible for verifying all site conditions in the field. New plantings shall be located where shown on the plans except where obstructions below ground or overhead are encountered or where changes have been made in the construction. If discrepancies occur, consult the Project Engineer/Architect. Necessary adjustments shall be made only after approved by the Project Engineer/Architect.
- B. Obstructions Below Ground or Overhead. It is not contemplated that planting should be one where the depth of soil over underground construction, obstructions or debris is insufficient to accommodate the roots or where pockets of debris or impervious soil will require drainage. Where such conditions are encountered in excavation of planting areas and where the debris, concrete, or other obstruction cannot be broken and removed by hand methods in the course of digging plant pits of the usual size and where the trees to be planted are found to be under overhead wires, other locations for the planting may be designated by the Project Engineer/Architect. **The Contractor is required to contact “Miss Utilities” (phone 1-800-552-7001). No work is to begin until all underground utilities have been marked.** Any damage to these lines during plant operations will be repaired by the Contractor in an approved manner at no additional cost to the City of Newport News.
- C. Drainage of Pits and Beds. Where planting pits are dug in wet areas or where adverse subsoil drainage problems are encountered, set plants six inches (6) higher than normal, using an extra depth of crushed stone and sand, up to twelve inches (12”) total depth to keep the root ball from settling. The immediate area outside the saucer shall be blended with suitable soil to meet existing grade within five feet (5’0”) of edge of pit. Drainage may also be provided by any other method approved by the Project Engineer/Architect prior to proceeding with planting.
- D. Soil Preparation. Soil for use in tree planting pits, as a backfill should be the existing soil excavated from the pit.

This existing soil should be broken up to create a friable working soil. Where group plantings occur, beds are to be prepared by tilling the soil including the amendments specified under Accessories 2.2 at a rate of 1 part topsoil (when requested, otherwise use existing soil) 1 part peat moss and 2 parts perlite to a depth to accommodate new plant material, and not less than 12" deep. The bed should be outlined with a 4" deep x 6" wide trench in the shape indicated by the landscape design. Place all trenched soil into the beds and till into bed.

- E. Excess Excavated Soil shall be disposed of where and as directed by the Project Engineer/Architect.

### 3.2 INSTALLATION

- A. Time of Planting. Planting operations shall be conducted under favorable weather conditions during the next season or seasons which are normal for such work as determined by accepted practice in the locality of the project. Planting operations may not be conducted from June 1 to October 1. Planting operations may be conducted during unseasonable conditions to the option and on the full responsibility of the contractor and with the approval of the Project Engineer/Architect. If losses occur, replacement shall be at no additional cost to the City of Newport News.
- B. Planting Pits. Reasonable care shall be exercised to have pits dug and soil prepared prior to moving plants to their respective locations. The minimum allowable dimensions of plant pits shall be as follows: depth should equal depth of root ball; for ball diameter or root spread. Where specified pit diameters would conflict with existing pavement, the pit dimension can be adjusted accordingly, unless pavement removal is noted on plan. See details D-1 and D-2.
- C. Setting Plants. Unless otherwise specified, all plants shall be planted in pits, centered and set on well compacted prepared soil mixture a minimum depth of 6 inches. The finished grade level of the plant, after settlement, will be the same as that at which the plant was grown. They shall be planted upright and faced to give the best appearance or relationship to adjacent structures. Ropes at top of root ball should be cut and the top 1/3 of burlap removed. Non-biodegradable burlap material shall be removed. Platform and surplus binding from top and sides of the balls shall be removed. If a wire basket is present, whether galvanized or not, remove the entire basket. If removing the basket is impossible due to size of

rootball or soil type, remove the top section of the basket or split the basket in half and fold it down in the planting hole. Backfill shall be placed and compacted carefully to avoid injury to roots and to fill all voids. When the hole is nearly filled, add water as necessary and allow it to settle. Fill the hole to finished grade. See Detail D-1 and D-2.

When using container grown plants, score (cut) the root mass every six (6) inches at least one (1) inch deep and spread apart root system before planting. Detail D-3.

- D. Staking. Stakes shall be equally spaced about each tree and shall be driven vertically into the ground to a depth as detailed and in such a manner as not to injure ball or roots. Trees of less than 3" diameter shall be fastened to three stakes at a height of about 4 ½ feet unless otherwise specified. Stakes shall be uniform in height and placed as designated on the accompanying drawing. See Detail D-1.
- E. Mulching. All plants shall be mulched with a 3" mounded layer of shredded hardwood bark. The mulch shall entirely cover designated planting beds.

### 3.3 MAINTENANCE

Maintenance shall begin immediately following the last operation of installation for each plant and shall continue in accordance with the following requirements:

- A. Watering shall be the responsibility of the Contractor awarded the contract during the guarantee period. Watering in the first month after acceptance will be weekly. The remaining 23 months shall be done a minimum of every 10 days or as needed. The frequency of watering is dependent upon weather conditions.
- B. Maintenance during the guarantee period shall include watering, weeding, tightening and repairing wires, removing and replacing dead material, resetting plants to proper grades or upright position, and other necessary operations. If planting is done after lawn preparation, proper protection to lawn areas (new and/or existing) shall be provided and any damage resulting from planting operations shall be repaired promptly at no extra cost to the City of Newport News.
- C. New planting shall be protected and maintained by the Contractor until installation of planting is complete and has been accepted.

### 3.4 INSPECTION FOR ACCEPTANCE

- A. Inspection of the planting, to determine completion of contract work, exclusive of the possible replacement of plants, will be made by the Project Engineer/Architect upon written notice requesting such inspection submitted by the Contractor at least 10 days prior to the anticipated date.
- B. Initial Acceptance. After inspection to determine completion on contract, the Contractor will be notified in writing by the Project Engineer/Architect of acceptance of all work, exclusive of the possible replacement of plants subject to guarantee or, if there are deficiencies, of the requirements for the completion of the work. Work remaining to be done shall be subject to re-inspection before acceptance.
- C. Final Acceptance. After the two-year guarantee period is completed, the Project Engineer/Architect will give a final acceptance and will accept the responsibility for maintenance.

### 3.5 SERVICE AND REPLACEMENT

At any time during the 2 year Guarantee Period. Contractor awarded the contract will remove dead, unhealthy, unsightly, badly impaired plants, as determined by the Project Engineer/Architect within a ten (10) work-day period after notification by Project Engineer/Architect, unless other arrangements are made in writing. A schedule will then be submitted in writing, by the Contractor, with either a spring, fall or winter (whichever is first) replacement date.

### 3.6 CLEAN UP

Clean Up to Site: At the end of each day's work, the contractor shall remove all trash and other debris resulting from his work from the site. At all times, rubbish and trash generated from the Contractor shall be kept clean for vehicular and pedestrian circulation throughout the site. Prior to the final acceptance, all paved areas adjacent to planting areas shall be cleaned thoroughly by sweeping and/or washing. All defacement or stains on paving or building caused by plant operations shall be removed at no additional cost to the City of Newport News. All construction equipment, excess material tools, rubbish or debris shall be removed from the site. All drains on the site which have accumulated soil, mulch or any other material due to the planting operation, shall be cleaned to the approval of the Project Engineer/Architect.



SECTION 02650 - FORCE MAIN, PUMPING STATION PIPING WATER SERVICE AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. General: Applicable provisions of the Contract Drawings and General Conditions govern work under this section.
- B. Scope of Work: Furnish all labor, materials and equipment for the complete force main, other appurtenances; interior and exterior piping, drains, valves, accessories and related work. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.
- C. Work specified elsewhere but is not limited to:
  - Section 01330 - Submittal Procedures
  - Section 01781 - Operation and Maintenance Data/Manual
  - Section 02000 - Earthwork
  - Section 02485 - Seeding
  - Section 03300 - Cast-In-Place Concrete
  - Section 09910 - Painting
- D. Submittals: Submittals shall be made in accordance with the procedure set forth in Section 01330 - "Submittal Procedures".
  - 1. Shop Drawings (SD) and catalog data (CD) shall be submitted for the following items:
    - a. Piping materials and pipe joints (SD, CD)
    - b. Restrained joints (SD, CD)
    - c. Valves and specials (SD, CD)
    - d. Pipe Supports (SD, CD)
    - e. Pipe sleeves, wall pipes, and pipe plates (SD, CD)
    - f. Backflow preventer (SD, CD)
    - g. Piping Layout (SD)
  - 2. Test results shall be submitted as specified.

## 1.02 MATERIALS

### A. General:

1. The waste water pumping station drawings show the general layout of piping and equipment and do not necessarily reflect the exact location of the various items. Accordingly, the Contractor shall not scale the drawings but shall acquaint himself with the extent and character of the work required and its relation to the work under other items. It is the intention of the drawings and specifications to provide complete and workable piping systems; any miscellaneous valves and fittings required for proper completion of the work shall be provided. All nuts and bolts on all piping, valves etc, shall be stainless steel.

### B. Ductile Iron Pipe (3-inches in diameter and larger) - Pipe shall conform to ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51 - latest revision, Pressure Class 250 psi. Ductile Iron pipe shall also be in accordance with the following requirements:

1. Buried Pipe - Buried pipe shall have mechanical joints in accordance with ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53 - latest revisions. Thickness to be class 52. Pipe to be supplied with stainless steel nuts and bolts.
2. Above Ground Pipe - Above ground pipe shall have flange joints in accordance with ANSI/AWWA C110/A21.10 and ANSI/AWWA C115/A21.15 - latest revisions. Flange pipe shall be rated for a working pressure of 250 psi. Thickness to be class 52. All nuts and bolts to be stainless steel.
3. Coatings and Linings - The interior of all pipe shall be standard thickness cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4 - latest revision. The exterior of all buried pipe shall be a petroleum asphaltic coating. Coating shall be inspected prior to installation into the trench and all damaged areas shall be repaired in accordance with the manufacturer's recommendation. The exterior of all non-buried piping shall be shop primed and painted in accordance with Section 09910 - "Painting".
4. Ductile iron pipe shall be as manufactured by American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, Inc., Griffin Pipe Products Company, Tyler Pipe Industries or approved equal.

### C. Ductile Iron Fittings (3-inches in diameter and larger) - Ductile iron fittings shall be mechanical joints for buried service and flange joints for non-buried service. Ductile iron fittings shall meet the following requirements:

1. Working Pressure - Fitting shall have a minimum pressure rating not less than 250 psi.
2. Buried Fittings - Buried fittings shall have a working pressure rating of 250 psi and shall have mechanical joints in accordance with ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53 - latest revisions and shall be restrained using thrust blocks and retainer glands.
3. Above Ground Fittings - Above ground fittings shall have flange joints in accordance with ANSI/AWWA C110/A21.10 - latest revision, with a rated working pressure of 250 psi.
4. Coatings and Linings - The interior of all ductile iron fittings shall be double cement lined and seal coated in accordance with ANSI/AWWA C104/A21.4 - latest revision. The

exterior of all buried fittings shall have a petroleum asphaltic coating. Coating shall be inspected prior to installation into the trench and all damaged areas shall be repaired in accordance with the manufacturer's recommendation. The exterior of all non-buried piping shall be shop primed and painted in accordance with Section 09910 - Painting".

5. Flange Piping, General - Use of multi-gaskets and spacers are prohibited.
  6. Ductile iron fittings shall be as manufactured by American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, Inc., Griffin Pipe Products Company, Tyler Pipe Industries or approved equal.
- D. Polyvinyl Chloride (PVC) Pipe: PVC pipe shall be as follows:
1. Schedule 80, type 1, PVC meeting ASTM D-1785 latest revision or Class 200, SDR-21 in accordance with ASTM-D2241.
  2. PVC pipe and fittings shall be listed in the NSF for potable water use.
  3. PVC fittings shall be Schedule 80 or SDR-21 and meet ASTM D-2464 or ASTM D-2467.
  4. All PVC pipe and fittings shall be manufactured having a minimum PVC resin cell class of 12454B or 12454C in accordance with ASTM D-1784 - latest revision.
  5. All joints shall be solvent weld using solvents in accordance with ASTM D-2564 - latest revision.
- E. Gate Valves (3-inches in Diameter and Smaller) - Gate valves shall meet the following requirements:
1. Class 125, bronze gate valve conforming to Manufacturers Standardization Society (MSS) MSS SP-80 with bolt on bonnet, non-rising stem and solid wedge with female normal pipe threads. Valve shall be suitable for 200 psi no-shock cold water, oil or gas (200 psi WOG).
  2. Hand wheel nut shall be zinc plated steel with clear chromate.
  3. Body, packing, stuffing box, bonnet, wedge shall be bronze meeting ASTM B-62 or ASTM B-584 allow C84400.
  4. Hand wheel shall be aluminum meeting ASTM B-85 allow A03800.
  5. Stem shall be silicon bronze meeting ASTM B-371 allow C69400 or ATSM B-99 allow C6500 H04.
  6. Packing Nut and Packing Gland shall be bronze meeting ASTM B-62 or ASTM B-584 allow C84400.
  7. Shall be as manufactured by Grinnell Figure No. 3000 threaded or approved equal.
  8. All nuts and bolts to be stainless steel.
- F. Gate Valves (4-inches in Diameter and larger) - Gate valves shall be in accordance with AWWA C509 - latest revision with a design working pressure of 200 psig and be supplied with the following:

1. Coatings - Supply exterior fusion bonded epoxy coating of not less than 8 dry mils in accordance with AWWA C550 - latest revision. Exterior finish coat shall be in accordance with Section 09910 - "Painting".
  2. Valves shall open left (counter-clockwise) by a 2" operating nut for buried service and by a hand wheel for above ground service.
  3. All above ground and buried service valves shall have flange joints in accordance with ANSI/AWWA C115/A21.15 - latest revision, Class 125.
  4. Valves shall be non-rising bronze stem, bronze seated with cast iron disk.
  5. Valve markings - Valve markings shall be case on the bonnet or body of each valve and shall show the manufacturer's name or mark, year the valve casting was made, the size of the valve, and the designation of working pressure.
  6. Valves shall be as manufactured by U.S. Pipe Metroseal 250 or American-Darling CRS-80, or approved equal.
  7. All nuts and bolts are to be stainless steel.
- G. Swing Check Valves - Swing check valves shall meet the following requirements.
1. AWWA C508 - latest revision.
  2. Seating Type: Seating type shall be resilient material to bronze seat construction.
  3. Coatings - Supply an exterior fusion-bonded epoxy coating of not less than 8 dry mils in accordance with AWWA C550 - latest revision. Exterior finish coat shall be in accordance with Section 09910 - "Painting".
  4. All nuts and bolts to be stainless steel.
- H. Restrained Joints: Shall be a "Megalug" retainer gland as manufactured by EBAA Iron Sales, Inc. or approved equal.
- I. Couplings: Sleeve type couplings for ductile iron pipe shall be used where shown on the construction drawings. Gaskets for sleeve type couplings shall be of molded rubber. The middle rings of the coupling shall be without a pipe stop and shall be at least ¼-inch (6 millimeters) thick and 5-inches (125 millimeters) wide for 8-inch (200 millimeters) and smaller pipe and 3/8-inch (9 millimeters) thick and 7-inches (175 millimeters) long for pipe 10-inches (250 millimeters) through 30-inches (750 millimeters) in diameter. Sleeve type couplings shall be shop coated from the manufacturer. Sleeve type couplings shall be style 38 couplings by Dresser Industries, Inc. or approved equal.
- J. Copper Pipe (3-inches in Diameter and Smaller): Buried pipe shall be seamless copper tubing conforming to ASTM B88 - latest revision, Type K, Temper 060, and shall be of the coiled type. Interior tube shall be Type L, hard-drawn copper tube. Fittings shall be wrought copper solder-joint pressure fittings conforming to ASNI B16.22 - latest revision. Copper tube and fittings shall be rated for a working pressure of 100 psi. All joints shall be soldered.
- K. Backflow Preventer: The reduced pressure backflow preventer shall be an WATTS 909 RPZ, 1" with ball valve test cocks or approved equal and shall consist of an internal pressure differential

relief valve located in a zone between two independently operating, positive seating check cartridges with capture springs and silicone seat discs. When normal flow exists, both checks are open and the pressure in the area between checks, called the zone, is at least 2 psi (13.8 kPa) lower than the inlet pressure. The differential pressure relief valve is closed during normal flow. If cessation of normal flow occurs, the differential pressure relief valve will automatically open and discharge to maintain the zone at least 2psi (13.8 kPa) lower than the inlet pressure. This action will prevent a backflow or back siphonage condition. After the required differential is established, the differential relief valve shall be closed again. Seats and seat discs shall be replaceable in both check modules and the relief valve. Service of all internal components shall be through a single access cover secured with stainless steel bolts. No special tools shall be required for servicing. The Contractor shall construct a funnel system below the backflow preventer to collect vented water and discharge collected water via a pipe to outside the building. Backflow preventer to be installed 18" minimum above grade and discharge port to be installed at least twice its diameter above the funnel.

## PART II - EXECUTION

### 2.01 INSTALLATION

#### A. Wastewater Pumping Station:

1. All piping shall be installed according to the plans and applicable codes. Pipe runs shall be true and direct consistent with space utilization. Proper allowances shall be made for expansion, gaskets, and all lines shall be adequately supported and anchored as necessary to prevent undue stress on pipes or equipment to which it may be attached. Blocking shall be adequate to prevent noise or vibration when flows are turned on or off.
2. Air bleed valves and small drains shall be provided at high and low points of the system and shall be minimum of ½-inch (12.5 millimeters).
3. All pipe shall be reamed to full size after cutting and all joints made up with compound applied to the male threads only.
4. Securing and supporting pipe shall be accomplished by means of approved pipe hangers, with due provision for pipe expansion, Pipes shall be securely anchored where necessary, to properly distribute stresses. Pipe hanger shall not exceed the following spacing:
  - 1-1/4 inches (31.25 millimeters) or smaller - 8 feet (2.4 meters) on centers
  - 1-1/2 inches (37.5 millimeters) or larger - 10 feet (3.0 meters) on centersPipe hanger shall be split ring malleable iron type with hanger rod, or trapeze type with horizontal angle iron "U" bolts, and hanger rods.
5. All piping shall be flushed with clear water to assure cleanliness and proper operation of all lines. Do not leave foreign materials inside of pipe lines.
6. Hangers, anchors and inserts shall either be cast into the precast structures during manufacture or installed on site by use of approved expansion type anchors and inserts.

#### B. Force Main:

1. The force main shall be installed in accordance with the drawings and applicable codes.
2. Handling and storage of pipe fittings and other materials shall be in exact accordance with the manufacturers published instructions.

3. The interior of the pipe shall be clean and joint surface brushed and wiped clean and dry when the pipe is lowered into trench. Hammer test cast iron pipe for soundness while lowering. Lower each pipe, fitting and valve into the trench carefully and lay true to line and without objectionable breaks in grade. The depth of cover below finished grade shall be not less than 3 feet (0.9 meters), except where connecting to structures and as much deeper as necessary to give proper clearance from other utilities and structures. Under no circumstances drop or dump pipe appurtenances into the trench. Give all pipes a uniform bearing on the trench bottom. Allow no trench water or dirt to enter the pipe or joint space during laying. Insert a watertight plug in open end of the piping when pipe laying is not in progress. Cut pipe as necessary to locate fittings and valves in the positions shown on the drawings; cut the pipe squarely and neatly and without damage to the pipe. Set plugs in opening left for branches to be installed later.
4. Jointing shall be performed in full accordance with the pipe manufacturer's published directions or specifications.
5. Fittings and branch connections. Install proper fittings at all changes in direction, dead ends, and interconnections of lines.
6. Setting Valves. Before setting each valve, make sure the interior is clean and test opening and closing. Set valves and stops with stems plumb and at the locations shown. Valve boxes shall be plumb, centered over valves, and with tops at finished grade. Tamp trench backfill thoroughly for a distance of 3 feet on each side of boxes. Valve covers shall be set in concrete slabs or collars as indicated on the plans.
7. Restrain movements of force main by pouring lean-mix concrete thrust blocks between the undisturbed trench face and plugged ends, bends and tees to prevent pipe movement at joints. In addition to the concrete thrust blocks provide concrete, restrained joints. Restraining devices shall be installed in accordance with manufacturers published instructions.
8. Flushing. Upon completion of the pressure piping system, test all valves to insure their full opening and flush out the system, and permitting the flow to continue from each until the water runs clear.

## 2.02 SEPARATION OF BURIED WATER AND SEWER LINES:

- A. There shall be no physical connection between a drinking water supply line and a sewer line or appurtenances. No sewer line shall pass within 100 feet (31 meters) of a potable water supply well or other potable water supply source or structure unless special construction and/or pipe materials are used to obtain adequate protection, as determined by the Engineer.
- B. Parallel Installation: Water and sewer lines shall be laid at least 10 feet (3 meters) horizontally from one another whenever possible. The distance shall be measured edge-to-edge. When conditions prevent a horizontal separation of 10 feet (3 meters), the water and sewer lines may be laid closer to each other provided that:
  1. The bottom of the water line shall be at least 18 inches (450 millimeters) above the top of the sewer line.

2. Where this vertical separation cannot be obtained, the sewer shall be constructed of ductile iron pipe, pressure tested in place without leakage prior to backfilling.
  3. The sewer manhole shall be of watertight construction and tested in place.
- C. Crossing Installation: Water and sewer lines crossing one another shall be installed with the water line over the sewer line to provide a separation of at least (450 millimeters) between the bottom of the water line and the top of the sewer line whenever possible. When conditions prevent this vertical separation, the following construction shall be used.
1. Sewers passing over or under water lines shall be constructed of ductile iron pipe.
  2. Water lines passing under sewers shall, in addition, be protected by the provision of:
    - a. A vertical separation of at least 18 inches between the bottom of the sewer line and the top of the water line;
    - b. Adequate structural support for the sewer line to prevent excessive deflection of the joints and the settling on and breaking of the water line.
    - c. A length of water line centered at the point of the crossing so that the joints shall be equidistant and as far as possible from the sewer line.
- D. No physical connection or contact shall exist between a water line and a sewer line or sewer manhole.
- E. If the Contractor is unable to maintain the specified vertical separation while following the lines and grades indicated, he shall immediately cease work and notify the Engineer so that one of the following adjustments can be directed by the Engineer:
1. Modification of sewer alignment and grade.
  2. Relocation of water line.
  3. Reconstruction of water line with ductile iron pipe for a distance of 10 feet (3 meters) on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.
  4. Concrete encasement of either or both the water and sewer lines.

**END OF SECTION**

SECTION 03300 - CAST - IN - PLACE CONCRETE  
(FOR WASTEWATER PUMPING STATIONS)

PART 1 - GENERAL

1.01 DESCRIPTION

- A. General: The Contractor shall furnish all labor, materials, tools, equipment and services for all concrete indicated. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.
- B. Work specified elsewhere but is not limited to:
- Section 01330 - Submittal Procedures
  - Section 02000 - Earthwork
  - Section 02485 - Seeding
  - Section 02650 - Force Main, Pumping Station Piping, Water Service and Accessories
  - Section 04600 - Through Wall Flashing
  - Section 04800 - Joint Sealants
  - Section 05500 - Structural and Miscellaneous Metals
  - Section 06120 - Carpentry
  - Section 07150 - Bituminous Dampproofing
  - Section 09910 - Painting

1.02 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. American Concrete Institute (ACI)

1. ACI 211.1 Standard practice for selecting proportions for normal, heavyweight, and mass concrete
2. ACI 301 Specifications for structural concrete for buildings
3. ACI 302 Guide for concrete floor and slab construction
4. ACI 304R Guide for measuring, mixing, transporting, and placing concrete
5. ACI 305R Hot weather concreting
6. ACI 306.1 Cold weather concreting
7. ACI 318 Building Code Requirements for Structural Concrete
8. ACI 347 Guide to formwork for concrete



B. American Society for Testing and Materials (ASTM)

1. AATM A82 Cold-drawn steel wire for concrete reinforcement
2. ASTM A185 Welded steel wire fabric for concrete reinforcement
3. ASTM A496 Deformed steel wire for concrete reinforcement
4. ASTM A497 Welded deformed steel wire fabric for concrete reinforcement
5. ASTM A615 Deformed and plain billet-steel bars for concrete reinforcement
6. ASTM C31 Making and curing concrete test specimens in the field
7. ASTM C33 Concrete aggregates
8. ASTM C39 (rev. B) Compressive strength of cylindrical concrete specimens
9. ASTM C42 (rev. A) Obtaining and testing drilled cores and sawed beams of concrete
10. ASTM C94 Ready-mixed concrete
11. ASTM C143 Slump of portland cement concrete
12. ASTM C150 Portland cement
13. ASTM C171 (r 1986) Sheet materials for curing concrete
14. ASTM C172 Sampling freshly mixed concrete
15. ASTM C173 Air content of freshly mixed concrete by the volumetric method
16. ASTM C231 Air content of freshly mixed concrete by the pressure method
17. ASTM C260 Air entraining admixtures for concrete
18. ASTM C309 Liquid membrane-forming compounds for curing concrete
19. ASTM C494 Chemical admixtures for concrete
20. ASTM C881 (rev. 1983) Epoxy-resin-base bonding systems for concrete

21. ASTM C920 Elastomeric joint sealants
  22. ASTM D1190 (r 1980) Concrete joint sealer, hot-poured elastic type
  23. ASTM D1751 Preformed expansion joint filler for concrete paving and structural construction (nonextruding and resilient bituminous types)
  24. ASTM D1752 Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural construction
  25. ASTM D1850 (r 1979) Concrete joint sealer, cold-application type
  26. ASTM D4397 Polyethylene sheeting for construction, industrial and agricultural application
- C. American Welding Society, Inc. (AWS)
1. AWS D1.4 Structural welding code-reinforcing steel
- D. Army Corps Of Engineers (COE)
1. COE CRD-C-572 1974 Specifications for polyvinylchloride waterstop
  2. COE-CRD-C-621 1983 Handbook for concrete and cement, specifications for nonshrink grout, Volume II (1949 Edition)
- E. U.S. Department of Commerce Product Standards (PS)
1. PS-1: 1983 Construction and industrial plywood

### 1.03 SUBMITTALS

Submit the Following:

A. Design Data:

1. Contractor Mix Design: Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Furnish a complete list of materials including type, brand, source and amount of cement, and admixtures; applicable reference specifications, and copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement. Obtain acknowledgement of receipt prior to concrete placement. Submit additional data regarding concrete aggregates if the source of aggregate changes.

B. Manufacturer's Catalog Data:

1. Waterstops
2. Materials for curing concrete
3. Joint sealant
4. Joint filler
5. Vapor barrier

C. Drawings:

1. Reinforcing steel
2. Formwork

Reproduction of contract drawings are unacceptable.

D. Reinforcing Steel: ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

E. Formwork: ACI 347. Include design calculations. Indicate arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Indicate placement schedule, construction, and location and method of forming control joints. Include locations of inserts, pipework, conduit, sleeves, and other embedded items. Furnish drawings and descriptions of shoring and reshoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members. Furnish schedule of form removal.

F. Certificates of Compliance:

1. Aggregates
2. Admixtures
3. Reinforcement
4. Cement

#### 1.04 MODIFICATION OF REFERENCES

In the ACI publication referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "building official," and the "structural engineer," shall be interpreted to mean the City of Newport News.

#### 1.05 DELIVERY

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement.

#### 1.06 STORAGE

ACI 301 for job site storage of concrete aggregates. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Provide for accurate identification after bundles are broken and tags removed.

### PART 2 - PRODUCTS

2.01 CONCRETE

- A. Contractor-furnished Mix Design: ACI 211.1 and ACI 301 except as otherwise specified. Concrete for the pumping stations shall have a 28-day compressive strength of 5000 psi (34,483 kPa) unless indicated or specified otherwise. Provide ASTM C33 aggregate size no. 57. Maximum water: cement ratio shall be 0.47. Minimum cement content of 675 pounds per cubic yard (366.5 kilograms per square meter) of concrete. Air content of 5 percent +/- 2 percent. Accomplish air entrainment using an air-entraining admixture.
- B. Walks and Pavement: Concrete for walks and driveway pavement shall have a 28-day compressive strength of 3000 psi (20,689.7 kPa) unless indicated or specified otherwise.

C. Slump Requirements:

ELEMENT

Walls, columns, and grade beams	3" +/- 1 (75 mm +/- 25)
Floors, exterior slabs, and other building construction	2" +/- 1 (50 mm +/- 25)

2.02 MATERIALS

- A. Cement: ASTM C150, Type II or III modified cement with a tricalcium aluminate content of 8 percent maximum. For exposed concrete, use one manufacturer for each type of cement. Pozzolan, fly ash, blast furnace slag or any other additive that is used primarily as a cement replacement shall not be used. Wetting agents and plasticizers shall not be used without the written consent of the Engineer.
- B. Water: Water shall be fresh, clean, and potable.
- C. Aggregates: ASTM C33, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.
- D. Nonshrink Grout: COE CRD-C-621.
- E. Admixtures:
  - 1. Air-entraining: ASTM C260
  - 2. Water reducing: ASTM C494, Type A, E, or F
- F. Materials for Forms: Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Plywood: ps-1, b-b concrete form panels or better. Steel form surfaces shall not contain irregularities, dents, or sags.
- G. Reinforcement:
  - 1. Reinforcing Bars: ACI 301 unless otherwise specified. ASTM A615, with the bars marked grade 60.
  - 2. Mechanical Reinforcing Bar Connectors: ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

3. Welded Wire Fabric: ASTM A185 or ASTM A497. Provide flat sheets of welded wire fabric for slabs and toppings.
  4. Wire: ASTM A82 or ASTM A496.
- H. Vapor Barrier: ASTM D4397 polyethylene sheeting, minimum 6 mil thickness.
- I. Polyvinylchloride Waterstops: COE CRD-C-572
- J. Materials for Curing Concrete:
1. Impervious Sheeting: ASTM C171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap
  2. Pervious Sheeting: AASHTO M 182
  3. Liquid Membrane-forming Compound: ASTM C309, white pigmented, Type 2, Class B
- K. Liquid Chemical Sealer-Hardener Compound: Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Compound shall not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.
- L. Expansion/Contraction Joint Filler: ASTM D1751 or ASTM D1752, 1/2-inch (12.5 millimeters) thick, unless otherwise indicated.
- M. Joint Sealants:
1. Horizontal Surfaces (3 percent slope, maximum):
    - a. Outside buildings: ASTM D1190
    - b. Inside buildings: ASTM D1190 or ASTM D1850.
  2. Vertical Surfaces (greater than 3 percent slope): ASTM C920, Type M, Grade NS, Class 25, use T.
- N. Epoxy Bonding Compound: ASTM C881, Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or hardened concrete. Grade 1, Class A (if placement temperature is below 40 degrees F (4<sup>0</sup> C)); Class B (if placement temperature is between 40 and 60 degrees F (4<sup>0</sup> and 15<sup>0</sup> C)); or Class C (if placement temperature is above 60 degrees F (15<sup>0</sup> C)). Provide grade 1 or 2 for horizontal surfaces and grade 3 for vertical surfaces.

## PART 3 - EXECUTION

### 3.01 FORMS

ACI 301. Provide forms, shoring, and scaffolding for concrete placement unless indicated or specified otherwise. Set forms mortar tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch (20 millimeters) unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water shall be watertight.

- A. Coating: Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.
- B. Removal of Forms: Prevent concrete damage during form removal. After placing concrete, forms shall remain in place for the following minimum time periods, not necessarily consecutive, where minimum temperatures specified in paragraph, entitled "curing periods and minimum temperatures" are maintained adjacent to the concrete and formwork. The minimum time period for removal of forms shall govern where it exceeds the minimum specified curing period. Where the formwork for one element supports the formwork for another element, the greater time period shall apply to both elements.

<u>Element</u>	<u>Time Period</u> <u>(Days Minimum)</u>
Walls, columns, sides of beams and girders and slabs on grade	2
Joist, beam or girder soffits:	
Clear span between structural supports	
Under 10 feet (under 3 meters)	7
10 to 20 feet (3 to 6 meters)	14
over 20 feet (over 6 meters)	21
One-way floor slabs:	
Clear span between structural supports	
Under 10 feet (under 3 meters)	4
10 to 20 feet (3 to 6 meters)	7
Over 20 feet (over 6 meters)	10

- 1. Special Requirements for Reduced Time Period: Forms may be removed earlier than specified if ASTM C39 test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached 85 percent (minimum) of the design strength.

- C. Reshoring: Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Where columns, walls, or other load bearing concrete members are placed in advance of other framing and forms are needed for future use, forms may be stripped after 2 days if loads are not applied to load bearing members, and if members are cured as specified in paragraph entitled "curing and protection." After forms are removed, slabs and beams over 10 feet (3 meters) in span and cantilevers over 4 feet (1.2 meters) shall be reshored for the remainder of the specified time period in paragraph entitled "removal of forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Reshoring elements shall have the same load-carrying capabilities as

original shoring and shall be spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

### 3.02 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement shall not contain rust, scale, oil, grease, clay and foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross sectional area or the nominal weight per foot of the reinforcement has been reduced to less than specified in paragraph entitled "reinforcing bars." Remove loose rust prior to placing steel. Tack welding is prohibited.

- A. Vapor Barrier Placement: Provide beneath the on-grade floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches (300 millimeters). Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement shall not damage vapor barrier material.
- B. Tolerances: Place reinforcement and secure with noncorrodible chairs, spacers, or metal hangers. Use precast concrete blocks or other noncorrodible material for supporting reinforcement on the ground.
- C. Splicing: AWS D1.4, except as otherwise indicated or specified. Splices shall be approved prior to use. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of cross wires, plus 2 inches (50 millimeters).
- D. Future Bonding: Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Bolt threads shall match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.
- E. Cover: ACI 301 for minimum coverage of 3-inches (75 millimeters), unless otherwise indicated.
- F. Setting Miscellaneous Material: Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.
- G. Construction Joints: Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.
- H. Expansion Joints and Contraction Joints: Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2-inch (12.5 millimeters) wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealer. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.
- I. Waterstop Splices: Fusion weld in the field.
- J. Form Ties and Accessories: The use of wire alone is prohibited. Form ties and accessories shall not reduce the effective cover of the reinforcement.

### 3.03 MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE

ASTM C94, ACI 301, ACI 302, and ACI 304, except as modified herein. Provide mandatory batch ticket information for each load of ready mix concrete.

- A. Measuring: Make moisture, weight, and air determination at intervals as specified in paragraph entitled "sampling and testing." Allowable tolerances for measuring cement and water shall be 1 percent; for aggregates, 2 percent; and for admixtures, 3 percent.
- B. Mixing: ASTM C94 and ACI 301. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F (29<sup>0</sup> C). Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 degrees F (29<sup>0</sup> C). Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.
- C. Transporting: Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.
- D. Placing: Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. All surfaces upon which concrete is to be placed shall be thoroughly dampened. The maximum free fall of concrete during placement shall be three feet. Placement at greater heights than three feet shall be accomplished by shutes, slides, or other approved methods. Concrete shall be worked around the reinforcement and embedded fixtures and into corners of the forms with care being taken to avoid segregation. Concrete shall be placed so as to avoid formation of cold joints between successively deposited layers. Place concrete in one continuous operation from one end of the structure towards the other.
  - 1. Vibration: ACI 301. Furnish a spare vibrator on the job site whenever concrete is placed. Consolidate slabs greater than 4 inches (100 millimeters) in depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches (100 millimeters) or less in depth by wood tampers, spading, and settling with a heavy leveling straight edge. Operate vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 18 inches (450 millimeters) apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 18-inch maximum vertical lifts. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.
- E. Tolerances: Variations in concrete slab levels shall not exceed 1/8 inch (3.1 millimeters) in ten feet. Grind down high spots and fill low spots using urethane leveling materials or an approved latex underlayment adhered with a concrete bonding agent.
- F. Cold Weather: ACI 306R. Provide 50 degrees F (10<sup>0</sup> C) minimum concrete temperature. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F (4<sup>0</sup> C) or when



concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F (10<sup>0</sup> C) minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 5 degrees F (2.8<sup>0</sup> C) in any one hour and 50 degrees F (10<sup>0</sup> C) per 24 hours after heat application.

- G. Hot Weather: ACI 305r. Provide and maintain required concrete temperature using figure 2.1.5 in ACI 305r to prevent the evaporation rate from exceeding 0.2 pound of water per square foot (1 kilogram of water per square meter) of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment (where worksite is remote to water source) to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

#### 3.04 SURFACE FINISHES (except floor, slab, and pavement.)

- A. Defects: Repair formed surfaces by removing minor honeycombs, pits greater than one square inch (twenty-five square millimeters) surface area or 0.25 inch (6.3 millimeters) maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb (including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects) which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerance of ACI 347. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.
- B. Not Against Forms (tops of walls): Surfaces not otherwise specified shall be finished with wood floats to even surfaces. Finish shall match adjacent finishes.
- C. Formed Surfaces:
1. As-cast Smooth Form: Provide as-cast smooth form for all surfaces. Form facing material shall produce a smooth, hard, uniform texture on the concrete. Remove fins and other projections.
- D. Rubbed Finish: Provide concrete with a smooth form finish. Finish as follows:
1. Smooth rubbed: Provide on newly hardened concrete within 24 hours following form removal. Wet surfaces and rub with an abrasive tool to produce uniform color and texture. Use only the cement paste drawn from the concrete rubbing process. Remove all excess cement matrix by working the surface with a rubber float, burlap or other means.
  2. Cork Floated On All Other Surfaces: Mix one part portland cement and one part fine sand with sufficient water to produce a stiff mortar. Dampen the surface and apply mortar with firm rubber float or trowel, filling surface voids. Compress mortar into voids using a slow-speed grinder or stone. If the mortar surface dries too rapidly to permit proper compaction and finishing, apply a small amount of water with a fog sprayer. Produce the final texture with a cork float using a swirling motion.

3.05 Surface Finish Samples: Provide a minimum of one sample concrete panel for each finish for each mix design, 3 feet (1 meter) by 3 feet (1 meter), 3 inches (75 millimeters) thick. Use the approved concrete mix design(s). Provide sample panels on-site at locations directed. Once approved, each set of panels shall be representative of each of the finishes specified and shall be representative of the workmanship and finish(es) required. Do not remove or destroy samples until directed by the Architect/Engineer.

3.06 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where quarry tile or ceramic tile are indicated. Provide interior floor slabs with a steel trowled finish. After troweling and moist curing are completed, apply a liquid chemical sealer-hardener compound on interior floor slabs that do not receive floor covering or protective coating.

A. Finish: Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleed water appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

1. Floated: Provide for machinery pads and other exterior slabs where not otherwise specified. Float the surface by hand with a wood or magnesium float, or use a power-driven float. Floating of any one area shall be the minimum necessary to produce an even finish, level within 1/4 inch (6 millimeters) in 10 feet (3 meters) for exterior work and level within 1/8 inch (3 millimeters) in 10 feet (3 meters) for interior work where floor drains are not provided.

2. Steel Trowled: First, provide a floated finish. When slab attains a proper set, trowel to a smooth, hard, dense finish. Finished surfaces shall be free of troweled marks, uniform in texture, and a true plane, flat within 0.01 foot (approximately 1/8 inch (3 millimeters)) in 10 feet (3 meters). Hand-finish portions of the slab not accessible to power finishing equipment (e.g., edges, corners) to match the remainder of the slab. Power trowel once and finally hand trowel where a finished floor covering (e.g. tile, carpet) is specified. Power trowel twice and finally hand trowel for exposed concrete floors.

3. Broomed: Provide for exterior walks, platforms, patios, and ramps, unless otherwise indicated. Provide a floated finish, then finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

4. Pavement: Screen the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screening, float the concrete longitudinally. Use a straight edge to check slope and flatness; correct and refloat as necessary. Obtain final finish by a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet (1 to 3 meters) wide and 2 feet (0.6 meters) longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch (3 millimeters).

B. Concrete Walks: Provide 4 inches (100 millimeters) thick minimum. Provide contraction joints spaced every 5 linear feet (1.5 meters) unless otherwise indicated. Cut contraction joints 3/4 inch (19 millimeters) deep with a jointing tool after the surface has been finished. Provide 1/2 inch (12.5 millimeters) thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet (15 meters) maximum

apart. Provide walks with a broomed finish. Provide a transverse slope of 1/4 inch (18 millimeters) per foot (meter). Limit variations in cross section to 1/4 inch (6 millimeters) in 5 feet (1.5 meters).

- C. Pits and Trenches: Place bottoms and walls monolithically or provide waterstops and keys.
- D. Curbs and Gutters: Provide contraction joints spaced every 10 feet (3 meters) maximum unless otherwise indicated. Cut contraction joints 3/4 inch (19 millimeters) deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch (12.5 millimeters) thick and spaced every 10 feet (3 meters) maximum unless otherwise indicated. Provide a pavement finish.

### 3.06 CURING AND PROTECTION

ACI 301 unless otherwise specified. Begin curing immediately following form removal. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener.

- A. Moist Curing: Provide for the removal of water without erosion or damage to the structure.
  - 1. Ponding or Immersion: Continually immerse the concrete throughout the curing period. Water shall not be more than 20 degrees F (11<sup>0</sup> C) less than the temperature of the concrete. For temperature between 40 and 50 degrees F (4 to 10<sup>0</sup> C), increase the curing period by 50 percent.
  - 2. Fog Spraying or Sprinkling: Provide uniform and continuous application of water throughout the curing period. For temperature between 40 and 50 degrees F (4 to 10<sup>0</sup> C), increase the curing period by 50 percent.
  - 3. Pervious Sheeting: Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.
  - 4. Impervious Sheeting: Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches (300 millimeters) minimum. Provide sheeting not less than 18 inches (450 millimeters) wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting, overlap and continuously tape sheeting joints, and introduce sufficient water to soak the entire surface prior to completely enclosing.
- B. Liquid Membrane-Forming Compound Curing: Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of figure 2.1.5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pound (0.97 kg) of water per square foot (meter) per hour.

1. Application: Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 200 square feet (4.9 square meters) maximum per gallon (liter) of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.
  2. Protection of Treated Surfaces: Prohibit foot and vehicular traffic and other sources of abrasion for not less than 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.
- C. Liquid Chemical Sealer-Hardener: Apply sealer-hardener to interior floors not receiving floor covering. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. The sealer-hardener shall not be applied until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of 2 coats of sealer-hardener.
- D. Curing Periods and Minimum Temperatures: After placing concrete, maintain air temperature adjacent to the concrete at 50 degrees F (10<sup>0</sup> C) minimum for the remainder of the specified time period.

<u>Time Period</u> (Days Minimum)	<u>Concrete Structure or Cement Type</u>
3	ASTM C150, type III concrete not specified otherwise.
7	ASTM C150, Type I or II.
10	Retaining walls that will be subjected to frost action or similar deteriorating conditions; pavement not under a roof.
28	Sewage pumping station walls below grade that are to receive a protective coating.

1. Additional Curing: Double the required curing period if either one of the average of both 7-day test cylinders indicate less than 90 percent of the strength specified (f'c).

### 3.07 SAMPLING AND TESTING

- A. Sampling: ASTM C172. Collect samples of fresh concrete to perform tests specified. ASTM C31 for making test specimens.
- B. Testing:
  1. Slump Tests: ASTM C143. Take concrete sample during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture

provided that the water cement ratio is not exceeded. Perform tests when strength test cylinders are made.

2. Temperature Tests: Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F (10<sup>0</sup> C) and above 80 degrees F (27<sup>0</sup> C)) whenever test cylinders and slump tests are made.
3. Compressive Strength Tests: ASTM C39. Make five test cylinders for each set of tests in accordance with ASTM C31. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Samples for strength tests of concrete placed each day shall be taken not less than once from every concrete truck load. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than  $f_c$  or if any strength test result falls below  $f_c$  by more than 500 psi (3450 kPa), take a minimum of three ASTM C42 core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of  $f_c$  and if no single core is less than 75 percent of  $f_c$ . Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete. The testing of the cylinders is to be accomplished by an approved, competent, independent testing laboratory. Complete certified reports shall be furnished the engineer in triplicate. The contractor shall furnish the necessary labor, material and facilities for making, storing, curing and testing of the sample standard test cylinders. The contractor shall notify the engineer 24 hours prior to placing concrete and all placing of concrete and making of the concrete test cylinders shall be done in the presence of the engineer or his representative.
4. Air Content: ASTM C173 or ASTM C231 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

**END OF SECTION**

SECTION 03310 - CONCRETE REPAIR AND PROTECTION SYSTEM  
(Wet Well Rehabilitation)

PART I - GENERAL

1.01 DESCRIPTION

- A. General: Applicable provisions of the contract drawings and general conditions govern work under this section.
- B. Scope of Work: Furnish all labor, materials, equipment, and supervisions for demolition of deteriorated concrete, the repair of delaminated or defective concrete to original lines and grade, application of moisture-barrier, bonding agent, reinforcement protection, build up mortar, application of coating systems, warranty, cleanup and restoration. All materials and work shall be in accordance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein. The contractor shall select one of the approved rehabilitation systems given under this section and adhere to any testing, inspection, site conditions or application requirements needed for the proper installation of the rehabilitation method chosen. The rehabilitation products may not be interchanged from one system to another.
- C. Work specified elsewhere but is not limited to:
  - Section 01330 - Submittal Procedures
  - Section 03300 - Cast-In-Place Concrete
  - Section 09910 - Painting

1.02 SUMMARY OF WORK

The work described in this section includes, but is not necessarily limited to:

- A. Wet well cleaning and sludge removal. Demolition of all defective or deteriorated concrete as directed by the Owner. Rehabilitation systems will be applied only to sound smooth grey concrete surfaces. Any white/yellow odorous concrete with loose aggregate will be removed to the satisfaction of the owner. The final prepared surface will spark when hit with a hammer and aggregate will chip instead of being dislodged. The demolition will be performed by water blasting, sandblasting and hammering if necessary. All deteriorated concrete will be removed and disposed of at the contractors expense and the well washed down and dried prior to inspection by the manufacturers representative and Owner.
- B. Repair of leaking, delaminated or defective concrete on interior wall, floors, fillets and ceiling surfaces of the wet well and drywell.
- C. Application of a temporary moisture-barrier producing epoxy cementitious leveling mortar on interior wall, floors, fillets and ceiling surfaces of wet well and drywell repair as directed by the engineer.
- D. Application of a mortar and epoxy coating system on interior walls, floors, fillets and ceiling surfaces of the wet well.

1.03 SUBMITTALS

Submit the following in accordance with the contract documents:

- A. Manufacturers pre-printed technical data sheets indicating product description, instruction for use, and physical performance data for all products submitted.
- B. Proof that the applicator is approved by the manufacturer to apply the products and maintain the warranty.

#### 1.04 QUALITY ASSURANCE

- A. Submit written evidence that the products used are fully-compatible and are part of a complete concrete repair and protection system from a single manufacturer.
- B. Submit written proof of product manufacturer's current ISO 9000 quality-control certification.
- C. Conduct pre-construction meeting with product manufacturer's representative to review application details prior to commencement of work.
- D. The product manufacturer's technical representative must be available for mandatory site inspections prior to the application of each component of the system. The contractor must obtain written approval from the representative to proceed with the application of the next component of the system or provide necessary corrective action approved by the representative and the Owner in order to proceed.

#### 1.5 WARRANTY

- 1. The contractor shall submit a written warranty for all labor, materials for a period of 5 years from project acceptance for the entire system. In the event of a failure of the system the contractor shall bear all responsibility and costs for repair of the system in accordance with the manufacturers recommendations. These recommendations are to be reviewed and approved by the owner. The contractor shall make all repairs within 30 days of notification at no cost to the owner.**
- 2. In addition a supplemental written renewable two year guarantee/warranty of all station bypassing and all other incidental costs for the rehabilitation must be submitted by the contractors bonding/surety company. No warranty shall be prorated but shall cover all costs. This warranty shall be renewed by the contractor for a period of 5 years.**

#### PART II - PRODUCTS

The acceptable systems are:

- A. Sauereisen F-370/F-180/F-190/209/F-120/121/210T/210RS/210S
- B. Tenmec MortarClad Series 218  
MortarCast Series 219  
Chembloc Series 434 H2S  
ChemGel Series 435
- C. Permacast MS10,000 mortar with ConShield  
Corr+Gard epoxy

The following are specifications for the system:

# SAUEREISEN

TYPICAL SPECIFICATION  
TO RESTORE AND / OR PROTECT MANHOLES, WET WELLS AND OTHER  
INFRASTRUCTURE  
USING NO.F-370/F-180/F-190/209/F-120/121/210T/210RS/210S

## 1.0 SCOPE

1.1 This specification covers the materials and application of a corrosion-resistant, trowel or spray applied polymer monolithic lining for protection of municipal wastewater collection and treatment systems subject to hydrogen sulfide and acid attack from microbiological sources. Also included are the materials and application for concrete restoration and the stoppage of active water leaks and water infiltration. The products of Sauereisen, 160 Gamma Drive, Pittsburgh, PA 15238-2989 shall be the standard of comparison. Written approval is required for all other products prior to bidding.

## 2.0 MATERIALS

2.1 The chemical-resistant monolithic shall be Sauereisen Sewergard No. 210T, 210RS or 210S Epoxy for protection of concrete in municipal wastewater collection and treatment systems.

Water infiltration through cracks, holes or weeping must be eliminated prior to application of the Sewergard products with Sauereisen F-180, F-190 or F-370.

Concrete restoration, as required by the engineer, shall be accomplished with Sauereisen F-120, F-121 or Filler Compound No. 209 underlayment / resurfacing products.

Application of underlayment / restoration products to resurface concrete is to be determined by the engineer and may not always be required prior to the application of Sewergard epoxy systems depending on the condition of the substrate. Sewergard Epoxy systems can be applied as stand alone products.

### 2.2 Properties

### InstaPlug No.F-180

Application time	
Working time at 70°F	15 seconds
Initial set at 70°F	60-90 seconds
Final set at 70°F	1 hour
Components	1 part



Bond strength to concrete	Concrete failure
Color	Gray
Compressive strength (ASTM C-109)	4,000 psi
Density (ASTM C-905)	121 pcf
Length change (ASTM C-157)	0%
Mixing ratio	3 Powder : 1 Water by volume

2.3 Properties H<sub>2</sub>OPruf No.F-190

Application time at 70°F	
Working time	30 minutes
Initial set	8 hours
Final set	24 hours
Components	2 parts
Thickness	1/16" (63 mils) per coat
Bond strength to concrete	Concrete failure
Color	Gray
Compressive strength	9,000 psi
Density (ASTM C-905)	131 pcf
Hydrostatic Pressure (ASTM C 497-70)	69.2 ft water head (30 psi)

2.3 Properties Hydroactive Polyurethane Grout No. F-370

Components	Polyurethane resin and hardener
Density, pcf (molded core) (ASTM D-1622)	2.03
Elongation (ASTM D-1623) Perpendicular	9.8%
Low temperature aging (-25°F, % Volume change) (ASTM D-2126) 1 day	0.00%
7 day	0.10%
Maximum service temperature	175°F
Shear modulus (ASTM C-2733) Perpendicular	117 psi
Shear strength (ASTM C-2733) Perpendicular	14.50 psi
Tensile strength (ASTM D-1623) Perpendicular	15.60 psi
Viscosity	500 cps
Water absorption (% Weight change) (ASTM D-2127)	< 1%

2.4 Properties Underlayment No. F-120 Trowel Grade

Application time	
Working time at 70°F	30 minutes
Initial set at 70°F	3 hours
Color	Tan
Compressive Strength @ 24 hours	3500 psi
@ 5 hours	2500 psi
Density	137 pcf
Mix ratio (powder to water, by weight)	9:1

2.5	<u>Properties</u>	<u>SubstrateResurfacer No. F-121</u>
	Components	1 Part
	Application time at 70°F	
	Working time	30 – 45 minutes
	Initial set	7 hour
	Compressive Strength @ 24 hours	2200 psi
	@ 7 days	6500 psi
	Density (ASTM C-905)	137 pcf
	Mix ratio (powder to water, by weight)	5.3/1
	Minimum Thickness	1/8"

2.6	<u>Properties</u>	<u>Epoxy Filler Compound No.209</u>
	Color	Off White
	Compressive Strength	10,000 psi
	Density (ASTM C-905)	87.2 pcf
	Flexural Strength (ASTM C-580)	4000 psi
	Modulus of Elasticity (ASTM C-580)	5.2 x 10 <sup>4</sup> psi
	Tensile Strength (ASTM C-307)	2200 psi
	Working Time	15 min @ 70°F
	Over coat time	3 hours @ 70°F

2.7	<u>Properties</u>	<u>SewerGard No. 210T</u>
	Application time	
	Working time - 70°F (ASTM C-308 modified)	40-50 minutes
	Initial set time - 70°F (ASTM C-308 modified)	17 hours
	Bond strength to dry or damp concrete manhole (ASTM C-478)	Concrete Failure
	Compressive strength (ASTM C-579)	7300 psi
	Flexural strength (ASTM C-580)	4900 psi
	Modulus of elasticity (ASTM C-580)	2.75 x 10 <sup>5</sup> psi
	Tensile strength (ASTM C-307)	2000 psi
	Thermal exp. coefficient	3.5 x 10 <sup>-5</sup> in/in/°F

2.8	<u>Properties</u>	<u>Sewer Gard-Rotary Spray No. 210RS</u>
	Components	3 Parts
	Application time- 70°F (ASTM C-308 modified)	
	Working time	30 minutes
	Initial set time	17 hours
	Compressive strength (ASTM C-579)	6800 psi
	Flexural strength (ASTM C-580)	4600 psi

Modulus of elasticity (ASTM C-580)	5.5 x 10 <sup>5</sup> psi
Tensile strength (ASTM C-307)	2500 psi
Bond strength to dry or damp concrete manhole (ASTM C-478) -	Concrete Failure
Thickness	125 mils
Thermal exp. coefficient	38.0 x 10 <sup>-6</sup>

2.9 Properties No. 210S

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Application time	
Working time - 70°F (ASTM C-308 modified)	30 minutes
Initial set time - 70°F (ASTM C-308 modified)	17 hours
Bond strength to dry or damp concrete manhole (ASTM C-478)	Concrete Failure
Compressive strength (ASTM C-579)	6800 psi
Flexural strength (ASTM C-580)	4600 psi
Modulus of elasticity (ASTM C-580)	5.5 x 10 <sup>5</sup> psi
Tensile strength (ASTM C-307)	2500 psi
Thermal exp. coefficient	38.0 x 10 <sup>-6</sup> in/in/°F

### 3.0 WORK AREA CONDITIONS

- 3.1 Temperature of Working Area - Optimum temperature for handling and applying the materials is 65-80°F. Store material within the 65° to 80°F range for 48 hours prior to use. At material temperatures below 65°F, the application becomes more difficult and curing is retarded. Above 85°F material working time is reduced.

Once SewerGard products are applied to surfaces, they will cure at temperatures as low as 50°F; although curing is retarded, typical properties of the fully cured material are not affected. The material can be applied to surfaces as warm as 90°F; however, increased temperatures will decrease working time of the material.

Application in direct sunlight and/or with rising surface temperatures may result in blistering of the materials due to expansion of entrapped air or moisture in the concrete.

Concrete surfaces that have been in direct sunlight must be shaded for 24 hours prior to application and remain shaded until the initial set has taken place. When the surface temperatures are rising, it may be necessary to postpone the application or apply during the cooler evening hours.

## 3.2 Surface Preparation

- 3.2.1 All structures to receive Sauereisen products must be properly designed and capable of withstanding imposed loads. Surfaces must be examined to see that they are free of laitance, dust, loose particles, oils, grease, chemical contaminants and previously applied paints or protective coatings.

Concrete surfaces that have been cured with conventional curing compounds or are contaminated with form oils or grease must be chemically cleaned or scarified to remove the contaminants prior to abrasive blasting or hydroblasting.

Suitably finished concrete must have a uniform surface texture, exposing fine aggregate and resembling coarse sandpaper. If surface texture is not uniform in appearance, repeat abrasive blasting or hydroblasting until the desired surface is obtained. Hydroblasting at a minimum 4000 psi is the recommended method of surface preparation.

All voids, holes, rough or irregular concrete in excess of 1/8" deep should be filled with Sauereisen No. F-120 Trowelable, presenting a uniform surface with existing concrete. The same irregular surfaces that are less than 1/8" should be filled with Sauereisen No. 209. For those areas that exceed 1/2" of deterioration or where troweling would be cost prohibitive, No.F-121 Resurfacer, Underlayment No. F-120 Castable or Gunite grade are recommended depending on the preferred method of application.

- 3.2.2 New Concrete - Concrete receiving Sauereisen Sewergard monolithics must have sufficient strengths to support curing of material. Fill in wormholes with No. 209.
- 3.2.3 Old Concrete - Abrasive or hydroblast concrete to achieve hard firm surface. Concrete should then be detergent washed to remove all oil, grease and other contaminants. All active hydrostatic leaks must be stopped by use of an appropriate Sauereisen water stop, waterproofing, or urethane grout. All structural defects, voids, or cracks in substrate must be repaired prior to Sewergard application. Fill all defects and voids as outlined in 3.2.1.

- 3.2.3.1 Consult Sauereisen for reinforcing details when concrete restoration exceeds 1".
- 3.2.4 Brick Manholes - All oil, grease, chemicals and paints or protective coatings must be removed from the brick by chemical or detergent cleaning prior to hydroblasting or abrasive blasting. All foreign particles and attacked or unsound mortar should be removed from the joints. Loose brickwork and voids in the mortar joints should be regouted with F-120 or F-121 to ensure structural integrity of the manhole and all active hydrostatic leaks must be stopped prior to Sewergard application.

### 3.3 Stopping Active Leaks

After surface cleaning, all visible leaks must be sealed using Sauereisen

InstaPlug No. F-180, No. F-370 Chemical Grout or No.F-190 H2OPRUF.

- 3.3.1 No.F-180 - Is a rapid setting hydraulic water plug for sealing active water leaks, filling small voids and special anchoring applications.

Prior to placing the InstaPlug No. F-180 provide a mechanical key by undercutting an abrupt edge completely around the area to be plugged or patched.

- 3.3.2 No.F-370 -Is used to stop water leaks coming through cracked or honey-combed concrete, voids, expansion joints and pipe intrusions.

No. F-370 thickens in cooler weather and will react to moisture more rapidly in hot weather, including atmospheric moisture. **Material freezes at 40°F; do not allow material to freeze.** If No. F-370 freezes, warm to 70-80°F and stir thoroughly to reconstitute. Do not allow material to come into contact with temperature in excess of 175°F.

- 3.3.3 No.F-190 - Is a two component material for use on concrete or masonry structures to prevent water seepage through the substrate.

## 4.0 APPLICATION

### 4.1 Sauereisen No. F-180 - InstaPlug

- 4.1.1 Mixing - Mix only as much material as can be mixed and applied in 15 seconds. The mixing ratio is three (3) parts Powder to one (1)

part Potable Water by volume. Place potable water in a clean, dry, mixing container. To the potable water then add all of the powder portion at one time. Mix with a gloved hand until a uniform putty consistency is achieved.

- 4.1.2 Installation - As the mortar becomes a plastic consistency, immediately force the material firmly into the prepared area. If running water is present, the material must be held in place until the leak stops and initial set has taken place.

#### 4.2 Sauereisen No. F-190 - H2O Pruf

- 4.2.1 Mixing - Mixing should be done mechanically with a slow speed, paddle type mortar mixer or a drill motor with a "Jiffy" type blade. Place 5 quarts of potable water in a clean mixing container. Vigorously shake the 16-ounce container of inorganic copolymer admixture and add to the mixing water. Mix this solution well. Slowly add the powder and mix for three minutes to achieve a uniform slurry. For spraying or higher temperatures, add up to an additional quart of cold water. To ensure maximum adhesion substrate must be saturated with water prior to placement of H2OPruf No. F-190.

Using a masonry brush liberally apply and work the first coat into the surface to a thickness of 1/16" (63 mils). After the first coat has taken an initial set, (min. 1-1/2 hours depending on temperature) the second coat can then be applied at the same thickness.

For spray application, apply a uniform coat to a minimum thickness of 1/8" (125 mils). The total thickness is not to be greater than 1/4". Immediately use a masons brush to produce a more uniform finish.

The following equipment is typically used for spray application:

RFI model No. RS - 45 peristaltic pump.

Material hose shall be 3/4" I.D. rated at 6,000 psi minimum. Gun shall be of pump manufacturer's recommendation with a minimum 1/8" orifice. Attach the material supply hose directly to the pump outlet. No screens, filters or surge tanks shall be used between the pump and nozzle.

#### 4.3 Sauereisen No. F-370 Hydroactive Polyurethane Grout

- 4.3.1 Mixing - Open the pail of resin and slowly stir in the pint of catalyst. If using an electric paddle mixer, use slow speed to avoid whipping

air, which contains moisture, into the grout. The grout may begin to react if too much moisture contaminates the mixture.

It is rare that more than one pint of catalyst is needed for each 5-gallon pail of resin. It is best to use less than a pint and then increase depending on need. When in doubt, under catalyze approximately 10%.

Mix only the amount of material that can be used within eight hours. If thickening occurs, Sauereisen Pump Flush can be added to return the material to its original viscosity (no more than 10% by volume).

It is normal for a thin crust to develop on the surface of the material, removal is not required. This crust is formed as a result of moisture in the air. Simply pump the material underneath the crust. Do not use the crusted material.

#### 4.3.2 Installation

##### 4.3.2.1 Injection Packers

Injection Packers should be placed in predrilled holes at strategic locations to ensure complete injection of the No. F-370. Consult Sauereisen for recommendations.

4.3.2.2 No. F-370 - Flush the pump and all lines with Pump Flush prior to pumping the No. F-370 to remove all traces of water and other contaminants. Do not add this contaminated material to the No. F-370. Pump No. F-370 into or behind fissures or voids to block infiltration and/or exfiltration. No. F-370 is pumped through preplaced injection packers (available from Sauereisen). Pumping equipment must be capable of attaining 250 psi, but most projects will require at least 1,000 psi.

Pump the No. F-370 for a short time and wait for the material to flow into all of the cracks and crevices under its own pressure. This will eliminate material waste and will prevent surrounding areas from exposure to traveling material.

Watch for material flow to appear in the surface cracks, and for water leak to slow. After the material stops moving, drill another hole near the end of the material vein. It is

desirable, although not necessary, that the No. F-370 be injected into active leaks.

No. F-370 reacts with water to generate its expansion. "Dry" concrete does contain enough moisture to allow the No. F-370 to cure, although set times will be greatly extended.

If very fast set times are required, for example, in a gushing leak, additional catalyst may be added to the base resin. Addition of extra catalyst will significantly reduce pot life. A 1:1 ratio will catalyze almost instantaneously. This rich mix is only recommended when using a two component pump. When using more than one pint of catalyst, test in a separate container to determine pot life.

As the job progresses, return at least twice to previously injected ports and reinject with more grout. This procedure aids in getting a denser resin into all sections of the void. Sauereisen recommends injecting each port three separate times.

After completion of grouting, the injection packers may be cut off flush with the concrete surface or left in place.

If the grout is to be exposed to ultraviolet light, i.e. sunlight, it is recommended that it be topcoated within 24 hours with an ultraviolet resistant coating compatible with urethanes.

#### 4.4 Sauereisen No.F-120 Trowel Grade

- 4.4.1 Mixing and Coverage - The No. F-120 Powder is mixed with potable water. The mixing ratio is 9.0 parts No. F-120 Powder to 1 part clean, potable water, by weight. Consult Sauereisen for mix ratio and procedures on the No. F-120 Castable and Gunite.
- 4.4.2 Pour the entire amount of potable water into the mixing container and add the powder slowly, mixing continuously to reduce the potential for entrapped air. Mix slowly and thoroughly for a minimum of 5 minutes until a uniform consistency is achieved. Addition of more water will decrease the physical properties that are desired.
- 4.4.3 The following coverage rates do not take into consideration material losses, wastage during application, or normal density variations:



COVERAGES CHART - NO.F-120	
TROWELABLE	
<u>THICKNESS</u>	<u>AMOUNT REQUIRED/SQ. FT.</u>
1"	11.25 lbs.

4.4.4 Application – Apply F-120 by trowel to pre-dampened surface. Allow to cure 5 hours before topcoating with Sewergard systems.

#### 4.5 Sauereisen No. F-121 Substrate Repair/ Waterproofer

4.5.1 Mixing should be done mechanically with a slow speed mortar mixer or drill motor with a “Jiffy” type-mixing blade to obtain a uniform consistency. The mixing equipment must be clean and free of contaminants.

4.5.2 Mix only as much SubstrateResurfacer as can be sprayed in 15-20 minutes.

Place 4 quarts of potable water in a clean mixing container. Slowly add one 50-lb. bag of SubstrateResurfacer No. F-121 Powder and mix for three minutes to achieve a uniform slurry. Do not retemper by adding more water and remixing. Material that has hardened due to delay in placing must be discarded.

#### 4.5.3 Installation

Using the RFI Material Pump MH100 or other suitable pump, apply a uniform coat of Substrate Resurfacer No. F-121 to a minimum of 1/8 inch or maximum thickness of 1/2 inch in a single pass. With larger pumps greater thicknesses may be achieved in a single pass. F-121 may also be applied using a straight shot nozzle for applications that exceed the capacity of the spinning nozzle typically used in manhole restoration.

#### 4.6 Sauereisen No.209

4.6.1 Mixing - Add contents of Hardener to Liquid and mix with a slow speed paddle or "Jiffy" mixer for 1 minute until thoroughly blended. Add the Powder gradually while mixing with same slow speed mixer to obtain a uniform consistency.

Mix only complete batches. Material which has begun to set must be discarded. Do not try to retemper the material.

- 4.6.2 Installation - To maximize working time, spread mixed No.209 onto a plasterer's hawk upon completion of the mixing. Apply No.209 to concrete with a smooth plasterer's rubber float. After application excess material must be removed by using the edge of the float or squeegee.

#### 4.7 Sauereisen No.210T

- 4.7.1 No. 210T is packaged in a premeasured unit consisting of Resin, Hardener and Powder.

- A. Remix both Liquid and Hardener prior to combining components.
- B. Empty contents of the Liquid into a clean, dry mixing container. Empty contents of Hardener into Liquid and mix thoroughly until blended for at least one minute.
- C. Add Powder component gradually while mixing to a uniform consistency.
- D. Mix only complete batches. Material which has begun to set must be discarded. Do not try to retemper the material. Do not add solvent, additive or adulterant to any component or mixed material. Use mixed material immediately.

- 4.7.2 Installation - SewerGard No. 210T is applied by trowel at a minimum 1/8 inch thickness.

Theoretical coverage is 44ft<sup>2</sup> per unit at 1/8" thickness. Coverage is theoretical and will vary depending upon jobsite conditions. Screed bars may be used to control thickness on large surface areas.

To provide a pin-hole free surface and removal of trowel marks in No. 210, a short-nap mohair paint roller slightly dampened with water may be used. Excess water should be shaken off prior to use.

After No. 210 has achieved a hardened surface, a holiday detector should be utilized to ensure a continuous pinhole-free lining. A Sauereisen SewerGard Patch Kit may be used to conveniently repair any pinholes. Consult Sauereisen for details.

For details regarding construction joints, protrusions or penetrations through concrete, consult Sauereisen for specific recommendations.

#### 4.8 Sauereisen No. 210RS

4.8.1 Mixing - No. 210RS is packaged in a premeasured container consisting of Resin, Hardener and Powder. Mixing should be done mechanically with a "Jiffy " mixer blade chucked in to drill motor. The mixing equipment must be clean and free of Portland cement or other contaminants.

Remix contents of SewerGard-Rotary Spray Resin and SewerGard-Rotary Spray Hardener components by shaking. Then add the Hardener to Resin in a clean mixing vessel and mix for a minimum of 1 minute until thoroughly blended.

Add SewerGard Powder component gradually while mixing to a uniform consistency.

Mix only complete batches. Material, which has begun to set, must be discarded. Do not try to retemper the material. Do not add solvent, additive or adulterant to any component or mixed material.

Remove the entire batch from the mixer when mixing is completed to prevent build-up in the equipment. While using one batch, another should be mixed in order to eliminate delays and to permit continuous operation.

4.8.2 Installation - SewerGard-Rotary Spray No. 210RS is then fed through a specialized pump and nozzle by RFI Construction Products as detailed and applied at a thickness of 60 –125 mils in a single pass.

#### 4.9 Sauereisen No.210S

4.9.1 Mixing - No.210S is packaged in a premeasured, container consisting of Liquid and Hardener.

A. Remix contents of Liquid component for a minimum of 2 minutes with a slow speed paddle or "Jiffy" mixer.

- B. Remix contents of the Hardener by shaking then add to Liquid and mix for a minimum of 3 minutes until thoroughly blended.
- C. Mix only complete batches. Material which has begun to set must be discarded. Do not try to retemper the material.

4.9.2 Installation - Sewergard No. 210S is applied by spray method to a thickness of 60 mils.

Theoretical coverage is 90ft<sup>2</sup> per unit at 60 mil thickness.

Coverage is theoretical and will vary depending upon surface conditions, porosity, application techniques and project specifics. Consult Sauereisen Application Parameters sheet that accompanies the material for specifics on spraying fiber filled systems

The following equipment is typically used for spray application of No.210S:

- A. Mastic pump - Graco 45:1 King, Model 224-618. Remove filter from surge tank. Remove cage above lower ball valve located near "foot" (lower end) of pump. Replace siphon tube from the material inlet with a 8" long 1 1/2" nipple. Other pumps may be suitable, depending on jobsite requirements.
- B. Gun - Graco Pistol-Grip Flo Gun, Model 224-991 without a diffuser.
- C. Gun tip - Graco Reverse-a-Clean™ housing part No. 222-674 with 0.039" orifice, Model GHD-539. The diffuser(if present) should be removed prior to use.
- D. Material hose - 6' whip end, 3/8" i.d.; working pressure 5,000 psi, 16,000 psi burst.
- E. Material hose - 0-25' overall, 1/2" i.d.; working pressure 4,000 psi, 16,000 psi burst.
- F. Material hose - 25-75' overall, 3/4" i.d.; working pressure 4,000 psi, 12,000 psi burst.
- G. Air compressor - 180ft<sup>3</sup> per minute at 100 psi, minimum.
- H. Air hose from compressor - 3/4" to 1" i.d.: 100' maximum length to mastic pump.

## 5.0 CLEAN-UP

- 5.1 No. F-180 - All equipment must be cleaned immediately after use with water. A stiff brush may be required to remove set material.
- 5.2 No. F-190 - All equipment should be cleaned by scrubbing with a stiff brush and water at the end of each working period or when build-up becomes pronounced.
- 5.3 No. F-370 - All tools should be cleaned with Acetone or MEK before final set of the materials.
- 5.4 No.F-120 /121 - All equipment should be cleaned by scrubbing with a stiff brush and water at the end of each working period or when buildup becomes pronounced.
- 5.5 No.209/210T, 210RS, 210S - All equipment should be cleaned with MEK before material cures.

## 6.0 SETTING/CURING

- 6.1 No. F-180 - **Immediately** after applying, use a steel trowel to trim the plug. After approximately 2 minutes, the material will be set too hard to allow trimming. Give a moist cure. Cures to a hard cementitious state in 60-90 seconds. Final set is in 1 hour. After 90 seconds, No. F-190 may be applied or after 1 hour, No. 89 may be applied over the No. F-180.
- 6.2 No. F-190 - Give the No. F-190 a brush coat finish using a masonry brush. Give a moist cure. Cure with water spray or moist burlap after No. F-190 has cured firm to the touch. Do not over wet, merely keep damp.
- 6.3 No. F-370 - Requires no finishing. Cures within 3-5 minutes after contact with water. No special curing procedures are required.
- 6.4 No.F-120/121 - Must be properly cured by means of fog spray, wet burlap, or appropriate Sauereisen curing compound. Application of a chemical-resistant lining may proceed after 7 hours at 70°F. If topcoating time exceeds 24 hours, then brush finish surface before initial set of No.F-120/121. Consult Sauereisen for cure recommendation if special conditions exist.

- 6.5 No.209 - Working time of fifteen (15) minutes at 70°F. The material takes an initial set in 3 hours. For temperatures below 70°F, working time and set time are lengthened. Filler Compound No.209 can be topcoated after three (3) hours.
- 6.6 No. 210T - SewerGard No. 210 will take an initial set in 17 hours at 70°F. Do not allow water or chemicals on the material surface for a minimum of 24 hours. For temperatures below 70°F, cure a minimum of 48 hours prior to water or chemical exposure.
- 6.7 SewerGard Rotary Spray No. 210RS - Do not allow flowing water or chemicals on the No. 210RS for a minimum of 24 hours at 50°F.
- 6.8 No. 210S - Do not allow flowing water or chemicals on the No. 210S for a minimum of 24 hours at 70°F. For temperatures below 70°F, cure a minimum of 48 hours prior to flowing water or chemical exposure.

## **7.0 PACKAGING**

- 7.1 No. F-180 – InstaPlug No. F-180 is packaged in a 50-lb. Pail.
- 7.2 No. F-190 – H<sub>2</sub>OPruf No. F-190 is packaged as a 52-lb. unit consisting of (1) 50 lb. bag of Powder and (1) 16 oz. Bottle of Liquid.
- 7.3 No. F-370 – Hydroactive Polyurethane Grout No. F-370 is packaged as follows:
- No. F-370 – 5-gal. Pail of Part A Resin  
- 1 pint can of Part B Catalyst
- Pump Flush – 5-gal. pail
- Extra Catalyst – 1 pint can
- Packer Injection Nozzles – packaged per order requirements.
- 7.4 No.F-120/121 - Nos.F-120/121are packaged in 50 lb. moisture-resistant bags.
- 7.5 No.209 - Filler Compound No.209 is packaged in a 5 lb. unit pail.
- 7.6 No. 210T - SewerGard No. 210T is packaged in premeasured unit. The 53.3 lb. unit contains a 1-gal. can of Hardener Part A, a 2-gal. bucket of Resin Part B, and a 40 lb. bag of Powder Part C.

- 7.7 SewerGard-Rotary Spray No. 210RS – SewerGard No. 210RS is packaged in a premeasured container consisting of SewerGard-Rotary Spray No. F-210RS Powder, Liquid and Hardener. It is a 59 lb. Unit consisting of:

Resin: 14.4 lbs. in a 2 – gallon bucket  
Hardener: 4.6 lbs. in a 1 – gallon bucket  
Filler: 40.0 lbs. in paper or plastic

- 7.8 No. 210S - Sewergard No. 210S is packaged in a premeasured, container consisting of Liquid and Hardener. No. 210S Liquid is packaged in a 6 gal. container and the No. 210S Hardener is packaged in a 1 gal. container.

## **8.0 SHELF LIFE**

- 8.1 No. F-180 - InstaPlug No. F-180 has a shelf life of six (6) months when stored unopened in a dry location at 70°F.
- 8.2 No. F-190 - H<sub>2</sub>OPruf No. F-190 has a shelf life of one (1) year when stored unopened in a dry location at 70°F.
- 8.3 No. F-370 – Hydroactive Polyurethane Grout No. F-370 has a shelf life of one (1) year when stored unopened in a dry location at 70°F.
- 8.4 No.F-120 - Underlayment No.F-120 has a shelf life of six (6) months when stored unopened in a dry location at 70°F.
- 8.5 No.209 - Filler Compound No.209 has a shelf life of one (1) year when stored in unopened, tightly sealed containers in a dry location at 70°F.
- 8.6 No.210T, RS and S - SewerGard No. 210 Resin, Powder and Hardener have a shelf life of one (1) year when stored in unopened, tightly sealed containers in a dry location at 70°F .

## **9. CAUTION**

- 9.1 Consult Sauereisen product Material Safety Data Sheets and container label Caution statements for any hazards in handling this material.

## 10. Prequalification

10.1 Sauereisen requires that all installing contractors of Sauereisen products be pre-approved and or pre-qualified prior to installation of Sauereisen products. Consult Sauereisen for details.

## 11. Inspections

11.1 As required by the engineer the manufacturer or manufacturer's representative may be required to perform periodic inspections. The cost of these inspections shall be borne by the contractor in accordance with manufacturer's published rates for inspection personnel, including transportation and per diem costs.

## 10. WARRANTY

1. **The contractor shall submit a written warranty for all labor, materials for a period of 5 years from project acceptance for the entire system. In the event of a failure of the system the contractor shall bear all responsibility and costs for repair of the system in accordance with the manufacturers recommendations. These recommendations are to be reviewed and approved by the owner. The contractor shall make all repairs within 30 days of notification at no cost to the owner.**
2. **In addition a supplemental written renewable two year guarantee/warranty of all station bypassing and all other incidental costs for the rehabilitation must be submitted by the contractors bonding/surety company. No warranty shall be prorated but shall cover all costs. This warranty shall be renewed by the contractor for a period of 5 years.**

## **TNEMEC CONCRETE REPAIR AND PROTECTION SYSTEM**

### **TYPICAL SPECIFICATION**

**TO RESTORE AND/ OR PROTECT WET WELLS AND OTHER INFRASTRUCTURE  
USING MortarClad Series 218, MortarCast Series 219, ChemBloc Series 434 H2S and ChemGel  
Series 435**

## PART 1--GENERAL

### 1.01 DESCRIPTION:



This section covers all workmanship, materials and quality requirements for concrete resurfacing work. Provide and apply resinous (epoxy) resurfacing materials as specified and as indicated on drawings.

1.02 RELATED WORK:

- A. Division 1 – General Requirements
- B. Section 01300 – Submittals
- C. Section 07150 – Sealants

1.03 REFERENCES:

This section contains references to the documents listed below. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Referenced publications found within this specification shall be the latest revision unless otherwise specified; and applicable parts of the referenced publications shall become a part of this specification as if fully included.

Reference	Title
<b>ASTM (American Society for Testing and Materials)</b>	
ASTM C 920	Specification for Elastomeric Joint Sealants.
ASTM D 3960	Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D 4259	Practice for Abrading Concrete.
ASTM E 337	Standard Practice Test Method for Measuring Humidity with a Psychrometer.
ASTM F 710	Practice for Preparing Concrete Floors and Other Monolithic Surfaces to Receive Resilient Flooring

Reference	Title
<b>FEDERAL STANDARD COLORS</b>	
F 595 B	Federal Standard Colors
Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
<b>ICRI (International Concrete Restoration Institute)</b>	
Guideline No. 03732 Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
<b>NACE (National Association of Corrosion Engineers)</b>	
NACE Publication 6D-173	"A Manual for Painter Safety"
NACE Publication 6G-164	"Surface Preparation Abrasives for Industrial Maintenance Painting"
NACE Publication 6G-164	"Surface Preparation Abrasives for Industrial Maintenance Painting"
NACE Publication TPC2	Coatings and Linings for Immersion Service: Chapter 1 Safety, Chapter Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
NACE Publication 6F-163	"Surface Preparation of Steel or Concrete Tank Interiors."
NACE RP0892-92	Standard Recommended Practice, Lining over Concrete in Immersion Service.
NACE RP0288-88	Standard Recommended Practice, Inspection of Linings on Steel and Concrete.
<b>SSPC (Steel Structures Painting Council)</b>	

Reference	Title
SSPC-SP12	Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultrahigh Pressure Water Jetting Prior to Recoating.
SSPC-SP13	Surface Preparation of Concrete
SSPC-PA-3	"A Guide to Safety in Paint Application"
SSPC-Guide 12	Guide for Illumination of Industrial Painting Project.
<b>OSHA (Occupational Safety &amp; Health Administration.)</b>	
1915.35	Standards – 29 CFR – Painting.
<b>ANSI (American National Standards Institute)</b>	
ANSI/ASC 29.4 Exhaust Systems	Abrasive Blasting Operations – Ventilation and Safe Practice

#### 1.04 QUALITY ASSURANCE

##### REQUIREMENTS:

1. Do not use or retain contaminated, outdated, or diluted materials for resurfacing. Do not use materials from previously opened containers.
2. Use only products of the approved Manufacturer. Use products of one manufacturer in any one resurfacing system with compatible materials. Provide same material product for touch-up as for original material.
3. If any requirements of this specification conflict with a referenced standard, the more stringent requirement shall apply.
4. Make available all locations and phases of the work for access by the Engineer or other personnel designated by the Engineer. The Contractor shall provide ventilation and egress to safely access the coating work areas for inspection.
5. Conduct work so that the resurfacing system is installed as specified herein. Inspect work continually to ensure that the resurfacing system is installed as specified herein. The Contractor shall inspect the work to determine conformance with the specifications and referenced documents.

The Contractor shall inform the Engineer of the progress and the quality of the work through daily reports as specified below. Any nonconforming coating system work shall be corrected as specified herein or as recommended by the Manufacturer.

6. Summarize test data, work progress, areas covered, ambient conditions, quality control inspection test findings, and other information pertinent to the resurfacing system installation in daily reports to be submitted to the Engineer or the Engineer's Representative.
7. The methods of construction shall be in accordance with all requirements of this specification.
8. Employ only tradespeople who have at least **five years** of experience performing resurfacing work of similar size and complexity as the work specified in this Section. Submittals to verify these qualifications are to be made within thirty (30) days of the Notice-to-Proceed and are subject to approval by the Engineer

#### 1.05 SUBMITTALS

- A. Submit the following prior to commencing with any phase of the work covered by this Section:
  1. Manufacturer's current printed recommendations and product data sheets for all coating system products supplied under this section including performance criteria, surface preparation and applications, volatile organic compound (V.O.C.) data, and safety requirements.
  2. Material Safety Data Sheets (MSDS) for any materials brought on-site including all resurfacing system materials, solvents, and abrasive blast media.
  3. Storage requirements including temperature, humidity, and ventilation for resurfacing system materials.
  4. Manufacturer's requirements, including application procedures for resurfacing materials shall be in writing and shall be followed in detail. All safety precautions recommended by the Manufacturer shall be strictly adhered to at all times when work is in progress.
  5. Color samples for all surfaces to be resurfaced that have been field-matched to existing colors.

6. Submit applicators' certification that resurfacing materials comply with Federal, State, and Local regulations for VOC (Volatile Organic Compounds).
7. Submit daily reports that contain the following information: Substrate conditions, ambient conditions, application procedures, work completed and location thereof. Mark-up drawings that show location of work.
8. Submit letter(s) with associated product data signed by Manufacturer certifying that submitted products are suitable for application on the surfaces to be resurfaced and for the service conditions.
9. Submit manufacturer's five-year material warranty for the concrete repair and protection system.

#### 1.06 DELIVERY AND STORAGE

Materials shall be stored in accordance with Manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life recommended by the manufacturer shall be removed from the site.

- A. Store all materials only in area or areas designated by the Engineer solely for this purpose. Confine mixing, thinning, clean-up and associated operations, and storage of materials-related debris before authorized disposal, to these areas. All materials are to be stored on pallets or similar storage/handling skids off the ground in sheltered areas in which the temperature is maintained between 50°F and 90°F.
- B. Mix all resurfacing materials in an enclosed mixing area designated by the Engineer. This enclosed area must protect the mixing operation and materials from direct sunlight, inclement weather, freezing, or other means of damage or contamination. Protect all other concrete and metallic surfaces and finishes from any spillage of material(s) within the mixing area.
- C. Do not use floor drains, dikes or storm drains for disposal of resurfacing system materials.
- D. The Contractor shall take all precautions and implement all measures necessary to avert potential hazards associated with the resurfacing system materials as described on the pertinent Material Safety Data Sheets or container labels.
- E. Deliver all materials to the job site in their original, unopened containers. Each container shall bear the Manufacturer's name and label.
  1. Labels on all material containers must show the following information:

- a. Name or title of product.
  - b. Federal Specification Number if applicable.
  - c. Manufacturer's batch number and date of manufacture.
  - d. Manufacturer's name.
  - e. Generic type of material.
  - f. Application and mixing instructions.
  - g. Hazardous material identification label.
  - h. Shelf life date.
  - i. Storage requirements.
2. All containers shall be clearly marked indicating any personnel safety hazards associated with the use of or exposure to the materials.
  3. All materials shall be handled and stored to prevent damage or loss of label.
  4. The Engineer shall designate resurfacing material storage and mixing areas.
  5. Do not use or retain contaminated, outdated, prematurely opened, diluted materials, or materials which have exceeded their shelf life.

#### 1.07 COORDINATION OF WORK

##### A. WORK AREAS:

The Engineer will designate the work areas on the job site. The Contractor's personnel shall not be permitted in any area other than those expressly designated by the Engineer.

##### B. COORDINATION

The contractor shall coordinate with the Engineer regarding availability of work areas, completion times, safety, access and other factors, which can impact plant operations.

#### 1.08 SAFETY

- A. The Contractor's work forces should comply with the provisions outlined in the following documents:

SSPC-PA-3 "A Guide to Safety in Paint Application"  
NACE Pub. "A Manual for Painter Safety"

- B. The Contractor shall provide personnel with all safety equipment necessary to protect them during any phase of the work. This shall include, but not be limited to safety glasses, goggles, earplugs, hard hats, steel toed work shoes, appropriate

personal protective clothing, gloves, and plant approved escape respirators (where required).

- C. No work shall be performed until the appropriate Work Requests and lock-outs are approved by the Engineer. The Work Request system provides a mechanism to advise plant staff of a contractor's work activities. The Lockout system is a safety procedure to prevent unintended equipment activation.
- D. Keep any flammable materials such as cleaning solvents, thinners, or resurfacing materials away from open flames, sparks or temperatures higher than 150°F. Drums containing flammable materials will be grounded. No solvent in any quantity shall be allowed inside containment enclosures or permitted confined spaces at any time during resurfacing work.
- E. Power tools are to be in good working order to avoid open sparking. No spark producing tools shall be utilized in restricted areas as indicated herein.
- F. The Contractor shall fireproof all work areas by maintaining a clean work area and having Underwriter's Laboratories approved fire extinguishers on-hand. The Contractor shall furnish these fire extinguishers.
- G. Workers doing abrasive blasting operations shall wear a fresh air supplied protective helmet and hood and personal protective clothing acceptable to industry standards and all government regulations.
- H. Dispose of rags used for wiping up resurfacing materials, solvents, and thinners by drenching them with water and placing in a metal container with a tight fitting metal cover. Complete this disposal process at the end of each day. Final disposal of these materials is the Contractor's responsibility.
- I. Matches, smoking, flames, or sparks resulting from any source including welding, must be remote from the work area during coating work. Smoking is permitted only in designated areas of the plant.

#### 1.10 JOB CONDITIONS:

- A. **See project plans for level of wetwell deterioration.**

### PART 2 -- PRODUCTS

#### 2.01 MANUFACTURERS

- A. Materials specified are those that have been evaluated for the specific service. Products of the Tnemec Company, Inc. are listed to establish a standard of quality. Equivalent materials of other manufacturer's may be submitted on written approval of the Engineer. As part of the proof of equality, the Engineer will require at the

cost of the Contractor, certified test reports from a nationally known, reputable and independent testing laboratory conducting comparative tests as directed by the Engineer between the product specified and the requested substitution.

- B. Requests for substitution shall include manufacturer's literature for each product giving name, product number, and generic type, descriptive information, solids by volume, recommended dry film thickness and certified lab test reports showing results to equal the performance criteria of the products specified herein. In addition, a list of five projects shall be submitted in which each product has been used and rendered satisfactory service.
- C. All requests for product substitution shall be made at least 10 days prior to the bid date.
- D. Any material savings shall be passed to the owner in the form of a contract dollar reduction.

## 2.02 MATERIALS

### A. EPOXY LINING SYSTEM

- 1. Materials specified herein are the only approved standard coating systems .
- 2. The following list specifies the material requirements for resurfacing systems. The approved products are as follows:
  - a. Surfacer : MortarClad – Series 218
  - b. Mortar : MortarCast – Series 219
  - c. Lining: Chembloc – Series 434 H2S
  - d. Topcoat/gelcoat: ChemGel – Series 435

### B. SEALANTS

Refer to Section 07150.

### C. ABRASIVE BLAST MEDIA

If dry or wet abrasive blast cleaning is the selected method of surface preparation, provide slag grit of a sieve size, gradation, and quality necessary to produce the degree of cleanliness and surface profile required herein.

## PART 3--EXECUTION



### 3.01 GENERAL

#### A. HOISTING, SCAFFOLDING, STAGING, AND PLANKING:

1. Provide, set-up, and maintain all required hoists, scaffolds, and staging and planking, and perform all access related hoisting work required to complete the work of this section as indicated and specified.
2. Scaffolds shall have solid backs and floors to prevent dropping materials from there to the floors or ground below.

#### B. ENVIRONMENTAL REQUIREMENTS:

1. Comply with the Manufacturer's recommendations as to environmental conditions under which resurfacing system materials can be applied.
2. Do not apply resurfacing system materials when dust is in work site.
3. The Contractor shall provide all temporary lighting during the work.

#### C. PROTECTION:

1. Cover or otherwise protect finish work or other surfaces not being resurfaced.
2. Erect and maintain protective tarps, enclosures and/or maskings to contain debris (such as dust or airborne particles resulting from surface preparation) generated during any and all work activities. This includes, but is not limited to, the use of dust/debris collection apparatus as required.

#### D. INITIAL INSPECTION OF SURFACES TO BE COATED:

It is the responsibility of the Contractor to inspect and report unacceptable concrete substrate surface conditions to the Engineer prior to the commencement of surface preparation activities. Unacceptable surface conditions are defined as the presence of cracked surfaces or concrete deteriorated to a depth of greater than 1" or otherwise unable to withstand surface preparation as specified herein.

#### E. THINNERS AND SOLVENTS:

The Contractor shall use only solvents and thinners as recommended by the Manufacturer.

### 3.02 SURFACE PREPARATION REQUIREMENTS

#### A. GENERAL:

1. All specified surface preparation shall be performed in accordance with the latest version of the SSPC, NACE, ICRI and other standards referenced in this section.
2. Concrete surfaces shall be abraded to produce a minimum surface profile of equal to 40 grit sandpaper with no loose concrete remaining. This preparation will be followed by vacuum cleaning to remove all dust, dirt or friable substances leaving clean, dust free surfaces for resurfacing.
3. Oil and grease shall be removed before mechanical cleaning is started via an alkaline-based emulsifying detergent as recommended by the resurfacing material manufacturer. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free of contaminants that might interfere with the adhesion of the resurfacing materials.
4. The air used for blast cleaning shall be free of oil and moisture to not cause contamination of the surfaces to be resurfaced.
5. Clean cloths and clean fluids shall be used in solvent cleaning.
6. Cleaning and resurfacing shall be scheduled so that dust and other contaminants from the cleaning process will not fall on wet, newly resurfaced areas.
7. Prepare concrete joint and install sealant following resurfacing material installation per Section 07150.

**B. INITIAL CLEANING/DECONTAMINATION:**

1. All existing areas to be resurfaced shall be pressure washed with alkaline –based detergent to remove all loose materials, acid constituents, grease, oil, and other contaminants.
2. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 9 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

**C. ABRASIVE BLAST CLEANING**

1. Used or spent blast abrasive shall not be reused on work covered by this section.
2. The compressed air used for blast cleaning will be filtered free of condensed water or oil. Moisture traps will be cleaned at least once every four hours or more frequently as is appropriate.

3. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. Oil separators shall be cleaned at least once every four hours or more frequently as is appropriate.
4. The Contractor shall perform a paper blotter test when requested by the Engineer or the Engineer's representative to determine if the air is sufficiently free of oil and moisture.
5. Regulators, gauges, filters, and separators will be in good working order for all of the compressor air lines to blasting nozzles at all times during this work.
6. An air dryer or drying unit shall be installed which dries the compressed air prior to blast connections. This dryer shall be used and maintained for the duration of surface preparation work.
7. The quality, volume, and velocity of life support and ventilation air used during surface preparation shall be in accordance with applicable safety standards and as required to ensure adequate visibility and proper dissipation of volatiles without impacting the prepared surface or the health of the public or personnel working for the Contractor, Subcontractors, Engineer, Engineer's Representatives, or anyone who may be affected by on-site maintenance coating work activities.
8. The abrasive blast nozzles used shall be the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and the necessary volume to obtain the required blast cleaning production rates and specified degree of cleanliness.
9. The Contractor must provide adequate ventilation for airborne particulate evacuation and lighting (meeting all pertinent safety standards) to optimize visibility for both blast cleaning and observation of the substrate during surface preparation work.
10. All phases of surface preparation work specified herein must be inspected by the Engineer before the Contractor proceeds with the subsequent phase of surface preparation.
11. If, between final surface preparation work and coating application, contamination of the prepared and cleaned substrate occurs, or if the prepared steel's appearance darkens or changes color, reblasting will be required until the specified degree of cleanliness is established.

### 3.03 SPECIFIC SURFACE PREPARATION REQUIREMENTS

- A. In addition to the Section 3.02 requirements, the Contractor will follow the requirements of this section.
- B. Where the coating is specified to be terminated, the Contractor shall prepare and apply materials as outlined in Tnemec Drawing TLS-02 (included at end of Section).
- C. For applications around penetrations and/or drains, the contractor shall prepare and apply coatings as detailed on Tnemec Drawing TLS-01 (included at end of Section).
- D. When the floor area is scheduled to receive a mortar application to pitch the floor, the walls above the floor shall be sawcut to a depth of 1/2 inch at a height from 0'-0" to 0'-6" above the floor. The cut shall be straight and level.
- E. The Contractor shall notify the Engineer should jobsite conditions prevent the above operations and/or applications.

### 3.04 APPLICATION REQUIREMENTS

#### A. GENERAL:

- 1. Areas not to be resurfaced shall be masked using duct tape or other protection materials to prevent these surfaces from being resurfaced.
- 2. Ensure straight even termination of resurfacing/topcoat materials on wall edges and flush with embedded steel.
- 3. The Contractor must follow the minimum and maximum recoat limitation times and related temperature range restrictions between successive lifts for all products specified herein per Manufacturer's stated requirements.
- 4. All equipment and procedures used for resurfacing system application shall be as recommended by the Manufacturer.
- 5. Unless specified elsewhere herein, the Contractor shall comply with the Manufacturer's most recent written instructions with respect to the following:
  - a. Mixing of All Materials.
  - b. Protection and Handling of All Materials.
  - c. Recoat Limitation and Cure Times.
  - d. Minimum Ambient and Substrate Temperatures, Substrate's Degree of Dryness, Relative Humidity, and Dew Point of Air.
  - e. Application.
  - f. Final Curing.
  - g. Use of Proper Application Equipment.

6. Curing of Resurfacing System:

The applied resurfacing system shall be protected from damage during curing and shall be cured as recommended by the Manufacturer. Ambient conditions shall be controlled by the Contractor during curing to ensure the minimum air temperature and minimum relative humidity as required by the Manufacturer is maintained.

B. PITCHING THE FLOOR:

1. Trowel apply mortar on all field areas and on lower wall from 0'-0" to 0'-6" prepared at 1/2" sawcut consistent.
2. Apply mortar in maximum 1-1/2" lifts (layers) filling deepest areas first.
3. Pitch/slope to drain.
4. Do not apply successive lifts until previous lift has cured for 12 hours minimum but not longer than 24 hours at 75° F. If 24 hours has elapsed re-scarify surfaces to receive additional resurfacing materials.

C. CHEMICAL RESISTANT LINING

1. General Note: The Contractor is advised that with all thick-film, quick curing materials applied to concrete surfaces, outgassing of the concrete can occur. Possible remedies include applying materials when the temperature of the concrete surfaces are descending, or applying a thin (1/8") layer of the specified surfacing material. Other remedies may exist, and may be submitted for the Engineer's approval.
2. Fill all voids, bugholes and other surface imperfections with Tnemec Series 218 MortarClad.
3. Apply prime coat of Tnemec Series 201 Epoxoprime to all surfaces to be coated. If material is applied by spray, material will be back-rolled to ensure adequate penetration and sealing of the surface. Schedule application of primer so that mortar will be applied within such a time as the primer has not cured hard.
4. Apply Tnemec Series 434 Chembloc chemical resistant mortar to all floor areas and walls scheduled to be coated at a nominal thickness of 125 mils. Application shall be either by trowel or spray. If spray-applied, material shall be finish-toweled to a hard, dense film.

5. Topcoat/gelcoat shall be a minimum of 15.0 mils thick upon cure regardless of the number of coats required.

C. SAFETY AND VENTILATION REQUIREMENTS:

Requirements for safety and ventilation shall be in accordance with SSPC Paint Application Guide No. 3.

3.05 FIELD QUALITY CONTROL INSPECTION AND TESTING

- A. Inspection by the Engineer or others does not limit the Contractor's responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.
- B. Perform the quality control procedures listed below in conjunction with the requirements of this Section.
  1. Inspect all materials upon receipt to ensure that all are supplied by the Manufacturer.
  2. Provide specified storage conditions for the resurfacing system materials, solvents, and abrasives.
  3. Inspect and record findings for the degree of cleanliness of substrates using. The pH of the concrete substrate will be measured using pH-indicating papers. pH testing is to be performed once every 50 sq. ft. Acceptable pH values shall be between 9.0 and 11.0 as measured by a full-range (1-12) color indicating pH paper with readable color calibrations and a scale at whole numbers (minimum). Use Hydriion Insta-Check Jumbo 0-13 or 1-12 or equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not "wipe" the surface. Compare the color indicated with the scale provided and record the pH.
  4. Inspect and record substrate profile (anchor pattern). Surfaces shall be abraded, as a minimum, equal to the roughness of 40 grit sand paper.
  5. Measure and record ambient air temperature once every two hours of each shift using a thermometer and measure and record substrate temperature once every two hours using a surface thermometer.
  6. Measure and record relative humidity every two hours of each shift using a sling psychrometer in accordance with ASTM E337.

7. Provide correct mixing of resurfacing materials in accordance with the Manufacturer's instructions.
8. Inspect and record that the "pot life" of resurfacing materials are not exceeded during installation.
9. Verify curing of the resurfacing materials in accordance with the Manufacturer's instructions.
10. Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE RP0188-90 to verify a pinhole-free surface. Voltage shall be set at 11,000 volts. Areas that do not pass the spark detection test shall be corrected at no cost to the Owner and rechecked. High voltage spark detection shall be conducted on the chemical resistant mortar before the installation of the gel coat.
11. Upon completion of the lining system installation the lined area shall be cleaned and prepared to permit close visual inspection by the Engineer or the Engineer's Representative. The Contractor at no additional cost to the Owner will mark any and all deficiencies or defective work (not in compliance with this section or related sections) for repair or removal/replacement.

### 3.07 ACCEPTANCE CRITERIA

#### A. ACCEPTANCE CRITERIA FOR SURFACE PREPARATION WORK:

All surfaces shall be prepared in accordance with the specification and referenced standards therein.

#### B. Acceptance Criteria for Coating System Application Work

1. Acceptable coating work will be based upon the following:
  - No pockmarks, trowel marks, depressions, unconsolidated areas, waviness or ridges, pinholes or holidays in either size or frequency.
  - No intercoat bond failures between lifts.
  - Proper curing of coatings.
2. Resurfaced areas shall pitch to drains.
3. There shall be no areas that puddle when flood tested.
4. The Engineer or Engineer's Representative shall, at their discretion, inspect the following:

- a. Profile and degree of cleanliness of substrate.
  - b. Thickness of materials/coverage rate confirmation.
  - c. Ambient temperature and humidity requirements and substrate temperature.
  - d. Curing and recoat times.
  - e. Proper curing of the resurfacing materials.
5. Rework required on any holidays or any other inadequacies found by the Engineer or the Engineer's representative in the quality of the coating work shall be marked. Such areas shall be recleaned and reworked by the Contractor according to these specifications and the manufacturer's recommendations at no additional cost to the Owner.
  6. The Contractor is responsible for keeping the Engineer informed of all progress so that inspection for quality can be achieved.
  7. The Contractor is ultimately responsible for the quality performance of the applied materials and workmanship. Inspections by the Engineer or the Engineer's Representative do not limit this responsibility.

### 3.08 FINAL INSPECTION

Perform a final inspection to determine whether the resurfacing system work meets the requirements of the specifications. The Engineer and the Engineer's Representative will conduct final inspection with the Contractor.

### 3.09 CLEANUP

Upon completion of work, the Contractor shall remove surplus materials, equipment, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any work-related damage. The surrounding surface areas including roadways and all other surfaces shall be restored to their pre-project condition.

### 3.10 WARRANTY

1. **The contractor shall submit a written warranty for all labor, materials for a period of 5 years from project acceptance for the entire system. In the event of a failure of the system the contractor shall bear all responsibility and costs for repair of the system in accordance with the manufacturers recommendations. These recommendations are to be reviewed and approved by the owner. The contractor shall make all repairs within 30 days of notification at no cost to the owner.**
2. **In addition a supplemental written renewable two year guarantee/warranty of all station bypassing and all other incidental costs for the rehabilitation must be submitted by the**



contractors bonding/surety company. No warranty shall be prorated but shall cover all costs. This warranty shall be renewed by the contractor for a period of 5 years.

## PERMACAST MS10,000 WITH CONSHEILD AND CORR+GARD

### TYPICAL SPECIFICATION TO RESTORE AND / OR PROTECT WET WELLS AND OTHER INFRASTRUCTURE

- 1 Intent:** It is the intent of this specification to provide for the waterproofing, sealing, structural reinforcement and corrosion protection of existing wet wells and similar underground structures by the safe, quick and economical application of a composite created from a uniform and densely compacted cementitious layer of design formulated mortar (MS 10,000 with ConSheild) and 100% solids epoxy (Corr+Gard)
- 2 General:** This specification establishes the minimum standard for material and method of application for the structural reinforcement, sealing and corrosion protection of leaking and deteriorated manholes by creating a composite from a design formulated cementitious liner and 100% solids epoxy. The cementitious liner is first applied onto the interior in one application at a thickness from 1/2 to 2 inches. The composite is then completed with the application of a 100% solids epoxy at a minimum thickness of 65 mils (.065 inches). The liner thickness is engineered for the groundwater pressures, dimensions and condition of each manhole.
- 3 Reference Specification:**
  - 3.1 ASTM C-109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
  - 3.2 ASTM C-293 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)

- 3.3 ASTM C-307 Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
- 3.4 ASTM C-469 Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
- 3.5 ASTM C-882 Standard Test Method for Bond Strength of Epoxy Systems Used with Concrete by Slant Shear
- 3.6 ASTM C-157 Modified Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
- 3.7 ASTM C-1202 (AASHTO T 277 Equivalent) Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
- 3.8 NACE RP0274 High Voltage Electrical Inspection of Pipeline Coating Prior to Installation

#### 4 **Material:**

##### 4.1 **Permacast MS-10,000 mortar**

A The material is an ultra high strength, high build, corrosion resistant mortar, based on Portland cement fortified with micro silica. When mixed with the appropriate amount of water, a paste-like material will develop which may be sprayed, cast, pumped or gravity-flowed into any area 1/2 inch and larger. This mortar will harden quickly without any need for special curing.

B The hardened binder is dense and highly impermeable. The above performance is achieved by a complex formulation of mineral, organic and densifying agents and sophisticated chemical admixtures. Graded quartz sands are used to enhance particle packing and further improve the fluidity and hardened density. The composition also possesses excellent thin-section toughness, high modulus of elasticity and is self-bonding. Fibers are added as an aid to casting, for increased cohesion and to enhance flexural strength.

C The water content may be adjusted to achieve consistencies ranging from thin motor oil to modeling clay. Despite its high fluidity, the mortar has good wet adhesion and does not sag or run after placement. The mortar may be cast against soil, metals (including aluminum and lead), wood, plastic, cardboard and other normal construction material.

##### D Physical properties

Unit Weight	125 pcf
Set Time at 70 °F ASTM C-403	
Initial Set	244 minutes
Final Set	440 minutes

Modulus of Elasticity ASTM C-469	
24 hours	180,000 psi
28 days	1,150,000 psi
Flexural Strength ASTM C-293	
24 hours	650 psi
28 days	800 psi
Compressive Strength ASTM C-109	
24 hours	3,000 psi
28 days	10,000 psi
Tensile Strength ASTM C-307	600 psi
Shear Bond ASTM C-882	>1,000 psi
Shrinkage ASTM C-157	None
Chloride Permeability ASTM C-1202	<550 Coulombs

#### 4.2 **Corrosion protection admixture – Con<sup>MIC</sup>Shield<sup>®</sup>**

- A Con<sup>MIC</sup>Shield<sup>®</sup> is a liquid admixture for concrete and mortars for the prevention of bacterial corrosion (MIC) common to concrete pipe, manholes and similar structures in municipal sewer environments. As an additive, it permeates the PERMACAST<sup>®</sup> mortar during the mixing phase and molecularly bonds to the cement particles to create an environment incompatible to the growth of harmful bacteria.
- B Con<sup>MIC</sup>Shield<sup>®</sup> becomes an integrated component of the hardened binder. It cannot wash off, delaminate or lose its effectiveness from wear. Scraping or erosion of the concrete surface only serves to expose additional material to the environment that would otherwise foster bacterial growth. As bacterial growth is neutralized, hydrogen sulfide gases released from the raw sewerage cannot be metabolized and converted into sulfuric acid in concentrations sufficient to damage the impregnated concrete and mortar.
- C This material is ideally suited for concrete used to manufacture precast pipe and manholes for use in municipal sewer environments or wherever Thiobacillus bacteria may cause microbiologically induced corrosion (MIC). Repair mortars with Con<sup>MIC</sup>Shield<sup>®</sup> subjected to concentrations of Thiobacillus bacteria in the laboratory have shown complete neutralization in just 24 hours.

#### 4.3 **Chemical protective coating – COR+GARD<sup>®</sup> Composite**

- A COR+GARD<sup>®</sup> is a two-component 100% solids epoxy design formulated for use in sewer systems. It is light green in color for enhanced visibility and may be applied robotically from the PERMACAST<sup>®</sup> patented Spincaster or by commercial paint sprayers or by brush. COR+GARD<sup>®</sup> will cure quickly, even when immersed in fresh or salt water and rapidly forms a tenacious bond to freshly

applied PERMACAST<sup>®</sup> mortars which are formulated to prevent delaminating calcium powders from forming during hydration. COR+GARD<sup>®</sup> composite produces a smooth, glossy and homogenous protective layer that is impervious to biological corrosion, water, oils and many highly corrosive chemicals.

B Once the cementitious underlayment has been applied to seal, reinforce and smooth the existing interior surface, the COR+GARD<sup>®</sup> epoxy is applied at a minimum thickness of .065 inches (65 mils) to provide a complete and uniform vapor barrier against attack by sewer gases and corrosion causing bacteria. The surface shall be free of entrapped air bubbles or holidays.

C Physical properties

Dry Time	4-6 hours @ 75 °F
Compressive Strength ASTM D-695	16,800 psi
Flexural Strength ASTM D-790	13,900 psi
Tensile Strength ASTM D-638	12,400 psi
Hardness ASTM D-2240	68-72 Shore D
Heat Distortion ASTM D-648	220 °F
Ultimate Elongation ASTM D-638	4.5 %
Adhesive Shear ASTM C-882	1,000 psi

**5 Quality Assurance and Acceptance:**

5.1 Since compressive strength correlates well to all other physical properties, ASTM C-109 is a good indicator of quality assurance in the field. Two test cubes of the PERMACAST<sup>®</sup> material may be taken randomly as directed by the inspector at owner's expense to verify strengths. Thickness can be verified with a wet gage at any random point of the new interior surface. Any areas found to be thinner than minimum tolerances shall immediately receive additional material. Visual inspection should verify a leak-free, uniform appearance.

5.2 Spark testing is an excellent test of the thickness, continuity and thoroughness of protective coatings like COR+GARD<sup>®</sup>. NACE RP0274 testing standard will detect bubble or blister type voids, cracks, thin spots, and foreign inclusions or contaminants in the coating. Any defect shall immediately receive additional material.

5.3 All work shall be performed by factory certified applicators in accordance with T&R testing voltage. The dielectric strength of COR+ GARD<sup>®</sup> requires testing at 100 volts per each mil of thickness.

- 5.4 Submit written evidence that the products used are fully-compatible and are part of a complete concrete repair and protection system from a single manufacturer.
- 5.5 Submit written proof of product manufacturer's current ISO 9000 quality-control certification.
- 5.6 Conduct pre-construction meeting with product manufacturer's representative to review application details prior to commencement of work.
- 5.7 The product manufacturer's technical representative must be available for periodic site inspections as the work progresses as directed by the owner and submit written reports to the engineer documenting field visits.

## **6 Submittals:**

- 6.1 All submittals shall conform completely to the requirements of the Contract document.
- 6.2 The following items may be required of the *installer* to be submitted to the *engineer*. This Contract shall not be considered complete until receipt and acceptance of the following:
  - A Reference submittals
    - a Contractor certification
    - b Material certification
  - B Product data
    - a Patching and plugging material
    - b Cementitious lining material
    - c Epoxy coating composite

## **7 Product handling:**

- 7.1 Special handling is not required for PERMACAST<sup>®</sup> mortar. Normal precautions for "nuisance dust" should be observed. Consult Material Safety Data Sheet for details.
- 7.2 Proper protective clothing and breathing apparatus shall be used to avoid direct contact with the liquid components of COR+GARD<sup>®</sup> composite if hand spraying or brushing COR+GARD<sup>®</sup> by man entry. Manufacturer's material safety data sheets shall be kept on site and the applicator shall ensure familiarization with these information and emergency procedures.
- 7.3 OSHA standards for confined space entry shall be strictly observed.

## 8 Product installation:

- 8.1 **Preparation:** Concrete surface preparation shall be performed in strict accordance with manufacturers instructions. Interior walls, floors, fillets and ceiling surfaces of wet well and drywell shall be sounded for delaminations. Loose, weak, deteriorated or defective concrete shall be removed to provide a clean, sound concrete surface prior to proceeding. Concrete wall and ceiling surfaces are to be prepared using mechanical means, either by sandblasting or high-pressure waterblasting with a sand injection system or hark hammering if deemed necessary by the engineer and followed by sandblasting to smooth the surface. In the event reinforcement is exposed as a result of selective demolition work, clean exposed steel reinforcement and areas to receive repair mortar by mechanical means, either by sandblasting or high-pressure water blasting with a sand-injection system to provide a white metal finish on steel, and a clean and structurally sound concrete surface for all areas to be patched. Finally, ash the interior surface with a high-pressure water blast containing Con<sup>MIC</sup>Shield<sup>®</sup>, usually 3,500 psi, sufficient to remove all laitance and loose material. Pressures sufficient to etch the existing surface will improve adhesion. Plug any active leaks with plugging material according to the instructions on data the sheets, and fill voids and overhangs with patching material.
- 8.2 **Equipment:** Mortar mixers, compressors and pumps are standard commercial models. The high-speed, rotating applicator device is used to provide a densely compacted liner of uniform thickness and thorough coverage.
- 8.3 **Mixing:**
- A Combine 50 pounds of the packaged dry mix with the specified amount of potable water while mixing with a high-speed shear mixer for four (4) minutes. Continue to agitate the mortar to prevent thickening beyond the desired fluidity. If it thickens, it may be retempered. The working time is approximately 40 minutes. Avoid overly windy and arid curing conditions; use curing membranes if rapid drying conditions exist.
- 8.4 **Application:**
- A Commence pumping the mixed mortar and begin spray applying the material at the lowest point desired for the new wall and work upward to just under the manhole frame. The material may applied to the specified thickness in one or more passes.

B If additional thickness is desired at any level, simply recommence material application until that area is thickened. Additional layers may be applied at any time.

**8.5 Chemical corrosion barrier:**

A In case of corrosion resulting from chemicals or at the Engineer's direction, COR+GARD<sup>®</sup> composite coating shall be applied over the fresh PERMACAST<sup>®</sup> liner to create a vapor barrier impervious to the chemical corrosion.

B The epoxy shall be uniformly applied onto the fresh mortar lining before re-exposure to the chemicals can contaminate the underlying mortar.

C If application is delayed beyond 24 hours, or if the mortar liner is exposed to foreign matter, it shall be rinsed to neutralize its surface and the epoxy shall then be applied.

**8.6 Finishing:** Trowel the surface of the liner to create a uniform finish. Caution shall be taken to prevent over working the material. Thickness may be verified at any point with a wet gage. Brushing is an optional procedure for texturing its finish for improved mechanical adhesion of epoxy.

**8.7 Clean up:** Upon completion, the base covering shall be removed and any debris disposed of properly. Additional material shall be hand applied to bench surfaces at a thickness of 3 inches tapering from the wall to the edge of the channel. Flows at bottom channels may remain active during the procedure.

**9 Warranty:**

**9.1 The contractor shall submit a written warranty for all labor, materials for a period of 5 years from project acceptance for the entire system. In the event of a failure of the system the contractor shall bear all responsibility and costs for repair of the system in accordance with the manufacturers recommendations. These recommendations are to be reviewed and approved by the owner. The contractor shall make all repairs within 30 days of notification at no cost to the owner.**

**9.2 In addition a supplemental written renewable two year guarantee/warranty of all station bypassing and all other incidental costs for the rehabilitation must be submitted by the contractors bonding/surety company. No warranty shall be prorated but shall cover all costs. This warranty shall be renewed by the contractor for a period of 5 years.**

### PART III - EXECUTION

#### 3.01 SURFACE PREPARATION:

- A. Concrete surface preparation shall be performed in strict accordance with manufacturers instructions. Interior walls, floors, fillets and ceiling surfaces of wet well and drywell shall be sounded for delaminations. Loose, weak, deteriorated or defective concrete shall be removed to provide a clean, sound concrete surface prior to proceeding with patching or leveling mortar work. Concrete wall and ceiling surfaces are to be prepared using mechanical means, either by sandblasting or high-pressure water blasting with a sand injection system and hammering if necessary. In the event reinforcement is exposed as a result of selective demolition work, clean exposed steel reinforcement and areas to receive repair mortar by mechanical means, either by sandblasting or high-pressure water blasting with a sand-injection system to provide a white metal finish on steel, and a clean and structurally sound concrete surface for all areas to be patched.

#### 3.02 APPLICATION:

- A. Apply repair materials in strict accordance with manufacturers instructions. Carefully observe mixing, application and curing recommendations for each concrete repair and protection product.
- B. Sequence of work will be as follows:
  - 1. Remove defective concrete, repair all leaks and prepare walls, floors, fillets and ceiling surfaces as required.
  - 2. Repair spalls and deep surface irregularities with hand-applied repair mortar.
  - 3. Apply temporary moisture barrier leveling mortar and bonding agent as recommended by the manufacturer. (if applicable)
  - 4. Test leveling mortar for moisture content at the surface using a moisture meter, and do not proceed with polymer coating application unless moisture content is below within manufacturers recommendations.



5. Test leveling mortar for moisture drive conditions per ASTM 4263-83, Plastic Sheet Test, and do not proceed with polymer coating application unless conditions of moisture drive are not present. (if applicable)
6. Apply high-build epoxy coating system over cured leveling as recommended by the manufacturer. (if applicable)

3.03 CLEAN UP:

Remove all debris resulting from concrete repair and protection work from project site.

**END OF SECTION**

## SECTION 04100 - CEMENT AND LIME MORTARS

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

##### A. General:

The Contractor shall furnish all labor, materials, tools, equipment and services for all cement and lime mortars as indicated.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.

##### B. Work Specified Elsewhere but is not limited to:

Section 01330	-	Submittal Procedures
Section 03300	-	Cast-In-Place Concrete
Section 04200	-	Brick Masonry
Section 04300	-	Concrete Masonry
Section 04400	-	Masonry Cleaning
Section 04600	-	Through Wall Flashing
Section 04800	-	Joint Sealants

#### 1.02 QUALITY ASSURANCE

##### A. Materials and testing standards: ASTM Standards.

#### 1.03 SUBMITTALS

##### A. Product data:

1. Design mix reports for each type of mortar used. Include description of contents and proportions.

##### B. Samples:

1. Color samples of colored mortar. Provide Richotex C-81 or approved equal.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

##### A. Portland cement: ASTM C150, Type I.

1. No air entrainment.
2. Natural color.
3. Maximum percent of alkalis: 0.60 in accord with Table 1A.

##### B. Hydrated lime: ASTM C207, Type S.

- C. Mortar aggregate: ASTM C144.
- D. Grout: ASTM C476.
- E. Water: Potable.
- F. Mortar pigments: Commercial colorants suitably compounded for use in mortar mixes. Do not exceed manufacturer's recommended pigment-to-cement ratios.

## 2.02 MIXES

- A. Mortar mixes: Use Type S.
  - 1. Wherever a fire-resistance classification or rating is shown for unit masonry construction, provide mortar of type which has been tested and listed for construction indicated.
  - 2. Comply with ASTM C270.
  - 3. Do not use masonry cement.
  - 4. Mix materials minimum of 3 minutes.
  - 5. Adjust consistency to satisfaction of mason.
  - 6. Use no antifreeze additives.
- B. Grout mixes: Comply with ASTM C476, Table 1.
  - 1. Use no antifreeze additives.
  - 2. Mix 5 MIN.
  - 3. Adjust consistency to satisfaction of mason.

## PART 3 - EXECUTION

### 3.01 INSTALLATION/APPLICATION/ERECTION

- A. Comply with requirements specified for materials being set or grouted.
- B. If mortar begins to stiffen within 2-1/2 hours, it may be retempered by adding water and remixing.
- C. Do not use mortar after it has begun to set.
- D. Use grout within 2 hours after initial mixing. Use no grout after it has begun to set.
- E. Use coarse grout in spaces with least dimension over 2 inches (50 millimeters).
- F. Use fine grout for grouting hollow metal in masonry.

**END OF SECTION**

## SECTION 04200 - BRICK MASONRY

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

##### A. General:

The contractor shall furnish all labor, materials, tools, equipment and services for all brick masonry as indicated.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

##### B. Work Specified Elsewhere but not limited to:

Section 01330	-	Submittal Procedures
Section 03300	-	Cast-In-Place Cement
Section 04100	-	Cement and Lime Mortars
Section 04300	-	Concrete Masonry
Section 04400	-	Masonry Cleaning
Section 04600	-	Through Wall Flashing
Section 04800	-	Joint Sealants
Section 05500	-	Structural and Miscellaneous Metals
Section 05550	-	Louvers and Vents
Section 05600	-	Fiberglass Reinforced Doors and Frames
Section 05650	-	Finish Hardware
Section 06210	-	Carpentry

#### 1.02 QUALITY ASSURANCE

##### A. Tolerances:

1. Maximum variation from plumb in vertical lines and surfaces of columns, walls and arrises:
  - a. 1/4 inch (6.3 millimeters) in 10 feet (3 meters).
  - b. 3/8 inch (9.4 millimeters) in a story height not to exceed 20 feet (6 meters).
2. Maximum variation from plumb for external corners, expansion joints and other conspicuous lines:
  - a. 1/4 inch (6.3 millimeters) in any story of 20 feet (6 meters) maximum.
3. Maximum variation from level of grades for exposed lintels, sills, horizontal grooves and other conspicuous lines:
  - a. 1/4 inch (6.3 millimeters) in any bay or 20 feet (6 meters).
4. Maximum variation from plan location of related portions of columns, walls and partitions:
  - a. 1/2 inch (12.5 millimeters) in any bay or 20 feet (6 meters).

5. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown on drawings:
  - a. Minus 1/4 inch (6.3 millimeters).
  - b. Plus 1/2 inch (12.5 millimeters).

#### 1.03 SUBMITTALS

##### A. Samples:

1. Submit brick sample for the City of Newport News review and color selection.

##### B. Project data:

1. Certification of brick type and grade.

#### 1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.

B. Protect all materials from elements.

C. Inspect masonry upon delivery to ensure color match.

#### 1.05 PROJECT/SITE CONDITIONS

A. Protect against weather, when work is not in progress.

B. Cover top walls with waterproof membrane, extend at least 4 feet (1.2 meters) down both sides of walls and anchor in place.

C. Protect against cold weather.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTANCE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers or approved equal are acceptable:

##### 1. Masonry anchors:

- a. AA Wire Products Co.
- b. Southern Slag.
- c. Dur-O-Wall.
- d. Heckman.
- e. Ty-Wall.

##### 2. Horizontal joint reinforcing:

- a. AA Wire
- b. Southern Slag.
- c. Dur-O-Wall.
- d. Ty-Wal.

e. Gateway.

## 2.02 MATERIALS

### A. Brick:

1. Size: Per Owner Color: Per Owner
2. ASTM C216, Type FBS, Grade SW.
3. Include special shaped, sized or cut brick such as radius, edge or corner units required for complete installation, in bid.

### B. Anchors, veneer:

1. Galvanized, ASTM A153-82.
2. 16 GA corrugated steel.
3. Nominal 7/8 inch (22 millimeters) wide x 7 inch (175 millimeters) long.

### C. Horizontal joint reinforcing:

1. Galvanized, ASTM A153-82.
2. Cold drawn steel wire, ASTM A82.
3. 3/16 inch (4.7 millimeters) side rods.
4. No. 9 GA cross rods.
5. Truss design.
6. Prefabricated corner and tee sections: Minimum length 32 inch (800 millimeters) from point of intersection.

D. Mortar: See Section 04100 - "Cement and Lime Mortars".

E. Sealants: See Section 04800 - "Joint Sealants".

## PART 3 - EXECUTIVE

### 3.01 INSPECTION

- A. Verify suitability of substrate to accept work.
- B. Verify that anchors and flashings are correct.
- C. Installation constitutes acceptance of substrate and responsibility for performance.

### 3.02 INSTALLATION/APPLICATION/ERECTION

#### A. General:

1. Build walls to thickness indicated.
2. Build in flashing, reinforcing, weeps and related items.
3. Install in running bond.
4. Perform all cutting with masonry saws.
5. Cut as required to provide pattern required.
6. Use solid units where cutting or laying would expose holes.
7. Avoid use of less than half size units whenever possible.
8. Do not install damaged units.

9. Wet brick having absorption rates greater than 0.025 OZ/SI/MIN; comply with Brick Institute of America recommendations.
10. Install brick work in conjunction with concrete unit masonry work.

B. Laying and tooling:

1. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints. Properly located openings, movement type joints, returns and offsets.
2. Lay brick with completely filled bed and head joints.
  - a. Butter ends with sufficient mortar to fill head joints and shove into place.
  - b. Do not slush head joints.
3. Maintain nominal 3/8 inch (9 millimeters) joint widths.
  - a. Cut joints flush where concealed.
  - b. Tool exposed joints.
  - c. Compress mortar in below grade joints.
4. During tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar.
5. Point-up all joints at corners, openings and adjacent work to provide neat, uniform appearance.
6. Remove brick units disturbed after laying.
  - a. Clean and relay in fresh mortar.
  - b. Do not pound units to fit.
  - c. If adjustments are required, remove units, clean and reset in fresh mortar.
7. Where work is stopped and later resumed, rack back 1/2 brick unit length in each course.
  - a. Wet units lightly.
  - b. Remove loose units and mortar prior to laying fresh masonry.
8. As work progresses, build-in items indicated and specified.
  - a. Fill in solidly with mortar around built-in items.
  - b. Grout-fill space between metal frames and masonry.

C. Reinforcing:

1. Brick veneer with concrete block back-up: Anchor veneer to back-up using horizontal joint reinforcing at 16 inch (400 millimeters) on center vertically.
2. Brick veneer with wood sheathing wall back-up: Anchor veneer to back-up using veneer anchors at not more than 1.78 SF (0.2 square meters) per anchor.
3. Coordinate continuous joint reinforcement with backer material to provide required reinforcement.
  - a. Embed longitudinal side rods in mortar for entire length with minimum cover of 5/8

inch (16 millimeters) on exterior side of walls and 1/2 inch (12.5 millimeters) at other locations.

- b. Lap reinforcement minimum of 6 inches (150 millimeters) at ends.
- c. Do not bridge control and expansion joints with reinforcing except at wall openings.
- d. Make corners and wall intersections by use of prefabricated "L" and "T" sections.
- e. Cut and bend units as required.
- f. Install reinforcing at 16 inches (400 millimeters) on center vertically.
- g. Install reinforcing 8 inches (200 millimeters) on center in starter courses and over openings.

4. Reinforce masonry openings over 12 inches (300 millimeters) wide, with horizontal joint reinforcing placed in 2 horizontal joints above lintel and below sill.

- a. Extend reinforcing minimum of 24 inches (600 millimeters) beyond jambs of opening.
- b. Bridge control joints where provided.

D. Control joints, flashing and sealants:

1. Provide vertical expansion, control and isolation joints where indicated.

- a. Where not indicated and where indicated, provide at maximum 30 feet (9 meters) on center.
- b. Rake out all mortar from joint.
- c. Locate control joints at points of natural weakness in masonry.

2. See Section 04600 - "Through Wall Flashing" for flashing and weep installation requirements.

3. See Section 04800 - "Joint Sealants" for sealant installation requirements.

- a. Seal joints between brick and relieving lintels.
- b. Seal expansion and control joints.



3.03 ADJUSTING AND CLEANING

- A. Remove and replace loose, stained, or damaged bricks.
  - 1. Provide new units to match.
  - 2. Install in fresh mortar.
  - 3. Point to eliminate evidence of replacement.
- B. Clean in accord with Section 04400 - "Masonry Cleaning".

**END OF SECTION**

## SECTION 04300 - CONCRETE MASONRY

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

##### A. General:

The contractor shall furnish all labor, materials, tools, equipment, and services for all concrete masonry construction as indicated.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.

##### B. Work specified elsewhere but not limited to:

Section 01330	-	Submittal Procedures
Section 03300	-	Cast-In-Place Concrete
Section 04100	-	Cement and Lime Mortars
Section 04200	-	Brick Masonry
Section 04400	-	Masonry Cleaning
Section 04600	-	Through Wall Flashing
Section 04800	-	Joint Sealants
Section 05500	-	Structural and Miscellaneous Metals
Section 05550	-	Louvers and Vents
Section 05600	-	Fiberglass Reinforced Doors and Frames
Section 05650	-	Finish Hardware
Section 06210	-	Carpentry

#### 1.02 QUALITY ASSURANCE

##### A. Tolerances:

1. Maximum variation from plumb in vertical lines and surfaces of columns, walls and arises:
  - a. 1/4 inch (6.3 millimeters) in 10 feet (3 meters).
  - b. 3/8 inch (9.4 millimeters) in a story height not to exceed 20 feet (6 meters).
2. Maximum variation from plumb for external corners, expansion joints and other conspicuous lines:
  - a. 1/4 inch (6.3 millimeters) in any story or 20 feet (6 meters) maximum.
  - b. 1/2 inch (12.5 millimeters) in 40 feet (12 m) or more.
3. Maximum variation from level of grades for exposed lintels, sills, horizontal grooves and other conspicuous lines:
  - a. 1/4 inch (6.3 millimeters) in any bay or 20 feet (6 meters).

4. Maximum variation from plan location of related portions of columns, walls and partitions:
  - a. 1/2 inch (12.5 millimeters) in any bay or 20 feet (6 meters).
  - b. 3/4 inch (19 millimeters) in 40 feet (12 meters) or more.
5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on drawings:
  - a. Minus 1/4 inch (6.3 millimeters).
  - b. Plus 1/2 inch (12.5 millimeters).

#### 1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.
- B. Protect all materials from elements.

#### 1.04 PROJECT/SITE CONDITIONS

- A. Protect against weather, when work is not in progress.
- B. Cover top of walls with waterproof membrane, extend at least 4 feet (1.2 meters) down both sides of walls and anchor in place.
- C. Protect against cold weather.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers or approved equal are acceptable:
  1. Masonry anchors and horizontal joint reinforcing:
    - a. AA Wire Products Co.
    - b. Southern Slag.
    - c. Dur-O-Wall
    - d. Ty-Wal.

#### 2.02 MATERIALS

- A. Concrete masonry units: Modular units, ASTM C90, Grade N, Type 1, and C145. (Provide aggregate in accord with ASTM C33).
  1. Sizes and shapes as indicated or required for conditions.

2. Face shell and web thickness: Table 3.
  3. Moisture content: Table 1.
  4. Fire-resistive units: U/L rated.
  5. Use bull nose units at external corners and at jambs of openings.
  6. Provide solid units, or grouted hollow units, under lintels.
  7. Provide concrete bricks of same material, texture and quality.
  8. Do not use chipped, cracked, spalled, or imperfect units exposed in finished work.
  9. Provide reinforced concrete masonry lintels fabricated from precast load-bearing masonry units, filled and reinforced as indicated.
- B. Joint reinforcing, horizontal:
1. Cold drawn steel wire, ASTM A82.
  2. 3/16 inch (4.68 millimeters) side rods.
  3. No. 9 GA cross rods.
  4. Galvanized, ASTM A153-B2.
  5. Truss design.
  6. Prefabricated corner and tee sections; minimum length 32 inches (800 millimeters) from point of intersection.
- C. Mortar and grout: See Section 04100 - "Cement and Lime Mortars".
- D. Sealants: See Section 04800 - "Joint Sealants".
- E. Anchors at intersecting load bearing walls: 1 x 1/4 x 24 inches (25 x 6 x 600 millimeters) galvanized steel with ends turned up 2 inches (50 millimeters).
- F. Bond breaker strips: 15 LB (6.80 kg) asphalt saturated felt.
- G. Grout fill: As specified in Section 04100 - "Cement and Lime Mortars".
- H. Reinforcing bars: As specified in Section 03300 - "Cast-In-Place Concrete" and indicated on drawings.
- I. Control joints:
1. Solid rubber section 5/8 inch (15.6 millimeters) thick with 5/16 inch (7.8 millimeters) flange conforming to ASTM D-2000 2AA-805.
  2. Durometer hardness of 80 when tested in accordance with ASTM D-2240.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Verify suitability to substrate to accept work.
- B. Verify that anchors and flashings are correct.
- C. Installation constitutes acceptance of substrate and responsibility for performance.

### 3.02 INSTALLATION/APPLICATION/ERECTION

#### A. General:

- 1. Build walls to thickness indicated.
- 2. Build in flashing, reinforcing, weeps and related items.
- 3. Perform all cutting with masonry saws.
- 4. Install in running bond.
- 5. Cut as required to provide pattern indicated.
- 6. Use solid units where cutting and laying would expose holes.
- 7. Avoid use of less than half size units, whenever possible.
- 8. Do not install damaged units.
- 9. Do not wet concrete masonry units.
- 10. Build chases and recesses as indicated and required for work of other trades. Provide not less than 8 inches (200 millimeters) of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

#### B. Laying and tooling:

- 1. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints. Properly locate openings, movement type joints, returns and offsets.
- 2. Lay masonry units with completely filled bed and head joints.
  - a. Butter ends with sufficient mortar to fill had joints and shove into place.
  - b. Do not slush head joints.
- 3. Maintain nominal 3/8 inch (9.4 millimeters) joint widths.
  - a. Cut joints flush where concealed.
  - b. Tool exposed joints.
  - c. Compress mortar in below ground joints.

4. During tooling of joints, enlarge any voids or holes, except weepholes, and completely fill with mortar.
5. Point-up all joints at corners, openings and adjacent work to provide neat, uniform appearance.
6. Remove masonry disturbed after laying.
  - a. Clean and relay in fresh mortar.
  - b. Do not pound units to fit.
  - c. If adjustments are required, remove units, clean, and reset in fresh mortar.
7. Where work is stopped and later resumed, rack back 1/2 masonry unit length in each course.
  - a. Remove loose units and mortar prior to laying fresh masonry.
8. As work progresses, build-in items indicated and specified.
  - a. Fill in solidly with mortar around built-in items.
  - b. Grout-fill space between metal frames and masonry.
  - c. Where built-in items are to be embedded in cores of hollow masonry units, place layer of metal lath in joint below and fill core with grout.

C. Reinforcing:

1. Provide continuous horizontal joint reinforcing as indicated.
  - a. Embed longitudinal side rods in mortar for entire length with minimum cover of 5/8 inch (15.6 millimeters) on exterior side of walls and 1/2 inch (12.5 millimeters) at other locations.
  - b. Lap reinforcement minimum 6 inches (150 millimeters) at ends.
  - c. Do not bridge control and expansion joints with reinforcement except at wall openings.
  - d. Make corners and wall intersections by use of prefabricated "L" and "T" sections.
  - e. Cut and bend as required.
  - f. Install reinforcing at 16 inches (400 millimeters) on center vertically.
  - g. Install reinforcing 8 inches (200 millimeters) on center in starter courses and over openings.
  - h. Use continuous joint reinforcing for bond tie between wythes.
2. Reinforce masonry openings over 12 inches (300 millimeters) wide, with horizontal joints above lintel and below sill.

- a. Extend reinforcing minimum of 24 inches (600 millimeters) beyond jambs of opening.
  - b. Bridge control joints where provided.
  3. At intersecting load-bearing walls provide rigid steel anchors 24 inches (600 millimeters) on center vertically, embed ends in mortar filled cores.
  4. Install vertical reinforcing bars, where indicated.
- D. Lintels, control joints, flashing and sealants.
1. Provide vertical expansion, control and isolation joints where indicated.
    - a. Where not indicated and where indicated, provide at maximum 30 feet (9 meters) on center.
    - b. Provide at all "T" intersections.
    - c. Rake out mortar in joint.
    - d. Locate control joints at points of natural weakness in masonry.
  2. See Section 04600 - "Through Wall Flashing" for flashing and weep installation requirements.
  3. See Section 04800 - "Joint Sealants" for sealant installation requirements.
    - a. Seal joints between concrete masonry unit and relieving lintels.
    - b. Seal control and expansion joints.
  4. Provide precast masonry or hot dipped galvanized steel.
    - a. Thoroughly cure masonry lintels before handling and installation.

### 3.03 ADJUSTING AND CLEANING

- A. Remove and replace loose, stained or damaged units.
1. Provide new units to match.
  2. Install in fresh mortar.
  3. Point to eliminate evidence of replacement.
- B. Clean in accordance with Section 04400 - "Masonry Cleaning".

**END OF SECTION**

## SECTION 04400 - MASONRY CLEANING

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

##### A. General:

The Contractor shall furnish all labor, materials, tools, equipment, and services for all masonry cleaning as indicated.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.

##### B. Work specified elsewhere but is not limited to:

Section 01330	-	Submittal Procedures
Section 03300	-	Cast-In-Place
Section 04100	-	Cement and Lime Mortars
Section 04200	-	Brick Masonry
Section 04300	-	Concrete Masonry
Section 04600	-	Through Wall Flashing
Section 04800	-	Joint Sealants

#### 1.02 PROJECT/SITE CONDITIONS

##### A. Protect adjacent surfaces and materials below from damage due to cleaning operations.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

##### A. Subject to compliance with the Contract Documents, the following manufacturers or equal are acceptable:

1. Cleaning solution: Detergent type.
  - a. Pro So Co., Sure Clean No. 600 Detergent Masonry Cleaner.
  - b. L & M Construction Chemicals, Inc., Quick Kleen.
2. Cleaning solution for manganese or vanadium stained masonry:
  - a. Pro So. Co., Vanatrol.
  - b. L & M Construction Chemicals, Inc., Vana Kleen.

### PART 3 - EXECUTION

#### 3.01 PREPARATION



- A. Carefully check masonry surfaces.
- B. If necessary, point with mortar.
- C. Allow 28 days before start of cleaning.
- D. Remove excess mortar using wooden paddles and scrapers.
- E. Clean all exposed to view masonry surfaces.

3.02 INSTALLATION/APPLICATION/ERECTION

- A. Do not use wire brushes.
- B. If metal tools are used, use only tools free of rust.
- C. Thoroughly rinse and presoak walls.
- D. Flush all loose mortar and dirt from surface.
- E. Wet to prevent "runoff" streaking.
- F. Apply solution using fibered wall washing brush.
- G. Scrape off mortar and reapply cleaning solution.
- H. After scrubbing, clean thoroughly with pressurized water.
- I. If brickwork cannot be cleaned satisfactorily with stiff brushes and water, the surfaces shall be thoroughly wet with clear water and scrubbed with a solution of not more than one part hydrochloric (muriatic) acid to ten parts water, followed immediately by a thorough rinsing with clear water. If masonry is cleaned with an acid solution, all corrodible parts shall be thoroughly protected.

**END OF SECTION**

## SECTION 04600 - THROUGH WALL FLASHING

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

##### A. General:

The Contractor shall furnish all labor, materials, tools, equipment, and services for all through wall flashing and weeps for all masonry construction as indicated.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.

##### B. Work specified elsewhere but is not limited to:

Section 01330	-	Submittal Procedures
Section 03300	-	Cast-In-Place Concrete
Section 04100	-	Cement and Lime Mortars
Section 04200	-	Brick Masonry
Section 04300	-	Concrete Masonry
Section 04400	-	Masonry Cleaning
Section 04800	-	Joint Sealants
Section 05500	-	Structural and Miscellaneous Metals
Section 05550	-	Louvers and Vents
Section 05600	-	Fiberglass Reinforced Doors and Frames
Section 05650	-	Finish Hardware

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

##### A. Subject to compliance with the Contract Documents the following manufacturers or equal or acceptable:

1. Through wall flashing:
  - a. AFCO Products, Inc.
  - b. Sandell Manufacturing Co.
  - c. Rubber and Plastics Compound Co., Inc.
  - d. B. F. Goodrich, Co.
  - e. Wasco Products, Inc.
2. Weeps for brick construction:
  - a. AA Wire Products Co.

- b. Dur-O-Wal, Inc.
- c. Heckman Building Products, Inc.
- d. Williams Products, Inc.

## 2.02 MATERIALS

- A. Flashing, through wall: Minimum 30 mil PVC or vinyl sheet
  - 1. ASTM D1004 tear resistance: 350 LB/IN, min.
  - 2. Width as required.
  - 3. Factory precut wherever possible.
- B. Flashing adhesive: As recommended by manufacturer for sealing laps and seals to vertical surfaces.
- C. Weeps for brick construction: 3/8 IN outside diameter colored plastic tubes.

## PART 3 - EXECUTION

### 3.01 INSTALLATION/APPLICATION/ERECTION

- A. Install to provide positive drainage of cavity moisture.
- B. Coordinate with built-in items and brick ledges.
- C. Place flashing on bed of mortar before covering with mortar.
- D. Terminate flashing 1/2-inch (13 mm) (typical) from face of wall.
- E. Extend flashings beyond edge of lintels and sills at least 1/4-inch (6mm) and turn up edge on inside to direct moisture to exterior.
- F. Lap flashing minimum of 4 inches and bond two pieces together with flashing adhesive.
- G. Install upper edge of flashing into block joint.
- H. Secure upper edge of flashing with adhesive.
- I. Provide weeps maximum four feet on center in head joints of first course of masonry immediately above flashings.
  - 1. Do not install weeps over door opening.
  - 2. Keep vertical joint behind ventilator free of mortar.

**END OF SECTION**

SECTION 04800 - JOINT SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. General:

The Contractor shall furnish all labor, materials, tools, equipment, and services for all sealant work as indicated.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein

B. Work included consists of but is not necessarily limited to:

1. Sealing all joints which will permit penetration of moisture, unless sealing work is specifically required under other sections, and including the following:
  - a. Exterior wall joints.
  - b. Masonry control joints, exterior, interior and between masonry and other materials.
  - c. Flooring joints.
  - d. Isolation joints.
  - e. Joints between paving or sidewalks and building.
  - f. Concrete control and expansion joints, exterior and interior.
  - g. Joints at penetrations of walls, floors and decks by piping and other services and equipment.
  - h. Exterior and interior perimeters of exterior and interior door and window frames, louvers, grilles, etc.
  - i. Thresholds at exterior doors.
  - j. Other joints where caulking, sealant or compressible sealant is indicated.

C. Work specified elsewhere but is not limited to:

- |               |   |                                     |
|---------------|---|-------------------------------------|
| Section 01330 | - | Submittal Procedures                |
| Section 03300 | - | Cast-In-Place Cement                |
| Section 04100 | - | Cement and Lime Mortars             |
| Section 04200 | - | Brick Masonry                       |
| Section 04300 | - | Concrete Masonry                    |
| Section 04400 | - | Masonry Cleaning                    |
| Section 04600 | - | Through Wall Flashing               |
| Section 05500 | - | Structural and Miscellaneous Metals |

- Section 05550 - Louvers and Vents
- Section 05600 - Aluminum Doors
- Section 05650 - Finish Hardware

## 1.02 SYSTEM DESCRIPTION

### A. Definition:

1. Words "caulk," "sealant" and "caulking" mean sealant work.

## 1.03 QUALITY STANDARDS

- ### A. Sealant materials: ASTM C603 and C510, F.S. TT-S-001543A, TT-S-00227E(3) and TT-S-00230C(2) as they apply.

## 1.04 SUBMITTALS

### A. Project data:

1. Warranty

### B. Shop drawings:

1. Manufacturer's literature and installation instructions.

### C. Samples:

1. Color charts for color selection.

## 1.05 PROJECT/SITE CONDITIONS

- ### A. Perform sealant work only when ambient temperature is 40 degF (5 degC) or higher.
- ### B. Apply only to joints which are free of material which will inhibit bond.
- ### C. Apply to cementitious materials only when thoroughly cured and dry.

## 1.06 WARRANTY

- ### A. Warranty that sealant work will be free of defects for a period of three years from date of final acceptance.
1. Failure of watertightness constitutes defect.
  2. Remove any defective work or materials and replace with new work and materials, and repair any other work damaged as a result of defective sealant work or materials at no additional expense to the Owner.
  3. Warranty signed by applicator.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers or equal are acceptable:
1. Polyurethane sealants: (Fed. Spec. IT-S-0023, Type II, Class A for 1 component, or TT-S-00227E, Type 1, Class A for 2 components.)
    - a. MAMECO International (Vulkem 116, 227, 45, 245).
    - b. Sika Chemical Corp. (Sikaflex-1A, Sikaflex-125L).
    - c. Sonneborn-Contech (Sonolastic NP-1, NP-II, Sonolastic Paving joint sealant, Sonolastic SL-1).
    - d. Tremco, Inc. (Dymeric).
    - e. Pecora (Dynatrol I, Dynatrol II, Urexpan NR-200, NR-201).
  2. Silicone sealants: (Fed. Spec. TT-S-001543A, Class A.)
    - a. General Electric Co. (Gesil N-2600, Silpruf, Sanitary Sealant for sealing plumbing fixtures).
    - b. Dow Corning Corp. (790, 795, 786 for sealing plumbing fixtures).
  3. Compressible sealant:
    - a. Sandell Mfg. Co., Inc.
    - b. Illbruck Co.
  4. Acrylic polymeric sealants: (Fed. Spec. TT-S-230).
    - a. Protective Treatment, Inc. (767).
    - b. Tremco (Mono).
    - c. Pecora (60 plus Unicrylic).

## 2.02 MATERIALS

- A. Sealants - General:
1. Provide colors matching materials being sealed.
  2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
  3. Nonsagging sealant for vertical joints.
  4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
  5. Before use of any sealant, investigate its compatibility with joint surfaces, fillers and other materials in joint system. Use only compatible materials.

6. Obtain sealing compounds from manufacturers who will provide manufacturers' field service representatives at project site for purpose of advising and instructing installers in proper procedures.
  - a. Provide such services, at no expense to the Owner.
- B. Sealant, polyurethane: One or two components.
- C. Sealant, acrylic: One component.
- D. Sealant, silicone: One component.
- E. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
- F. Sealant backer rod: Rod stock of polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, nonbituminous material recommended by sealant manufacturer to:
  1. Control joint depth.
  2. Break bond of sealant at bottom of joint.
  3. Provide proper shape of sealant bead.
- G. Sealant, compressible:
  1. Size so that width of material is twice joint width.
  2. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on front face with nonreactive release agent that will act as bond breaker for applied sealant. Sandell "Polytite-B" or Illbruck "Will-Seal."
  3. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on front face with an elastomeric membrane. Color as selected. Sandell "Polytite-R."
- H. Adhesive, compressible sealant: As recommended by sealant manufacturer.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Clean all joints.
- B. Where finish coating or covering is to be applied to surface, wait until such coating or covering has been applied before installing sealant; e.g., paint, wallcovering, glazed coating.

### 3.02 INSTALLATION/APPLICATION/ERECTION

- A. Make joints water and airtight.
- B. Where required by manufacturer, prime joint surfaces.
  1. Limit application to surfaces to receive caulking.

2. Mask off adjacent surfaces.
- C. Make depth of sealing compounds not more than one-half width of joint, but in no case less than 1/4 inch (6 mm).
- D. Subcaulk joints that are deep, or joints without suitable backstop, to proper depth.
- E. For correctly sized backer rods.
- F. Apply bond breaker where required.
- G. Tool sealants using sufficient pressure to fill all voids.
- H. Upon completion, leave caulking with smooth even neat finish.
- I. Install compressible sealant to position at indicated depth.
  1. Take care to avoid contamination of sides of joint.
  2. Protect side walls of joint (to depth of caulking).
  3. Install with adhesive faces in contact with joint side.

### 3.03 SCHEDULE

- A. Furnish sealant as indicated for the following areas:
  1. Exterior areas:
    - a. Polyurethane
  2. Interior nonwet, noncorrosive areas:
    - a. Acrylic, or
    - b. Polyurethane, or
    - c. Silicone
  3. Compressible sealant: Where indicated

**END OF SECTION**



## SECTION 05500

### STRUCTURAL AND MISCELLANEOUS METALS

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. General: Applicable provisions of the contract drawings and general conditions govern work under this section.
- B. Scope of Work: Furnish all labor, materials and equipment to provide all bolts, anchors, plates, spikes and other materials necessary for the work, all stock or standard items, and all specify constructed miscellaneous metalwork as indicated or required for completion. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.
- C. Work specified elsewhere:
- Section 01300 - Submittals
  - Section 03300 - Cast-In-Place Concrete (For Wastewater Pumping Stations)
  - Section 04200 - Brick Masonry
  - Section 04300 - Concrete Masonry
  - Section 04600 - Through Wall Flashing
  - Section 05600 - Fiberglass Reinforced Doors and Frames
  - Section 09910 - Painting
- D. Submittals shall be made in accordance with the procedures set forth in Section 01300 - "Submittals". Shop drawings (SD) and catalog data (CD) shall be submitted for the following items:
1. Angle and channel supports (SD)
  2. Supplementary and special framing (SD)
  3. Miscellaneous supports (SD)
  4. Floor hatch (CD, SD)
  5. Wet well ladder (SD)
  6. Bar Screen (SD)
  7. Aluminum railing (SD, CD)
  8. Aluminum Dry Well Ladders and platforms (SD, CD)

##### 1.02 MATERIALS

- A. Materials.
1. Cast iron items shall conform to the requirements of ASTM A-48-76, Class No. 25A, 25B, or 25C.
  2. Structural steel members shall conform to the requirements of ASTM A 36, unless otherwise indicated or specified.

3. Steel Pipe: Pipe shall conform to ASTM A 501-84 or A 53-84a, Grade B.
4. Malleable iron items shall conform to the requirements of ASTM A 47-77, Grade 32510 or 35018.
5. Aluminum alloy products shall be of uniform quality, free from injurious defects. Unless otherwise approved or specified, alloy and tempers shall be as listed below:

**ARCHITECTURAL ALUMINUM MANUFACTURERS ASSOCIATION**

<u>Use</u>	<u>Alloy Description</u>	<u>Temper</u>
Castings	214	F
Structural Shapes	6061	T6
Extrusions	6063	T5
Sheet & Plate	3003	H14
Pipe	6063	T6
Drawn Tubing	6061	T6
Bolts, Nuts, Screws	2024	T4
Rivets	6061	T6

6. Interior aluminum work, unless otherwise specified, shall have finish No. AA-C22-A41, anodized clear.
  7. Hot-dip galvanized zinc coatings shall be in accordance with ASTM A 183 or A 153.
- B. Dissimilar Metals and Concrete/Masonry: Contractor shall take every precaution to prevent electrolytic action between dissimilar metals on all exterior work and on interior work exposed to moisture or high humidity. Copper shall not be used in connection with aluminum work, nor shall aluminum be used where copper compounds could drain on the bare aluminum. Steel in contact with aluminum shall be painted one coat of zinc-chromate primer and one coat of aluminum pigmented bituminous paint. Aluminum in contact with masonry or concrete shall be painted on contact surfaces with two coats of aluminum pigmented bituminous paint. Stainless steel shall not contact carbon steel or zinc.

- C. General:
1. Contractor shall coordinate the work under this section with that specified in other sections so that all necessary items are provided as required. Supplementary parts needed to complete each item, even though not shown or specified, shall be included. Anchors not shown in detail on the drawings shall conform to the accepted practices of the trade and shall be as approved by the Owner. Miscellaneous supporting members, braces, and framing member shall be provided under this section of the specifications, except as otherwise specified.
  2. Supports on the exterior side of exterior walls and anchors and bolts in exterior walls and roof shall be hot-dip galvanized. Anchors and bolts in other locations shall be zinc-coated or coated with asphalt paint.
  3. Inserts of approved type shall be furnished and installed where necessary for the support of equipment, apparatus, or other work.
- D. Access Hatches: Aluminum access frames and covers shall be manufactured with ¼-inch (6 millimeters) thick, one piece aluminum extruded frame, with a continuous concrete anchor as part of the one piece extrusion. The door panels shall be ¼-inch (6 millimeters) thick aluminum diamond plate, to withstand a live load of 300 lbs. per square foot with a safety factor of times 3. The doors shall be provided with stainless steel hinges with tamper proof fasteners. All hardware is stainless steel. The doors shall open to 90° and lock automatically in that position with a stainless steel positive locking arm with stainless steel compression spring assist and a stainless steel release handle. Doors shall be provided with a stainless steel lifting handle, stainless steel locking bar, or stainless steel snap-lock with removable key handle. The doors shall close flush with the top of the frame, resting on a ½-inch (13 millimeters) wide lip around the entire inside of the frame for added support. Access frame and cover shall be as manufactured by Halliday Products Specialty Metals, the BILCO Company, or equal.
- E. Wet Well Ladders: Ladders shall be fabricated of aluminum. Side rails 1-1/2 inches (38 millimeters) in diameter shall be spaced 16 inches apart, with square rungs ¾-inch (19 millimeters) bars spaced not more than 12 inches shouldered and riveted to rails. Side rails shall be set 6 inches (150 millimeters) clear of wall and secured with 2-1/2-inch by 3/8-inch brackets bolted to the wall with ½-inch (38 millimeters) corrosion resistant concrete anchors or toggle bolts. Top rung shall be 6 inches below top of wet well slab, and bottom rung shall be a maximum 12 inches from top of ground in wet well bottom. Ladders shall be under access hatch.
- F. Bar Screen: Sewage Bar Screen shall be fabricated of anodized aluminum to match the size and dimensions of the existing bar screen.
- G. Drywell Ladder and Platform: Design and submitted shop drawings by a Professional Engineer licensed to practice in the Commonwealth of Virginia. All components shall be designed in accordance with OSHA standards.

H. Railings, Handrails and Posts:

1. Railings, handrails, and posts shall be fabricated of aluminum alloy 6061-T6. Joints shall be welded flush, with welds ground smooth.
2. Provide post and rail end cap assemblies for exposed open pipe ends.
3. Rails adjacent to walls shall be provided with wall returns at each end.
4. Rails shall conform to the requirements of the Occupational Safety and Health Administration, except design loading shall be a concentrated load of at least 200 pounds (91 kilograms) applied in any direction at any point on the top rail, and also a vertical and horizontal thrust of 50 pounds per linear foot (74 kilograms per meter) applied on the top railing. The concentrated load and distributed loads need not be assumed to act concurrently.

**END OF SECTION**

## SECTION 05500 - STRUCTURAL AND MISCELLANEOUS METALS

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. General: Applicable provisions of the contract drawings and general conditions govern work under this section.
- B. Scope of Work: Furnish all labor, materials and equipment to provide all bolts, anchors, plates, spikes and other materials necessary for the work, all stock or standard items, and all specify constructed miscellaneous metalwork as indicated or required for completion. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.
- C. Work specified elsewhere:
- |               |   |                       |
|---------------|---|-----------------------|
| Section 01330 | - | Submittal Procedures  |
| Section 03300 | - | Cast-In-Place Cement  |
| Section 04200 | - | Brick Masonry         |
| Section 04300 | - | Concrete Masonry      |
| Section 04600 | - | Through Wall Flashing |
| Section 05550 | - | Louvers and Vents     |
| Section 05600 | - | Aluminum Doors        |
| Section 05650 | - | Finish Hardware       |
| Section 09910 | - | Painting              |
- D. Submittals shall be made in accordance with the procedures set forth in Section 01330 - "Submittal Procedures". Shop drawings (SD) and catalog data (CD) shall be submitted for the following items:
1. Angle and channel supports (SD)
  2. Supplementary and special framing (SD)
  3. Miscellaneous supports (SD)
  4. Floor hatch (CD, SD)
  5. Wet well ladder (SD)
  6. Bar Screen (SD)
  7. Aluminum railing (SD, CD)
  8. Aluminum Spiral Staircase and platforms (SD, CD)

#### 1.02 MATERIALS

- A. Materials.
1. Cast iron items shall conform to the requirements of ASTM A-48-76, Class No. 25A, 25B, or 25C.
  2. Structural steel members shall conform to the requirements of ASTM A 36, unless otherwise indicated or specified.
  3. Steel Pipe: Pipe shall conform to ASTM A 501-84 or A 53-84a, Grade B.
  4. Malleable iron items shall conform to the requirements of ASTM A 47-77, Grade 32510 or

35018.

5. Aluminum alloy products shall be of uniform quality, free from injurious defects. Unless otherwise approved or specified, alloy and tempers shall be as listed below:

ARCHITECTURAL ALUMINUM MANUFACTURERS ASSOCIATION

<u>Use</u>	<u>Alloy Description</u>	<u>Temper</u>
Castings	214	F
Structural Shapes	6061	T6
Extrusions	6063	T5
Sheet & Plate	3003	H14
Pipe	6063	T6
Drawn Tubing	6061	T6
Bolts, Nuts, Screws	2024	T4
Rivets	6061	T6

6. Interior aluminum work, unless otherwise specified, shall have finish No. AA-C22-A41, anodized clear.
7. Hot-dip galvanized zinc coatings shall be in accordance with ASTM A 183 or A 153.

- B. Dissimilar Metals and Concrete/Masonry: Contractor shall take every precaution to prevent electrolytic action between dissimilar metals on all exterior work and on interior work exposed to moisture or high humidity. Copper shall not be used in connection with aluminum work, nor shall aluminum be used where copper compounds could drain on the bare aluminum. Steel in contact with aluminum shall be painted one coat of zinc-chromate primer and one coat of aluminum pigmented bituminous paint. Aluminum in contact with masonry or concrete shall be painted on contact surfaces with two coats of aluminum pigmented bituminous paint. Stainless steel shall not contact carbon steel or zinc.

C. General:

1. Contractor shall coordinate the work under this section with that specified in other sections so that all necessary items are provided as required. Supplementary parts needed to complete each item, even though not shown or specified, shall be included. Anchors not shown in detail on the drawings shall conform to the accepted practices of the trade and shall be as approved by the Owner. Miscellaneous supporting members, braces, and framing member shall be provided under this section of the specifications, except as otherwise specified.
2. Supports on the exterior side of exterior walls and anchors and bolts in exterior walls and roof shall be hot-dip galvanized. Anchors and bolts in other locations shall be zinc-coated or coated with asphalt paint.
3. Inserts of approved type shall be furnished and installed where necessary for the support of equipment, apparatus, or other work.

- D. Access Hatches: Aluminum access frames and covers shall be manufactured with ¼ inch (6 millimeters) thick, one piece aluminum extruded frame, with a continuous concrete anchor as part of the one piece extrusion. The door panels shall be ¼ inch (6 millimeters) thick aluminum diamond plate, to withstand a live load of 300 lbs. per square foot (1470 kilogram per meter squared), with a safety factor of times 3. The doors shall be provided with stainless steel hinges with tamper proof

fasteners. All hardware is stainless steel. The doors shall open to 90° and lock automatically in that position with a stainless steel positive locking arm with stainless steel compression spring assist and a stainless steel release handle. Doors shall be provided with a stainless steel lifting handle, stainless steel locking bar, or stainless steel snap-lock with removable key handle. The doors shall close flush with the top of the frame, resting on a 1/2 inch (13 millimeters) wide lip around the entire inside of the frame for added support. Access frame and cover shall be as manufactured by Halliday Products Specialty Metals, the BILCO Company, or equal.

- E. Wet Well Ladders: Ladders shall be fabricated of aluminum. Side rails 1-1/2 inches (38 millimeters) in diameter shall be spaced 16 inches (406 millimeters) apart, with square rungs 3/4 inch (19 millimeters) bars spaced not more than 12 inches (304 millimeters), shouldered and riveted to rails. Side rails shall be set 6 inches (150 millimeters) clear of wall and secured with 2-1/2 by 3/8 inch (64 by 10 millimeters) brackets bolted to the wall with 1/2 inch (38 millimeters) corrosion resistant concrete anchors or toggle bolts. Top rung shall be 6 inches (152 millimeters) below top of wet well slab, and bottom rung shall be a maximum 12 inches (304 millimeters) from top of ground in wet well bottom. Ladders shall be under access hatch.
- F. Bar Screen: Sewage Bar Screen shall be fabricated of anodized aluminum to match the size and dimensions of the existing bar screen.
- G. Spiral Stairway: Furnish spiral stairway as manufactured by Ameristeel or approved equal. Stairways shall be shipped complete in a single unit.
  - 1. Diameter 4'-6", direction from bottom up clockwise, center column, size standard, tread degree is 22 1/2°, Risers are 7 1/2". Aluminum balusters, number of balusters per tread 1, 2 Aluminum platforms with railing enclosing 2 - 48" square slab openings platform shape as per the project plans, platform rail - two sides with 90° radius to return to wall complete with closure chain as shown on drawings at 2 locations.
  - 2. Platform rails to match stairway rails.
  - 3. Supply all mounting hardware (stainless steel nuts and bolts) attaching all landings and railings to concrete slabs and concrete and block walls.
- H. Railings, Handrails and Posts:
  - 1. Railings, handrails, and posts shall be fabricated of aluminum alloy 6061-T6. Joints shall be welded flush, with welds ground smooth.
  - 2. Provide post and rail end cap assemblies for exposed open pipe ends.
  - 3. Rails adjacent to walls shall be provided with wall returns at each end.
  - 4. Rails shall conform to the requirements of the Occupational Safety and Health Administration, except design loading shall be a concentrated load of at least 200 pounds (91 kilograms) applied in any direction at any point on the top rail, and also a vertical and horizontal thrust of 50 pounds per linear foot (74 kilograms per meter) applied on the top railing. The concentrated load and distributed loads need not be assumed to act concurrently.

**END OF SECTION**

## SECTION 05550 - LOUVERS AND VENTS

### PART 1 - GENERAL

#### 1.01 Description

##### A. General:

The contractor shall furnish all labor, materials, tools, equipment and services for all exterior louvers and vents as indicated.

A. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.

##### B. Work specified elsewhere but is not limited to:

Section 01330	-	Submittal Procedures
Section 03300	-	Cast-In-Place Concrete
Section 04100	-	Cement and Lime Mortars
Section 04200	-	Brick Masonry
Section 04300	-	Concrete Masonry
Section 04400	-	Masonry Cleaning
Section 04600	-	Through Wall Flashing
Section 04800	-	Joint Sealants
Section 05500	-	Structural and Miscellaneous Metals
Section 09910	-	Painting

#### 1.02 QUALITY ASSURANCE

A. AMCA ratings and certification for air performance and water penetration.

#### 1.03 SUBMITTALS

##### A. Shop drawings:

1. Size, fabrication and installation details.
2. Louver number and minimum data that is shown on and arrangement of data shall be similar to drawings.
3. AMCA ratings for free area and water penetration.

#### 1.04 PROJECT/SITE CONDITIONS

- A. Coordinate with mechanical ductwork as required.
- B. Coordinate with generator requirements.
- C. Coordinate with exhaust ventilation fans and systems.



## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the contract documents, the following manufacturers are acceptable:

1. Louvers:
  - a. Airolite Company
  - b. Construction Specialties, Inc.
  - c. Ruskin Manufacturing
  - d. Barber Coleman
  - e. Industrial Louvers, Inc.
  - f. Airolite
  - g. Ellison
  - h. American Warming
  - i. Northland
  - j. United Air

### 2.02 MATERIALS

A. Louvers: 4-inch (100 mm) thick, storm proof, with continuous blade appearance.

1. Extruded aluminum, alloy 6063T5, minimum 0.081 inches (2 mm) thick.
2. Bird screen: 1/8-inch (3 mm) aluminum mesh. Install in standard, folded frame.
3. Accessories: Anchors, fastenings, reinforcing and required ancillary items fabricated of compatible material.
4. Finish: Louvers shall receive electronically deposited color anodized finish complying with Aluminum Association Code AA-C22A44. Finish is applied to 0.7 millimeters thickness onto chemically etched and pretreated aluminum extrusion. Color shall be Dark Bronze. Contractor shall submit color for owners approval prior to ordering.
5. Provide back gravity operated damper.
6. Size as shown on construction drawings and as required to match intake exhaust system requirements.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Verify suitability of openings to accept units.
- B. Correct unsatisfactory conditions.
- C. Installation constitutes acceptance of responsibility for performance.

### 3.02 INSTALLATION/APPLICATION/ERECTION

- A. Install in accord with manufacturer's recommendations.
- B. Install anchoring and bracing accessories as required.

**END OF SECTION**

## SECTION 05600 - FIBERGLASS REINFORCED DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

##### A. General:

The Contractor shall furnish all labor, materials, tools, equipment, and services for all fiberglass reinforced plastic (FRP) doors and frames and transoms as indicated.

Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.

##### B. Work specified elsewhere but is not limited to:

Section 01330	-	Submittal Procedures
Section 03300	-	Cast-In-Place Concrete
Section 04100	-	Cement and Lime Mortars
Section 04200	-	Brick Masonry
Section 04300	-	Concrete Masonry
Section 04400	-	Masonry Cleaning
Section 05650	-	Finish Hardware
Section 09910	-	Painting

#### 1.02 SUBMITTALS

##### A. Manufacturer's product literature.

##### B. Shop drawings.

1. Shop drawings shall provide pertinent dimensions, color, hardware locations, transom and lite sizes, dimensions, and door elevations. Mortises for hardware must be molded in at the factory as the door is built. Mortises shall not be routed or cut out of the stile structure or the jambs.

#### 1.03 DELIVERY, STORAGE AND HANDLING

##### A. Deliver to the site in a sealed, undamaged container fully identified with the manufacturers name, project number, the tag location, the door type, color and weight.

##### B. The doors and frames shall be shipped in wood crates with wood perimeters.

##### C. Store materials in original cartons, on edge in such a way to prevent falling or damage to face, corners or edges.

### PART 2 - PRODUCTS

- 2.01 MANUFACTURER - Fiberglass reinforced plastic (FRP) doors, frames and transoms shall be as manufactured by CHEM-PRUF DOOR Company, Brownsville, Texas, DOR-TEC FIBERGLASS DOOR AND FRAME SYSTEMS, Eldridge, IA or approved equal.

## 2.02 MATERIALS

- A. Doors: Door shall be made of fiberglass reinforced plastic (FRP) using resins tailored to a specific corrosive environment (sanitary sewerage environments) and have a fiberglass content of 25% by weight. The doors shall be flush construction, having no seams or cracks. All mortises shall be molded in at the factory. The doors shall be 1-3/4" thick with a 15 mil (plus or minus 3 mils) color gelcoat and have an R-factor of 12. Secondary painting over pultrusion to achieve color is not acceptable.
- B. Stiles and Rails: Shall be constructed starting from the outside toward the inside, of a 15-20 mil gel coat of the color specified followed by a matrix of at least three layers of 1.5 ounce per square foot of fiberglass mat. The stile and rail shall be molded in one continuous piece to a U-shaped configuration and to the exact dimensions of the door (patented). In this manner there will be no miter joints or disparate materials used to for the one-piece stile and rail. Pultrusions will not be acceptable for stiles and rails as (1) the color gel coat is not an integral part of the structure (it must of necessity be applied as paint when the structure is assembled), and (2) mortises must be cut into the pultrusions, thus weakening the pultrusions by removing as much as two-thirds of its thickness and (3) the practice of mitered joints in pultrusions leaves access areas for penetration of contaminants to the inside of the door.
- C. Door Plates: Shall be molded in one continuous piece, starting with a 15-20 mil gel coat of the color specified, integrally molded with at least two layers of 1.5 ounce per square foot fiberglass mat and layer of 16 ounce per square yard unidirectional glass roving.
- D. Reinforcement: Adequate reinforcing and compression members shall be used to accommodate surface hinges, closures, locksets, kickplates, push or pull plates. When engineering considerations dictate, mild steel is buried in the fiberglass matrix to provide enhanced screw holding power. In no case should screws be used unto fiberglass matrix to provide holding for hinges, locks, or closures or any structured attachment.
- Thrubolting is recommended for attachment of hinges, and closures in as much as the strength of thrubolting is five to six times as great as edge attaching with screws. When thrubolting is to occur, a compression member is to be located which will provide memory and resistance to the torquing of thrubolts.
- All voids between the door plates shall be completely filled with the equivalent of 4-6 pounds expanded polyurethane foam, having a flame spread of 25 or less per ASTM E-84. A phenolic-coated kraft honeycomb may be substituted for urethane foam where engineering requirements dictate.
- E. Flame Spread: All reinforcing resins shall contain a halogenated additive or co-reactant plus Antimony Trioxide to achieve a flame spread of 25 or less per ASTM E-84 and shall be self-extinguishing per ASTM D-635.
- F. Window Lites: All window openings and louver openings in the door schedule should be molded integrally with both door plates so that no moisture may penetrate the door cavity through the window lite structure (patented). Window lites shall be structurally retained by at least 4 fiberglass glazing pins and sealed in such a manner that the integrity of the seals remain intact.

Cutting a window opening in the door and the use of pultruded shapes for window ledges or the use of externally applied picture frames applied to retain the glass are unacceptable where sanitation and cleanliness are desired.

- G. Color: The color of the door and frame shall be integrally molded as the part is made and shall be dark brown as approved by the Owner.
- The exterior door frames and trim shall be dark brown as approved by the Owner.
- The deposit of 15-20 mils of gel coat is the equivalent of 50 to 60 coats of paint applied by spray.
- H. Frames: Frames shall be similar to the doors in construction and materials except the frame shall be solid fiberglass. The stop and frame will be molded all in one piece. The frame shall be integrally gelcoated to the approved color when molded. Mortises will be molded in. It is not permitted to rout in mortises or remove any material from the head or jambs, to provide mortises.
1. Reinforcement for mounting hinges, closures, etc., shall be of mild steel plates strategically located and buried in the resin-glass matrix so they will not be exposed to elements.
  2. The jamb shall be flat on the backside (against the opening) and uniform in thickness so as to provide a solid, uniform surface against the wall opening. No wood blocks or spacers are permitted.
- I. Louvers: Louvers shall be identical to the doors in construction, materials and color. The fins shall be solid fiberglass. (Patented)
- J. Transoms: All transoms shall be identical to the doors in construction, materials, thickness, and reinforcement.
- K. Hardware: All hardware where applicable (locksets, hinges, closures, etc.) shall be installed at the door manufacturing plant. The hardware manufacturer's warranty shall be included with the hardware installation.

#### PART 3 - EXECUTION

- A. Installation: Installation shall be in strict compliance with manufacturer's written instructions using non-corrosive materials and methods.

#### PART 4 - GUARANTEE

- A. Guarantee: The door manufacturer shall unconditionally guarantee its doors for ten years against failure due to corrosion from the wastewater lift station environment.

**END OF SECTION**

## SECTIONS 05650 - FINISH HARDWARE

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. General: The contractor shall furnish all labor, materials, tools, equipment, and services for all finish hardware, as indicated.

Although such work is not specifically indicated, provide and install supplementary or miscellaneous items, appurtenances and devices incidental to, or necessary for, a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.

- B. Work specified elsewhere but is not limited to:

Section 01330	-	Submittal Procedures
Section 04400	-	Masonry Cleaning
Section 04800	-	Joint Sealants
Section 05600	-	Fiberglass Reinforced Doors and Frames

#### 1.02 QUALITY ASSURANCE

- A. Finish designations and standards: Builders Hardware Manufacturers Association (BHMA) Standard 1301.
- B. Installer qualifications: Supervised or inspected by certified Architectural Hardware Consultant (AHC).

#### 1.03 SUBMITTALS

- A. Shop drawings:
1. Catalog cuts.
- B. Project data:
1. Operating and maintenance data:
    - a. Parts catalog.
    - b. Operating instructions and maintenance data.

#### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Include installation instructions.
- B. Deliver hardware items at times and to locations as directed.
- C. Check hardware reorder missing items.
- D. Control items before and after installation so that completion will not be delayed by hardware losses.
- E. Protect finishes by temporary coverings as required.

F. Deliver extra hardware to the Owner, boxed and identified.

#### 1.05 PROJECT CONDITIONS

A. Coordinate installation with finishing operations.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers or equal are acceptable:

1. Lock sets and latch sets:
  - a. Corbin Russwin
2. Closers:
  - a. Norton
3. Hinges:
  - a. Chem-Pruf Door Company
4. Door trim:
  - a. Chem-Pruf Door Company
5. Weatherstripping and thresholds:
  - a. National Guard Products, Inc.
  - b. Pemko Manufacturing Company.
  - c. Reese Enterprises, Inc.
  - d. Zero Weatherstripping, Inc.

#### 2.02 MATERIALS

A. Hardware - General:

1. Furnish items of hardware for proper door swing.
2. Provide strike boxes.
3. Provide lock devices which allow doors to be opened from inside room without a key.
4. Provide dust-proof strikes for all doors with automatic or manual flush bolts or other bolts to floor.
5. Finishes:
  - a. Locks: 630
  - b. Kick plates: 630
  - c. Butts: 630
  - d. Door stops, ded locks, mortise bolts, and miscellaneous hardware: 630
  - e. Exposed arms and covers of closers. Auminum

- B. Fasteners:
1. Manufacture hardware to conform to templates.
  2. Generally, prepare for Phillips oval head machine screw installation.
  3. Exposed screws to match hardware finish or, if expose in surfaces of other work, to match finish of other work as closely as possible.
  4. For mineral core doors, use screws which thread to head to apply butts.
  5. Provide concealed fasteners unless through bolted.
  6. Through bolt closers exterior doors.
  7. Provide noncorrosive fasteners.
- C. Locks and latches: Locks and latches shall be a Corbin Russwin heavy duty cylindrical knob lock set CK4251 keyed to match the Owners lock system. The Contractor shall request a key for keying the lockset from the Project Inspector.
- D. Door closers: ANSI A156.4, Grade 1.
1. Shall be a Norton Yale Security Inc. Series 7500 CLpT SRI AL
  2. Supply arms, brackets, and plates, as required.
  3. All closers with integral back checks and cold weather fluid.
  4. Other exterior out-swinging doors: Closer with overhead stop.
- E. Hnges: ANSI A156.1. Shall be a Chem-Pruf 304 stainless steel NRP-Half Surface hinge with polymer bearings.
- F. Thresholds: ANSI A156.6, Type J600, aluminum.
1. Provide one piece unit not more than 1/2-inch high of style required.
  2. Provide required bolt cutouts.
- G. Hardware, miscellaneous:
1. Standard items by Chem-Pruc Door Company, Inc.
- H. Weatherstripping:
1. National Guard Products, Inc. perimeter seals, 160 DKB and 200 NDKB.
- I. Operation - Keying.
1. Establish keying with the City of Newport News.
    - a. Tag and identify keys.
    - b. Provide three keys for each lock or cylinder.
    - c. Master key and key in groups as directed.
    - d. Key to existing master key system.
    - e. Provide construction master key for exterior door.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Verify suitability of substrate to accept installation.



B. Installation constitutes responsibility for performance.

3.02 INSTALLATION/APPLICATION/ERECTION

A. Install in accordance with manufacturer's installation instructions.

B. Use SDI mounting heights for hardware.

3.03 ADJUSTING AND CLEANING

A. Adjust and check each operating item of hardware to ensure proper operation of function.

1. Lubricate moving parts with lubricant recommended by manufacturer.
2. Replace units which cannot be adjusted and lubricated to operate smoothly.

B. When hardware is installed more than one month prior to startup and demonstration, final acceptance or occupancy, during week prior to acceptance or occupancy, make a final check and adjustment of all hardware items.

1. Clean and lubricate as necessary to assure proper function and finish.
2. Adjust door control devices to compensate for operation of heating and ventilating equipment.

C. Instruct the Owner personnel:

1. Operating and maintenance procedures.
2. Key control system.

**END OF SECTION**

## SECTION 06210 - CARPENTRY

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. General: Applicable provisions for the Contract Drawings and General Conditions govern this section.
- B. Scope of Work: Furnish all labor, materials and equipment for the complete installation of all carpentry and carpentry related work. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.
- C. Work specified elsewhere but is not limited to:
  - Section 01330 - Submittal Procedures
  - Section 03300 - Cast-In-Place Concrete
  - Section 04200 - Brick Masonry
  - Section 04300 - Concrete Masonry
  - Section 07150 - Bituminous Dampproofing
  - Section 07400 - Building Insulation
  - Section 09910 - Painting
  - Section 16010 - Electrical General Provisions

#### 1.02 General:

- A. Installer must examine all parts for the supporting structure and the conditions under which the carpentry work is to be installed, and notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.
- C. Delivery and Storage: Keep materials dry during delivery and storage. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation within stacks.
- D. Protect installed carpentry work from damage by work of other trades until owner's acceptance of the work. Advise contractor or required protection procedures.

#### 1.03 Carpentry Materials:

- A. Lumber shall be sound, free from warp and dressed, and each piece shall be grade marked.
- B. Roof rafters, joists and bridging shall be No. 1 Southern Pine.
- C. Framing lumber for blocking, plates, nailers and other incidental uses shall be No. 2 Southern Pine.
- D. Moulding and other trim shall be Grade B or better.

- E. Plywood shall be as shown on the drawings.

## PART 2 - EXECUTION

### 2.01 General

- A. Materials: Use only sound, thoroughly seasoned materials of the longest practical lengths and sizes to minimize joining. Use materials free from warp which cannot be easily corrected by anchoring and attachment. Sort out and discard warped material and material with other defects which would impair the quality of the work.
- B. Securely attach carpentry work to be substrates by anchoring and fastening as shown and as required by recognized standards.
- C. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
- D. Attachment and anchorage:
  - 1. Use common wire nails, except as otherwise shown or specified.
  - 2. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

### 2.02 RAFTER AND CEILING JOIST FRAMING

- A. Ceiling Joist: Provide member size and spacing shown,
- B. Rafters: Provide member size and spacing shown. Notch to fit exterior wall plates and anchor using special metal framing anchors. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
- C. Provide special framing as shown for eaves, overhangs, dormers and similar conditions, if any.

### 2.03 PLYWOOD ROOF SHEATHING

- A. Install in accordance with APA Specifications for Unblocked Diaphragm.
- B. Apply all roof sheathing (4 x 8 sheets) with face grain perpendicular to rafters.
- C. Stagger end joints at 4-foot intervals and center on rafter.
- D. Nailing - 8 D common nails.
  - 6-inch O.C. at supported edges
  - 12-inch O.C. at intermediate supports
- E. Allow 1/6-inch open space between end joints and 1/8-inch open space between edge joint for expansion and contraction of panels.

**END OF SECTION**

## SECTION 07150 - BITUMINOUS DAMPPROOFING

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

- A. The extent of surface to receive bituminous dampproofing is shown on the drawings.
- B. General: The installer must examine the substrates and the conditions under which the dampproofing is to be applied, and advise the Contractor in writing of unsatisfactory conditions. Do not proceed with the dampproofing work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- C. Scope of Work: Furnish all labor, materials and equipment to provide bituminous dampproofing as indicated or required for completion. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications," dated August 1983, as amended, except as noted herein.
- D. Work specified elsewhere but is not limited to:
  - Section 01330 - Submittal Procedures
  - Section 03300 - Cast-In-Place Concrete
  - Section 04200 - Brick Masonry
  - Section 04300 - Concrete Masonry
  - Section 04800 - Joint Sealants

### PART 2 - MATERIALS

#### 2.01 General

- A. Materials shall be as specified on the drawings.

### PART 3 - INSTALLATION

#### 3.01 GENERAL

- A. Clean the substrate of dirt, oil, loose materials and other substances which would interfere with penetration, bond or performance of dampproofing materials.
- B. When ambient temperature is 40 F. or less and falling, do not proceed with dampproofing. Do not apply dampproofing materials to frozen substrates or to any substrate in a condition not complying with manufacturer's recommendations.
- C. Protect other work from spillage of dampproofing materials, to prevent materials from penetrating and clogging drains and conductors. Replace or restore other work which is soiled or otherwise damaged by the installation of the dampproofing and associated work.
- D. Cold bitumen on exterior surfaces and other surfaces required on plans. The exterior of the wet well shall be coated with 2 coats of bituminous material.
  - 1. Prime substrate if recommended by the manufacturer's instructions, using type and quantity of primer recommended by manufacturer.

2. Apply coat of cold, liquid bituminous dampproofing material, by brushing or spraying at the rate of 1.0 gal. Per 50 sq. ft., to produce a uniform dry film thickness of not less than 15 mils.
3. Repeat the application specified above, after allowing 24 hours of drying of first coat. Apply second coat at the rate of 1.0 gal. Per 50 sq. ft., except double the thickness of second coating where first application has failed to produce a smooth, lustrous impervious coating.

**END OF SECTION**

## SECTION 07310 - ROOFING

### PART 1 - DESCRIPTION

#### 1.01 SCOPE

- A. General: Applicable provisions for the Contract Drawings and General Conditions govern this section.
- B. Scope of Work: furnish all labor, materials and equipment for the complete installation of the roofing, shingles, rafter, felt and roofing related work. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.
- C. Work specified elsewhere but is not limited to:
  - Section 01330 - Submitted Procedures
  - Section 06210 - Carpentry
  - Section 07150 - Bituminous Dampproofing

### PART 2 - GENERAL

#### 2.01 GENERAL

- A. Work shall be first class in all respect, such that the completed roofing results in a watertight installation for the complete work.

### PART 3 - MATERIALS

#### 3.01 Asphalt

- A. Asphalt saturated rag felt shall be laid in horizontal layers with joints lapped toward the eaves, at least 2 inches, and lapped at ends, at least 6 inches.

#### 3.02 Shingles

- A. Shingles shall be as indicated on the plans. Shingles shall be installed in accordance with manufacturer's instructions. Cracked shingles or shingles with broken corners shall not be used. Shingles shall be double lapped at ridge and embedded in Johns-Manville block plastic cement.

**END OF SECTION**

## SECTION 07400- BUILDING INSULATION

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

##### A. General:

1. The Contractor shall furnish all labor, materials, tools, equipment and services for all building insulation as indicated.
2. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.

##### B. Work specified elsewhere but is not limited to:

- |               |   |                               |
|---------------|---|-------------------------------|
| Section 01330 | - | Submittal Procedures          |
| Section 04200 | - | Brick Masonry                 |
| Section 04300 | - | Concrete Masonry              |
| Section 06210 | - | Carpentry                     |
| Section 07150 | - | Bituminous Dampproofing       |
| Section 07310 | - | Roofing                       |
| Section 09910 | - | Painting                      |
| Section 16010 | - | Electrical General Provisions |

#### 1.02 QUALITY ASSURANCE

##### A. Insulation reference standards:

1. U/L requirements.
2. ASTM E119.
3. ASTM E84.

#### 1.03 SUBMITTALS

##### A. Product data.

1. Manufacturer's specifications and installation instructions.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

##### A. Subject to compliance with the Contract Documents, the following manufacturers or equal are acceptable.

1. Rigid board insulation:



- a. Dow Chemical Co.
  - b. UC Industries (USG/Condec).
  - c. Minnesota Diversified Products, Inc.
2. Blanket or batt insulation:
- a. Owens-Corning Fiberglass Corporation.
  - b. United States Gypsum Co. (USG).

## 2.02 MATERIALS

- A. Insulation, rigid board: Foamed, extruded polystyrene.
1. Compressive strength: 18 PSI min.
  2. Vapor transmission: 0.75 perm-in., max.
  3. Water absorption: 0.6 percent max.
  4. Thermal conductivity (k-value at 75 degF (23 degC)): 0.20.
  5. Integral high-density skin.
  6. F.S.HH-I-524B, Type II Class B.
- B. Sealant and mastic (for setting polystyrene insulation board): Manufacturer's recommended standard.
- C. Insulation, blanket or batt: Glass or other inorganic fibers and resinous binders formed into flexible blankets or semirigid sheets.
1. Thermal conductivity (k-value at 75 degF (23degC)): 0.27.
  2. Foil faced vapor barrier laminated to one face.
  3. E84 flame spread: Not greater than 25.
  4. Minimum thickness: R-19.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Verify suitability of substrate to accept installation.
- B. Installation indicates acceptance of responsibility for performance.

### 3.02 INSTALLATION/APPLICATION/ERECTION

- A. General:
1. Insulate full thickness over surfaces to be insulated.

2. Fit tightly around obstructions, fill voids.
  3. Cover all penetrations with insulation.
  4. Seal all joints with sealant or tape as applicable.
  5. Seal or tape to abutting materials to maintain vapor tightness.
  6. Tape butted joints of batt or blanket insulations.
  7. Comply with manufacturer's instructions for installation unless more stringent requirements are specified. If not available or not applicable, consult manufacturer's technical representative for specific recommendations before proceeding with work.
  8. Apply single layer to achieve total thickness.
  9. Do not use broken or torn pieces of insulation.
  10. Install so that completed installation is vapor tight.
  11. Repair any areas to ensure vapor tight integrity.
- B. Installation - blanket or batt insulation.
1. Set with vapor barrier to inside of building; do not obstruct ventilation spaces.
  2. Secure units per manufacturer's recommendations.
  3. Fill all miscellaneous voids indicated to be insulated.
  4. Tape joints and ruptures in vapor barrier.
  5. Use vapor barrier tape and seal each area of insulation to surrounding construction to ensure vapor-tight installation.
- C. Installation - rigid board insulation in cavity walls.
1. Do not proceed with installation until subsequent work which conceals insulation is ready to be performed.
  2. Extend insulation full thickness in one layer over entire area to be insulated.
  3. Install solid coating of mastic on inside wythe of masonry.
  4. Press courses of insulation between wall ties (horizontal reinforcing) with edges butted tightly both ways.
  5. Set units firmly into mastic.
  6. Caulk all joints.

**END OF SECTION**

## SECTION 09910 - PAINTING

### PART 1 - GENERAL

#### 1.01 SCOPE

A. Work specified elsewhere, but not limited to :

Section 01330	-	Submittal Procedures
Section 03300	-	Cast-In-Place Concrete
Section 04300	-	Concrete Masonry
Section 05500	-	Structural and Miscellaneous Metals
Section 05550	-	Louvers and Vents
Section 05600	-	Fiberglass Reinforced Plastic Doors and Frames
Section 06210	-	Carpentry
Section 15010	-	Mechanical Equipment
Section 16010	-	Electrical General Provisions
Section 16210	-	Raceway, Fittings and Boxes
Section 16220	-	Enclosed Circuit Breakers
Section 16310	-	Panelboards
Section 16550	-	Emergency Power System
Section 16675	-	Pump Control Panel

B. This specification covers preparation of surfaces, performance and completion of painting of all surfaces as required by the drawings and as specified herein.

C. The Contractor shall furnish all supervision, labor, tools, materials, equipment, scaffolding and/or other structure, and supervision required for the transportation, unloading, storage and application of the paint and associated products covered by this specification.

D. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein

E. All work shall be done in strict accordance with this specification, the design drawings and the painting package, including manufacturer's printed instructions.

F. The Contractor will obtain, at its own expense, all permits, licenses and inspections and shall comply with all laws, codes, ordinances, rules and regulations promulgated by authorities having jurisdiction which may bear on the work. This compliance will include Federal Public Law 91-596 more commonly known as the "Occupational Safety and Health Act of 1970."

#### 1.02 PAINTING NOT INCLUDED:

A. The following categories of work are not included as part of the painter-applied finish work, or are included in other sections of these specifications, unless otherwise shown or specified.

1. Pre-finished items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for finished mechanical and electrical equipment including light fixtures.

2. Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas.
3. Finished metal surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, except as otherwise indicated.

1.03 QUALITY ASSURANCE:

A. Include on label or containers:

1. Manufacturer's name
2. Product name & number
3. Color
4. Batch number

B. Resolution of Conflicts:

Clarification shall be requested promptly from the Owner when instructions are lacking, conflicts occur in the specification, or the procedure seems improper or inappropriate for any reason.

C. Resolution of Conflicts:

Copies of all manufacturer's instructions and recommendations shall be furnished to the Owner by the Painting Contractor.

1.04 SUBMITTALS:

- A. A list of coating materials giving the manufacturer's name, product name & product line number for each materials.
- B. Two copies of the manufacturer's technical data sheet for each coating, giving descriptive data, curing time, mixing, thinning and application instructions.
- C. Color Samples:
  1. Two samples of each color specified for the project;
  2. Prepare samples of clear and stained finished on the same type and grade of substrate specified for the project;
  3. Make color sample at least 5" X 7" in size.
- D. Certificates: Manufacturer's certified test reports confirming compliance with specified performance.

1.05 PRODUCT DELIVERY, STORAGE & HANDLING

- A. Deliver materials in sealed containers with manufacturer's label intact;

B. Storage of materials:

1. Store materials in a protected area at a temperature between 40° F and 110° F.
2. Open and mix materials in storage area.

1.06 JOB CONDITIONS:

A. Apply coating only under the following prevailing environmental conditions.

1. Air and surface temperatures are not below 50° F. or above 110° F.
2. Relative humidity is not higher than 85% and the surface temperature is at least 5° F. above the dew point.
3. Wind velocity is under 15 mph for exterior spray painting.
4. The atmosphere is relatively free of airborne dust.

B. Cover or otherwise protect surfaces not to be painted.

C. Protection: Protect work of other trades, whether to be painted or not, against damage painting and finishing work. Correct any damages by cleaning, repairing or replacing, and repainting, as directed by the Owner.

D. Clean-up: During the progress of the work, remove from the project daily all discarded paint materials, rubbish, cans and rags.

1.07 SAFETY:

A. Submit to the client, current manufacturer's product data sheets as well as Material Safety Data Sheets. Also, have these documents available to your employees at the jobsite. These are considered working documents - be familiar with them.

B. Make sure your employees are aware of any hazards peculiar to the jobsite, as well as location of first aid stations, emergency phone numbers and evacuation routes.

C. Report to a responsible person such as safety engineer, sub-contracts administrator, etc., any condition which may pose a threat to the health and welfare of your employees.

D. Keep your own working area clean and safe.

E. Obey all jobsite rules and regulations.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products specified are manufactured by Tnemec Company, Inc., North Kansas City, Missouri, and are specified as a standard of quality.

- B. Equivalent materials of other manufacturers may be substituted only by approval of the Owner. Requests for substitution shall include manufacturer's literature for each product giving the name, generic type, descriptive information, solids by volume, recommended dry film thickness and a list of five projects where each product has been used and rendered satisfactory service. No request for substitution shall be considered that would decrease film thickness or offer a change in the generic type of coating specified. Manufacturer's certified test reports showing that the substitute product(s) equal or exceed the performance of the specified products shall be submitted.
- C. Products for each specified function and system shall be of a single manufacturer.

## 2.02 APPROVED MATERIALS

- A. Aliphatic Acrylic Hi-Build Polyurethane Enamel  
Series 74 and 75 Endura-Shield
- B. Moisture-Cured Rust-Inhibitive Urethane Primer  
Series 50-330 Poly-Ura-Prime
- C. Water-Borne Acrylic-Epoxy Coating  
Series 114 H. B. Tneme-Tufcoat
- D. Vinyl Ester Coating  
Series 120 Vinester
- E. Heat-Resistant Aluminum Coatings  
Series 39 Silicone Aluminum
- F. Hi-Build Polyamide Epoxy Primer and Finish  
Series 66 Hi-Build Epoxoline
- G. Oil-Cementitious Exterior Coating  
Series 22 Galv-Guard
- H. Modified-Acrylate Elastomer Coating (Sand and Smooth Finish)  
Series 156 and 157 Enviro-Crete
- I. 100% Catalyzed Epoxy Surfacer and Filler  
Series 63-1500 Filler and Surfacer
- J. Epoxy-Polyimide Potable Water Tank System  
Series 20 Pota-Pox
- K. Vinyl Ester Filler and Surfacer  
Series 120-5003 Vinester F & S
- L. Polyamine Epoxy Floor Primer  
Series 201 Epoxoprime
- M. Polyamine Epoxy Floor Sealer  
Series 281 Tneme-Glaze or Non-Skid

- N. Modified Acrylic Masonry Filler  
Series 130 Environfill
- O. Aklyd Wood Primer  
Series 36-603 Undercoater
- P. Alkyd Enamel  
Series 2H Hi-build Tneme-Gloss
- Q. Emulsified Acrylic Coating  
Series 6 Tneme-Cryl
- R. Enhanced Aliphatic-Polyester Polyurethane  
Series 291 CRU

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. All surface preparation, coating and painting shall conform to applicable standards of the Steel Structures Painting Council (SSPC), and the manufacturer's printed instructions. Material applied prior to approval of the surface by the Owner shall be removed and reapplied to the satisfaction of the Owner at the expense of the contractor.
- B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be maintained and transfers of key personnel shall be coordinated with the Owner.
- C. The contractor shall provide a supervisor at the work site during cleaning and application operation. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining the fulfillment of the contract.
- D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags per SSPC-SP1.
- E. Coating and painting systems include surface preparations, prime coating and finish coatings. Any off-site work which does not conform to this specification is subject to rejection by the Owner.
- F. Shop applied prime coatings which are damaged during transportation, construction or installation shall be thoroughly cleaned and touched up in the field as directed by the Owner. The contractor shall use repair procedures which insure the complete protection of all adjacent primer. The specified repair method and equipment may include wirebrushing, hand or power tool cleaning or dry air blast cleaning. In order to prevent injury to surrounding painted areas, blast cleaning may require use of lower air pressure, small nozzle and abrasive particle sizes, short blast nozzle distance from surface, shielding and masking. If damage is too extensive or uneconomical to tough-up, then the item shall be re-cleaned and coated or painted as directed by the engineer.
- G. Application of the first coat shall follow immediately after surface preparation and cleaning and within an eight hour working day. Any cleaned areas not receiving first coat within an eight hour period shall be re-cleaned prior to application of first coat.

- H. Prior to assembly, all surface made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or paint system specified.

### 3.02 PRE-WORK INSPECTION

- A. Examine surfaces to be coated and report any conditions that would adversely affect the appearance or performance of the coating systems and which cannot be put into an acceptable condition by the preparatory work.
- B. Do not proceed with surface preparation and application until the surface is acceptable or authorization to proceed is given by the Owner.

### 3.03 SURFACE PREPARATION:

#### A. General

1. Dislodge dirt, plaster nibs, mortar spatter and other dry material by scraping or brushing. Remove dust and loose material by brushing, sweeping, vacuuming or blowing with high-pressure air.
2. Remove oil, wax, grease by scraping off heavy deposits and cleaning with mineral spirits or a hot trisodium phosphate solution followed by a water rinse.
3. Verify that surfaces to be coated are dry, clean and free of dust, dirt, oil, wax, grease or other contaminants.

#### B. Concrete, Masonry and Cement Stucco

1. Allow new concrete masonry to cure 28 days.
2. Scrape or grind fins and protrusions flush with the surface.
3. Patch holes and cracks flush with the surface using a Portland cement grout or an approved patching material.
4. Rake mortar joints clean.
5. Remove surface laitance or efflorescence by acid etching or whip sandblasting.



C. Plaster

1. Remove nibs and other protrusions by scraping flush with the surface; sand smooth.
2. Patch voids and cracks with speckling compound to match the texture of the surface.

D. Gypsum Wallboard

1. Sand joint compound smooth and flush with the surface using fine grit sandpaper.
2. Fill nicks, scratches, holes and uneven spots with speckling compound and, after dry, sand flush with the surface.

E. Shop-primed Metal

Hand or power tool clean field connections, welds, burned and abraded areas to remove rust and contaminants and touch up with specified primer before further use occurs.

F. Concrete Floors

Acid etch or brush blast to achieve a uniform surface profile comparable to one hundred grit or medium textured sand paper following manufacturer's recommended procedures.

G. Ferrous and Non-ferrous Metals

1. Solvent Cleaning (SPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.
2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wirebrushing.
3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wirebrushing, power impact tools or power sanders.
4. White Metal Blast Cleaning (SSPC-SP5): Blast clean to a gray-white uniform metallic color until each element of surface area is free of all visible residues.
5. Commercial Blast Cleaning (SSPC-SP6): Blast cleaning until at least two thirds of each element of surface area is free of all visible residues.

H. Lightweight Metal:

Prepare surfaces in accordance with SSPC-SP3 hand or power tool cleaning.

I. Galvanized Steel:

Prepare surfaces by Solvent Cleaning in accordance with SSPC-SP1.

3.04 APPLICATION:

- A. Mix and thin materials in accordance with the manufacturer's printed instructions.
- B. Apply materials at specified film thickness by method recommended by the manufacturer.
- C. Allow each coat to dry thoroughly before recoating.
- D. Vary color slightly for each successive coat.
- E. Cut in edges clean and sharp where work joints other materials or colors.
- F. Make finish coats smooth, uniform in color, and free of brush marks, laps, runs, dry spray, over spray and skipped or missed areas.
- G. Environmental conditions must comply with the recommended instructions of the manufacturer and be in accordance with the coating manufacturer's printed instructions.

3.05 INSPECTION:

- A. Request acceptance of each coat before applying succeeding coats.
- B. Touch-up and repair all work that is not acceptable to the Owner and request final acceptance.

3.06 CLEANING:

- A. Remove paint spatters from glass, plumbing fixtures and adjoining surfaces.
- B. Repair any damage to coatings or surfaces caused by cleaning operation start.
- C. Remove debris from job site and leave storage area clean.

Alphabetic designations in the following schedule refer to Approved Materials listed in paragraph 2.02.

	FIELD COATS		
	1	2	3
Structural Steel & Miscellaneous Iron:	F	A	
Exterior	F	F	
Interior:	F	F	
Trolley Beam:	F	F	
Submerged:	F	F	
Castings, Cast-Iron Pipe & Fittings			
Non-submerged:	F	F	
Submerged:	F	F	
Electrical Conduit & Miscellaneous Fabrications:	F	F	
Interior	F	F	
Exterior	F	F	
Unit Heaters, Ventilating Equipment Valves & Hangers:			
Interior:	F	F	

Exterior:	F	A	
Interior Wood:	O	P	P
Machinery, Interior & Non-Submerged:	F	F	
Interior Concrete Masonry Units, Dry Well Concrete Walls, Beams & Ceilings	F	F	F
Water Pipe	F	F	
Steps	F	F	
First Step and Around Perimeter of Hatches	F	F	

PAINTING COLOR SCHEDULE

<b>ITEM</b>	<b>COLOR</b>
Electrical	Red (Interior) Brown (Exterior)
Pumps	Green
Wastewater Pipe	Green
Water Pipe	Light Blue
Steps	Silver
Vent fans and covers	Silver
Bird Screen	Silver
First step and around perimeter of hatches	Safety Orange
By-Pass Stands	Green (Plug: Silver)
Fuel Lines	Yellow
Walls and Ceilings	White

**END OF SECTION**

## SECTION 15010

### MECHANICAL EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION OF WORK

- A. General: applicable provisions of the contract drawings and general conditions govern work.
- B. Scope of work: the work includes furnishing all labor, material and plant and installing all mechanical equipment necessary to the intended operation of the pumping station. While every effort has been made to show all necessary details of the equipment required, it is the intent of the plans and specifications to provide a completed, operable facility whether all minor components of construction are noted or not. All materials and work shall be in conformance with the city of Newport News, department of engineering, "standard specifications", dated august 1983, as amended, except as noted herein.
- C. Work specified elsewhere but is not limited to:
- Section 01330 - submittal procedures
  - Section 01781 - operation and maintenance data/manual
  - Section 03300 - cast-in-place concrete
  - Section 04200 - brick masonry
  - Section 04300 - concrete masonry
  - Section 16010 - electrical general provisions
  - Section 16550 - automatic transfer switch and sound attenuating sound enclosure
  - Section 16675 - pump control panel

##### 1.02 MANUFACTURERS

- A. Manufacturers of equipment covered by these specifications shall be reputable firms with at least five years experience in the manufacturer, testing and supervision of installation and operation of the equipment. All materials and equipment furnished shall be guaranteed free from defects in workmanship or design, and the contractor shall replace, without cost to the owner, any part or equipment which is defective or shows undue wear within one year after the equipment has been in permanent operation.

##### 1.03 SUBMITTALS

- A. Shop drawings of all equipment shall be submitted to the owner for approval. Information shall include dimensions, capacity, material, finish, guarantee, etc.

- B. Six (6) copies of a complete operations manual for all equipment, including detail drawings, maintenance instructions and other pertinent data shall be compiled and submitted to the owner for review and approval before acceptance of the facility.

#### **1.05 SEWAGE PUMPING UNITS**

- A. Furnish and install a quantity of 3-200 HP sewage pumping units in accordance with Section \_\_\_\_\_.

#### **1.06 VENTILATION MATERIALS AND EQUIPMENT**

- A. Ventilation work shall include the furnishing of all ductwork, exhaust fans and fan work. The purpose of the plans is to show the general arrangement and location of the various components of the ventilation system. Some flexibility in arrangement and locations may be permissible; however, no alterations shall be made except with the specific approval of the owner.
- B. All equipment shall be new and shall conform to underwriter's laboratories, incorporated, standards. The installation of the work shall be performed by skilled mechanics and shall comply with all requirements of the national fire protection association.
- C. Detail drawings: shop drawings of all equipment shall be submitted to the owner for approval. Drawings shall show dimensions, capacity, material, finish, guarantee, etc.
- D. Sheet metal work: metal ductwork shall be 1/16-inch thick aluminum alloy 6061-16. Ductwork shall be secured to the walls with 1-inch wide, 1/8-inch thick aluminum straps on 36-inch centers. Where cutting of walls is necessary for installation of ductwork, cuts shall be made as neatly as possible and after completion of the work shall be patched and the rough openings shall be covered with flashing. All aluminum which comes in contact with concrete surfaces shall be coated with a bituminous paint.
- E. All PVC ductwork shall be as shown on the plans and shall be Schedule 80 PVC. It shall be secured to the walls as specified for metal ductwork.
- F. Exhaust fans:
  - 1. The motor room ventilation fans shall be Greenheck sidewall propeller, direct drive model SE1-12-432-G-1, 1/12 HP, 1350 RPM 911 CFM @ .15" S.P., 120 volt, single phase, with aluminum back draft damper, HOA switch, thermostat and bird screen.

2. The wet well vent fan shall be Greenheck, belt drive, centrifugal Inline Fan Model BSQ-160-30 delivering 4500 cfm @ 1.25" S.P., 3 HP, single phase, 120 volt, 1800 RPM spark proof motor. Provide roof curb to match roof slope, Greenheck MODEL GPF, and curb cap, Greenheck MODEL GRSR. Fan shall provide 30 air changes per hour.
3. The dry well vent fan shall be Greenheck, direct drive, centrifugal Inline Fan Model BSQ-160-30 delivering 5300 cfm @ .75" S.P., 3 HP, single phase, 120 volt, 2000 RPM. Provide roof curb to match roof slope, Greenheck MODEL GPF, and curb cap, Greenheck MODEL GRSR. Fan shall provide 30 air changes per hour.

G. Motor driven trolley and electric chain hoist:

1. The motor driven trolley and electric chain hoist shall be as manufactured by CM Solutions, Lodestar Series XL. The trolley and chain hoist shall be furnished as one unit with a single point electrical connection, 460 volt, 3 phase, 60 Hz. and a common controller.
2. The motor driven trolley shall be rated at ¼ HP, 460 volt, 3 phase, 60 Hz, 50 FPM, 3 ton capacity, Lodestar Series XL.
3. The electric chain hoist shall be Lodestar Series XL, 30 FT lift, 12 FPM, single speed, 2 HP, 460 volt, 3 phase, 60 Hz, 3 ton capacity. Supply and install cable reel system for unit power cord.

H. Electric Unit Heaters:

1. The control room electric unit heaters (2) shall be Reznor Model #AEUH7.0, 7.0 KW, 480 volt, 3 phase with wall mounted thermostat, lockout switch and wall mounting bracket.
2. The dry well electric unit heaters (1) shall be Reznor Model #AEUH20.0, 20.0 KW, 480 volt, 3 phase with wall mounted thermostat, lockout switch and wall mounting bracket.

I. Dehumidifier:

1. The electric dehumidifier shall be 120 volt, 1 phase, 50 pint minimum capacity, 200 CFM @ 80 degrees FDB/ 50% RH entering air temperature. Provide drain line to sump.

## **1.07 MISCELLANEOUS**

- A. Painting: the entire pump assemblies shall receive two shop coats of machinery green enamel. Paint for touch-up painting shall be supplied by the pump manufacturer.
- B. Supervision of installation. The pump manufacturer shall furnish a service representative to supervise and inspect the installation and initial operation of the pump.

## **1.08 ALARM SYSTEM**

- C. The contractor shall furnish and install complete; all internal alarm systems, circuits, sensing devices and appurtenant equipment to provide the specified alarm and operational information to the Newport news operations center. The alarm transmitter shall be Motorola (model MRU plus) advanced alarm status or equal. Location and height of antennae must be sufficient to ensure that the alarm signal will be received at the Newport News operations center.
- D. System equipment: the contractor shall furnish and install all sensing and transmitting equipment required to integrate all alarms listed in Section 16675

## **PART 2 - TESTS**

### **2.01 GENERAL**

- A. Manufacturer to furnish percentage of efficiency, percentage of pf, amp at full load, 3/4 load, 1/2 load with quotation and be prepared to furnish actual test results on individual ratings if requested.
- B. All equipment shall be tested under operating conditions. The necessary gauges, meters and devices required to display compliance of the equipment with the specifications shall be furnished by the contractor.

## **PART 3 – INTERCOM SYSTEM**

### **3.01 GENERAL**

- A. Provide an industrial intercom system for the pump station consisting of a master intercom in the control room and a hands-free slave intercom at the wet well as shown on the plans.
- B. Intercom shall consist of solid state amplifier with controls and speaker/microphone in a sealed, submergence-proof cast aluminum case. Amplifier shall amplify both transmitted and received signals. Unit shall operate on 120 volt, 60 HZ power and draw from 9 VA standby to 25 VA at full output of 8 watts. Output impedance will



be 8 ohms at 2 volts RMS. Input impedance will vary from 500 ohms at full volume to 10k ohms at off position. Unit shall operate from 0 to 150 degrees F.

- C. The intercoms shall be furnished with the required audio cable and conduit of sufficient length to connect the intercoms
- D. The intercom system shall be Atkinson Dynamics, or equal.

## **PART 4 - EXECUTION**

### **4.01 INSTALLATION**

- A. Installation of all equipment shall be accomplished in accordance with contract drawings and the equipment manufacturer's recommendations. Equipment must be properly aligned and anchored to prevent movement or undue stress or associated components or adjacent equipment.
- B. The contractor shall verify that the openings called for on the contract drawings are of the correct dimensions to facilitate the installation of the equipment to be provided.

**END OF SECTION**

## SECTION 15020 - TEMPORARY BY-PASS PUMPING SYSTEM

### PART 1 - GENERAL

#### 1.01 DESCRIPTION OF WORK

- A. General: Applicable provisions of the contract Drawings, Technical Specifications and General Conditions shall govern this work.
- B. Scope of Work: Under this item the Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary by-pass pumping system for the purpose of diverting the existing sanitary sewer flow around the work area during by-pass pumping operations. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.
- C. Work specified elsewhere but is not limited to:
  - Section 01330 - Submittal Procedures

#### 1.02 MANUFACTURERS

- A. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Owner that he specializes in the design and operation of temporary by-pass pumping systems. The vendor shall provide at least five (5) references of projects of a similar size and complexity as this project performed by his firm within the past three (3) years. The by-pass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- B. ACCEPTABLE VENDORS:
  - 1. Godwin Pumps of America, Inc.  
120 Dorset Avenue  
Virginia Beach, Virginia 23462
  - 2. Sunbelt Rentals Pump and Power Services.  
4750 Baxter Road  
Virginia Beach, Virginia 23462
  - 3. Rain For Rent  
P.O. Box 1077  
Hopewell, Virginia 23860
  - 4. Or approved equal.

#### 1.03 SUBMITTALS

- A. The Contractor shall submit to the Owner detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of sanitary sewerage flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and by-pass pumping locations from damage due to the discharge flows; and compliance with the requirements and permit conditions specified in these contract documents. No construction shall begin until all provisions and

requirements have been reviewed and approved by the Owner.

B. The plan shall include, but not be limited to, the following details.

1. Staging areas for pumps;
2. Sewer plugging method and types of plugs;
3. Number, size, material, location and method of installation of suction piping;
4. Number, size, material, location and method of installation of discharge piping.
5. By-pass pump sizes, capacity, number of each size to be on site and power requirements;
6. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);
7. Standby power generator size, location;
8. Downstream discharge plan;
9. Method of protecting discharge manholes or structures from erosion and damage;
10. Thrust and restraint block sizes and locations;
11. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill;
12. Method of noise control for each pump and/or generator;
13. Any temporary pipe supports and anchoring required;
14. Design plans and computation for access to by-pass pumping locations indicated on the drawings;
15. Calculations for selection of by-pass pumping pipe size;
16. Schedule for installation of and maintenance of by-pass pumping lines; and
17. Plan indicating selection location of by-pass pumping line locations.

#### 1.04 EQUIPMENT

- A. All pumps used shall be centrifugal, end suction, fully automatic self-priming units that do not require the use of foot-valves in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.
- B. All pumps shall be Godwin “Dri-prime” Automatic Self-priming Pumps (CD, DPC, or HL Series) as manufactured by Godwin Pumps of America, Inc. or Gorman Rupp Automatic Self Priming Pump (PA Series) as manufactured by The Gorman Rupp Company or approved equal.
- C. The Contractor shall provide the necessary stop-start controls for each pump.

- D. The Contractor shall include one stand-by pump of each size to be maintained on site.
- E. Back-up pumps shall be on-line, isolated from the primary system by a valve.
- F. Discharge Piping - in order to prevent the accidental spillage of flows all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Under no circumstances will aluminum "Irrigation" type piping or glued PVC pipe be allowed. Discharge hose will only be allowed in short sections and by specific permission from the Owner.
- G. Allowable piping materials will be Godwin 'QD' steel pipe (Godwin Pumps of America, Inc.) or fused, high density polyethylene pipe as manufactured by Phillips Driscopipe, Inc. or approved equal.

## 1.05 SYSTEM DESCRIPTION

### A. DESIGN REQUIREMENTS:

1. By-pass pumping systems shall have sufficient capacity to pump a peak flow of 750 gpm at 143 feet TDH and 750 gpm at 30 feet TDH. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow can be safely diverted. By-pass pumping system shall be operated 24 hours per day.
2. The Contractor shall provide standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each size pump utilized shall be installed and ready for use in the event of primary pump failure.
3. By-pass pumping system shall be capable of by-passing the flow around the work area.
4. The Contractor shall make all arrangements for by-pass pumping during the time when the station is shut down for any reason. System must overcome any existence force main pressure on discharge.

### B. PERFORMANCE REQUIREMENTS:

1. It is essential to the operation of the existing sewerage system that there be no interruption in the flow of sewage throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his work, carry it past his work and return it to the existing sewer downstream of his work.
2. The design, installation and operation of the by-pass system shall be the Contractor's responsibility. The by-pass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
3. The Contractor shall provide all necessary means to safely convey the sewage. The Contractor will not be permitted to stop or impede the main flows under any circumstances.
4. The Contractor shall maintain sewer flows in a manner that will not cause surcharging of sewers, damage to sewers, and that will protect public and private property from damage and flooding.

5. The Contractor shall protect water resources wetlands and other natural resources.
6. The Contractor shall minimize noise of by-pass equipment at all times.

C. QUALITY CONTROL AND MAINTENANCE

1. Test:

The Contractor shall perform leakage and pressure tests of the by-pass pumping discharge piping using clean water prior to actual operation. The owner will be given 24 hours notice prior to testing.

2. Inspection:

Contractor shall inspect by-pass pumping system every two hours to ensure that the system is working correctly.

3. Maintenance Service:

The Contractor shall ensure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

4. Extra Materials:

Spare parts for pumps and piping shall be kept on site as required.

5. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

6. Adequate noise reduction.

D. PRECAUTIONS:

1. The Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the by-pass pipelines. The Contractor shall locate his by-pass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the owner. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.

2. During all by-pass pumping operations, the Contractor shall protect the pumping station and main and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the pumping station and main and all local sewer lines caused by human or mechanical failure.

E. INSTALLATION AND REMOVAL:

1. The Contractor shall make connections to the existing sewer and construct temporary by-pass pumping structures only at the access location indicated on the drawings and as may be required to provide adequate suction conduit.

2. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal

without surge, to prevent surcharging or causing other major disturbances downstream.

3. When working inside sanitary sewer manholes or force main, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces.
4. The pipeline must be located off streets and sidewalks and on shoulders of the roads. When the by-pass pipeline crosses local streets and private driveways, the Contractor must place the by-pass pipelines in trenches and cover with temporary pavement. Upon completion of the by-pass pumping operations, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The Contractor is responsible for obtaining any approvals for placement of the temporary pipeline within the Right of way

**END OF SECTION**

## SECTION 15030 - ABOVE GROUND FUEL STORAGE TANK

### PART 1 - GENERAL

#### 1.01 DESCRIPTION OF WORK

- A. General: Applicable provisions of the contract Drawings and General Conditions shall govern this work.
- B. Scope of Work: The Contractor shall furnish all labor, material, equipment and supervision necessary for a complete project constructed in accordance with the project plans and specifications. All material and work shall be in conformance with the City of Newport News Department of Engineering "Standard Specifications", dated August, 1983, as amended, except as otherwise noted herein.
- C. Work specified elsewhere but is not limited to:
  - Section 01330 - Submittal Procedures
  - Section 01781 - Operation and Maintenance Data/Manual
  - Section 02000 - Earthwork
  - Section 02485 - Seeding
  - Section 02650 - Gravity Sewer Force Main, Pumping Station Piping, Water Service and Accessories
  - Section 16550 - Emergency Power System

#### 1.02 MANUFACTURERS

- A. Manufacturers of equipment covered by these specifications shall be reputable firms with at least five years experience in the manufacturer, testing and supervision of installation and operation of the equipment. All materials and equipment furnished shall be galvanized free from defects in workmanship or design, and the contractor shall replace, without cost to the Owner, any part or equipment which is defective or shows undue wear within one year after the equipment has been in permanent operation.
- B. The 500 gallon vaulted above ground fuel storage tank shall be as manufactured by ConVault, Inc., 800-628-5502.

#### 1.03 SUBMITTALS

- A. The Contractor shall submit six (6) copies of the shop drawings of all equipment to the Owner for approval. Information shall include dimensions, capacity, material, finish, warranties, fuel tank, containment system accessories and fuel lines, etc.
- B. Six (6) copies of a complete operations manual for all equipment, including detail

drawings, maintenance instructions and other pertinent data shall be compiled and submitted to the Owner for review and approval before acceptance of the facility.

## PART 2 - MATERIALS

### 2.01 GENERAL

A. The Contractor shall supply and install in accordance with manufacturing guidelines a 500 gallon above ground fuel storage tank and fuel line(s) that comply with all current Federal, State of Virginia and City of Newport News aboveground fuel storage regulations. The fuel storage system shall be equipped with the following minimum options:

1. Overfill containment
2. Overfill warning system
3. Concrete Site Pad
4. Electronic Leak Detectors
5. 2" x 8' vent riser
6. 4" iron and brass lockable fill cap
7. 4" one piece gauge stick
8. Decal package on all 4 sides and float gauge
9. 2" vent cap/side vent
10. 1" suction tube and double cap
11. ball valves are required on the fuel lines
12. 3/4" double wall fuel lines (feed & return)
13. 12 foot high fuel vapor ventilation
14. Low fuel level float and alarm light in fuel panel
15. High fuel level float and alarm light in fuel panel
16. Name plates with all alarm indicating lights
17. Electric solenoid valves (2), one located at generator on supply line and one at the fuel tank on the supply line.
18. Inline electric fuel pump located at the generator and properly sized for the application.

B. Primary Tank

The primary rectangular 500 gallon tank shall be a minimum of 0.125 inch thick carbon steel and constructed in accordance with U.S. Standard 142. The tank shall meet all Federal, State of Virginia, and City of Newport News aboveground fuel storage regulations, and shall meet all the requirements of N.F.P.A. 30.

C. Concrete Encasement

The concrete encasement shall be a concrete exterior of 6 inches thick with a minimum design strength of 4000 psi. The concrete design shall include the



following for long term durability: less than 3% air entrainment, water reducing admixture, fibermesh, and steel reinforcement. An exterior steel jacket covering the concrete vault shall not be permitted. The vault enclosure shall have 411 concrete support legs and shall be monolithic construction with no mid-level scam or joint permitted that will compromise the liquid tightness of the vault.

D. Fire Resistance

The tank system shall be designed and tested by Underwriters Laboratory to provide 2 hour fire protection for the primary tank. Tank shall bear the official UL Subject 2083 listing label upon delivery to the site.

E. Thermal and Corrosion Protection

1. The tank construction shall include thermal insulation equivalent to 0.25 inches of polystyrene to protect against temperature extremes and to effect an annular space for leak detection.
2. All steel fittings exterior to the concrete encasement shall be anti-oxidant power coated to inhibit corrosion.

F. Secondary and Leak Monitoring

The tank system shall include an impervious barrier of 1.0 mil high density polyethylene to contain leaks from the primary tank. A leak detector access tube shall be located between the inner tank and secondary barrier.

G. Overall Containment

The tank system shall include a minimum 7 gallon powder coated Overfill/Spill containment basin surrounding the fill pipe.

H. Overfill Protection

Overfill protection shall be provided by the following:

1. The tank system shall include a direct reading liquid level gauge-visible from the fill pipe access.
2. The tank system shall also be equipped with a flow limiter inside the fill pipe which will gradually slow the delivery rate when the tank is 95% full.

I. Exterior Tank Finish

The tank system shall have no maintenance exposed aggregate exterior finish. Painted concrete, fiber clad steel, or painted steel vault tanks are not acceptable.

J. Warranty

The tank assembly shall be of a type that has been production for at least five years and shall be warranted for a minimum of 30 years by the manufacturer.

K. Fuel Lines and control wiring.

The Contractor shall install all fuel lines (feed & return) from the new fuel storage tank to the generator. Fuel lines shall be flexible  $\frac{3}{4}$  - inch double wall piping manufactured by Advanced Polymer Technology, Inc. or approved equal.

New fuel lines shall be located underground and shall be bedded in 6 - inch of sand and encased in PVC schedule 80 conduit. Control wiring shall be run in the same trench in  $\frac{3}{4}$ " PVC schedule 80 conduit.

Fuel lines located above and below ground elevation shall be encased in schedule 80 PVC conduit. This conduit shall be securely attached to the fuel storage tank or station structure in a neat workman like manner.

Fuel Lines located inside the station shall be flexible double wall and encased in schedule 80 PVC.

Exterior fuel lines from tank to the ground level shall be black iron. No copper materials are allowed. The fuel line design shall allow for settlement of the station building or fuel tank pad.

L. Testing

After installation, the fuel storage system shall be tested at system operating conditions and at conditions recommended by the manufacturer. Leaks or failures disclosed by the tests shall be repaired as necessary.

**END OF SECTION**

## SECTION 15100

### PUMPING EQUIPMENT

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED:

Under this section, the contractor shall provide all labor, equipment and material necessary to furnish, install, test and place in operation Vertical Dry-Pit Pumping Units designed for wastewater service as shown in the plans and as specified herein.

Furnish and install three (3) Vertical Flexible Shaft Dry Pit Pumping Units complete with all accessories, controls and appurtenances as shown in the plans and specified herein or as required for a complete operating system. Each Pumping Unit shall be rated for continuous duty in accordance with the operating conditions defined in these specifications. Each unit shall be furnished with pump, driver, motor support base with guard and flexible intermediate drive shaft with necessary steady bearing(s) and shaft guard. Controls are specified in Division 16.

Furnish and Install one (1) sump pump as shown in the plans and as specified herein.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE INCLUDES:

Section 01300 – Submittals

Section 03300 – Cast-in-Place Concrete (For Wastewater Pumping Stations)

Section 09910 – Painting

Section 16010 – Electrical General Requirements.

Section 16480 – Motors, Motors Starters and Control Relays

Section 16675 – Pump Control Panel

Section 16690 – Variable Frequency Drives

##### 1.03 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153 (1996) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 48 (1994, AE 1) Standard Specification for Gray Iron Castings

#### NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1993; Rev 1; Rev 2) Motors and Generators

## 1.04 SUBMITTALS

The following shall be submitted in accordance with the Contract Documents (The Contractor shall label all documents with the pump station name and number it is intended for):

### A. Data

#### 1. Sewage Pump System.

Pump characteristic curves showing capacity in gpm, net positive suction head (NPSH), head, efficiency, and pumping horsepower from 0 gpm to 110 percent of design capacity for operation of the existing pumps with the new variable speed motors. The pump characteristic curves shall clearly show conformance with the design flow and head conditions at both operating speeds as indicated on the drawings. A complete list of equipment and material, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions for equipment provided.

#### 2. Spare Parts.

Spare parts data for each different item of material and equipment specified, after approval of the related submittals, and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Spare parts shall include, but not be limited to:

- 3 spare impellers with wear rings;
- casing wear rings;
- casing gasket;
- 3 sets packing;
- 3 sets packing sets packing glands.

#### 3. Sump Pump System

Pump characteristic curves showing capacity in gpm, head, and horsepower. A complete list of equipment and material, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions for equipment provided.

### B. Drawings

Sewage Pump System. Drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

### C. Instructions

Sewage Pump System. Diagrams, instructions, and other sheets proposed for posting.

D. Field Test Plan

Contractor shall submit a field test plan for approval by the Owner 30 days prior to facility testing.

E. Reports

Field Testing and Adjusting Equipment. Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

F. Operation and Maintenance Manuals

Sewage Pump System. Three (3) copies of operation and three (3) copies of maintenance manuals for the equipment furnished (for each pump station). One complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

G. Warranty

Sewage Pump System. The pump manufacturer shall warrant the Vertical Dry Pit Pumping Units, including motors, being provided to the Owner against defects in workmanship and materials for a period of one year under normal use, operation, and service. The warranty shall be in printed form and shall apply to all units

1.05 DELIVERY AND STORAGE

Pumps shall be protected against corrosion for the period between resurfacing and installation. All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants. All machined surfaces shall be slushed with heavy, non-corrosive oil, and all bearings shall be lubricated. If the pumps are to be stored for more than 90 days, the interior of the pump shall be filled with a high-grade non-corrosive oil, and all bearings shall be lubricated. The Contractor shall inspect the stored pumps weekly, manually rotate or slide all moving parts, and renew the slush oil as necessary. Before the pumps are put into operation, they shall be cleaned.

1.06 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Owner of any discrepancy before performing the work.

## PART 2 - PRODUCTS

### 2.01 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 5 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Owner, reasonably convenient to the site.

#### A. Nameplates

Each pump shall have the manufacturer's name, address, type or style, model or serial number, impeller size, capacity and head rating, frame and bearing numbers, catalog number, and other pertinent data embossed on a stainless steel data plate secured to the pump.

#### B. Equipment Guards

Projecting setscrews, keys, and rotating parts so located that any person may come in close proximity thereto shall be enclosed or guarded.

#### C. Pump Control System

1. Pump control system shall be in accordance with Section 16675, "Pump Control Panel."

2. Operating Sequence

At a preset point during a rise in wet well level or the operator entered "Lead Pump On", two (2) sewage pumps shall start. The Variable Frequency Drives (VFD) shall start at a minimum speed set from VFD keypad and increase pump speed until the operator entered "Flow" set point has been met and shall maintain flow at set point until the "All Pumps Off" set point has been met. In the event that the station inflow is greater than the "Flow" set point the level will rise in the wet well until the operator entered "Lag Pump On" set point is met. At this time the third (3<sup>rd</sup>) pump VFD will start and all three (3) pumps will increase speed to match the new operator entered "Lag Pump Flow Rate", the pumps shall maintain flow at set point until the "Lead Pump On" set point has been met at which time the third pump shall stop and the two (2) running pumps shall return to their original "Flow" set point. When the wet well level drops to the "All Pumps Off" set point the pumps shall stop. The automatic alternating control circuitry shall switch the operating sequence of the pumps on preset time schedule selected by the pumping station operator. The system shall include provisions for locking the lag pump out of service when the station is operating on an emergency standby engine generator set. Alternate Operating Sequences are noted in Specification Section 16675 – "Pump Control Panel."

#### D. Bolts, Nuts, Anchors, and Washers

Bolts, nuts, anchors, and washers shall be steel; galvanized in accordance with ASTM A 153.

## 2.02 SEWAGE PUMP AND APPURTENANCES

### A. Operating Characteristics:

Sewage pumps (3) shall be Vertical Flexible Shaft Dry Pit, non-clog, single-suction, centrifugal wastewater pumps with the following operating characteristics:

1. Pump Service: raw sewage.
2. Peak Design Operating Point: 4,300 gpm flow, 115 feet TDH, 1160 rpm, 79 percent efficiency ( $NPSH_R < 19$  feet).
3. Alternate Points on curve (maximum flows with corresponding heads):
  - a. Operating Point: 1,700 gpm flow, 35 feet TDH, 600 rpm, 70 percent efficiency ( $NPSH_R < 5$  feet).
  - b. Operating Point: 2,700 gpm flow, 66 feet TDH, 850 rpm, 75 percent efficiency ( $NPSH_R < 10$  feet).
  - c. Operating Point: 2,943 gpm flow, 136 feet TDH, 1,160 rpm, 72 percent efficiency.
4. Impeller: 19.125-inch.
5. Motor Type: Electric squirrel-cage induction.
6. Size: 200 horsepower, 1,200 rpm (variable speed).
7. Rotation: Per drawings.
8. Suction Size: 10-inch, with a 10" x 10" elbow and cleanout.
9. Discharge Size: 10-inch.
10. Maximum Sphere Size: > 3-inch.
11. Shut-Off Head: 181 feet TDH.

### B. Pumps:

1. Manufacturers
  - a. Pump(s) shall be the product of Yeomans Pumps, Aurora, IL, or an approved equal, model as follows:
    1. Model 10522-6 / 5, Series 6250

- b. Manufacturer shall have installations of like or similar application with a minimum of 5 years service for this pump size.
2. Design
- a. Position: The discharge connection shall be a 125 lb. standard raised face flange positioned as indicated on the Drawings.
  - b. Impeller
    1. Impeller shall be of the balanced solids-handling type made of close-grained cast iron conforming to ASTM A48 Class 30 or better. It shall be of one-piece construction, single suction, enclosed two to four vane, radial flow design with well-rounded leading vanes and then tapered toward the trailing edge. The waterways through the impeller shall have extremely smooth contours, devoid of sharp corners, so as to prevent rags or stringy, fibrous material from catching or clogging.
    2. The clearance between the impeller outside diameter and cutwater shall be capable of passing a 5" sphere.
    3. The impeller shall be cast in one piece and shall be dynamically balanced. Rotation of the impeller shall correspond to the pump discharge orientation as indicated on the Drawings. The design of the impeller and the shape of the blades shall be such that rags or similar materials will not clog the pump or seriously affect the efficiency. The impeller shall be keyed to the shaft and firmly held in place by a streamlined 316 stainless steel or bronze locking device. The arrangement shall be such that the impeller cannot be loosened by torque from either forward or reverse rotation.
    4. Wiper vanes are required on the back shroud of the impeller to minimize end thrust and reduce pressure on the stuffing box.
    5. Impeller shall be trimmed to specifically meet the conditions of operation.
  - c. Volute/Casing
    1. Volute/casing is to be cast with extra thick walls made of close-grained cast iron conforming to ASTM A48, Class 30 or better. It shall be of sufficient thickness and suitably ribbed to withstand all stresses and strains of service at full operating pressure. It is to be one-piece, constant velocity equalizing pressure with smooth fluid passages large enough to pass any size solid that can pass through the impeller.
    2. The volute shall be side flanged tangential discharge and be capable of rotation in 45-degree increments to accommodate piping orientation. Volute discharge shall be 8" diameter minimum as measured on the inside diameter of the discharge flange opening. Diffusion vanes are not permitted. No stationary guides or splitters will be permitted on either the suction or discharge sides of the casing. The casing shall be provided with tapped and plugged 3/4" vent tap, drain, and gauge connections.



3. The volute shall be furnished with large cleanout openings located at the impeller centerline, to allow access to the impeller and interior parts of the pump. The inner contours of the cleanout shall match the contours of the casing.
  4. The casing shall be designed to permit the removal of the rotating assembly without disturbing the suction or discharge piping. The casing shall be hydrostatically tested to 1.5 times the design head or 1.25 times the shutoff head whichever is greater.
- d. **Wear Rings**
1. Removable hardened stainless steel wear rings shall be provided for both the suction cover and the impeller, with the wearing surfaces normal to the axis of rotation. They shall be securely fastened with counter-sunk, machine-head, stainless steel screws to prevent any relative motions and designed for easy replacement.
  2. Both wear rings shall be a minimum of 3/8-inch thick and shall be made of hardened 400 series stainless steel, with the impeller ring hardened to 325 to 375 Brinell and the casing ring hardened to 425 to 475 Brinell and designed to compensate for a minimum of one-quarter inch wear.
- e. **Stuffing Box**
1. The stuffing box shall be readily accessible and its construction shall permit the use of either a standard commercially available mechanical seal or teflon seal ring and packing without special machining. The stuffing box shall be designed for a minimum of five (5) rings of packing in addition to a seal ring and suitable for use of clean water for sealing. The stuffing box shall be provided with a split removable cast iron (bronze) gland to facilitate packing replacement. The seal ring shall be located adjacent to and on the outboard side of the second packing ring. The stuffing box shall be drilled and tapped for a 1/4-inch minimum water seal connection. The seal ring shall be a split ring, 25 percent glass filled TFE type, of sufficient strength for the intended service, drilled and tapped for easy removal, and suitably positioned to assure uniform distribution of the sealing medium. The top of the pump casing cover shall be provided with a lip suitable for use as a reservoir to retain stuffing box leakage and a 1/2-inch minimum NPT tapped hole to permit leakage to be drained away.

f. Pump Shaft

1. The pump shaft shall be made from high grade heat treated alloy steel, rigid shaft type, of sufficient size to transmit the full driver horsepower with a liberal safety factor, accurately machined over its entire length and free from any harmful or damaging vibrations. The pump shaft shall include a tapered end for positive alignment and ease of removal at the impeller hub. Shaft deflection shall not exceed .002 inches at the stuffing box at  $\pm$  40% of the best efficiency point of the impeller curve furnished. A renewable stainless steel shaft sleeve shall be provided extending from the impeller hub through the stuffing box. The shaft sleeve shall be internally ground and positively secured to the shaft to prevent relative rotation. Passage of water between the shaft and sleeve shall be prevented by O-ring or other approved means. Shrink fit shaft sleeves will not be acceptable. The shaft sleeve shall be hardened 400 series stainless steel with a 425 to 450 Brinell hardness and a 32 micro-inch surface finish.

g. Pump Bearings

1. The pump shall be provided with radial and thrust anti-friction ball or tapered-spherical roller type bearings of ample size to carry all loads imposed under continuous operation without overheating. The bearings shall be grease lubricated and a relief port lip seal shall be provided so that excessive grease pressure will not damage the bearings. The pump bearing frame shall be designed so that the complete rotating element can be removed from the pump casing without disconnecting of the suction or discharge piping. The bearings shall be designed in accordance with AFBMA standards for a minimum L-10 life of 40,000 hours at the most extreme operating points on the pump performance curve and a minimum of 100,000 hours at the primary duty point.

h. Bearing Frame

1. The pump bearing frame shall be made of ASTM A48 Class 30 cast iron material. The bearing frame shall be shoulder fitted, accurately centered and rigidly fixed to the pump casing and backplate. The bearing frame shall contain jacking bolts and shims for the axial adjustment of the rotating element when necessary to provide the manufacturer's recommended clearance between the impeller and suction cover over the life of the pump.

i. Suction And Backplate

1. The suction and backplate shall be of the same material as the casing, cast separate from the volute and built to allow complete removal of the bearings, shaft and impeller without disturbing the pump suction or discharge piping connections. The suction and backplate shall be shoulder fitted to the casing and assembled with studs to assure accurate alignment. The backplate shall be designed to support the rotating assembly and shall have a convertible stuffing box of ample depth and design to accommodate either a

## **SECTION 15800**

### **HVAC INSTRUMENTATION AND CONTROLS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 15010, "Mechanical Equipment", applies to work of this section.

##### **1.02 SUMMARY**

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

##### **1.03 SYSTEM DESCRIPTION**

- A. Provide a control system consisting of sensors, indicators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

##### **1.04 SUBMITTALS**

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  - 1. Each control device labeled with setting or adjustable range of control.

##### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who a certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

## **1.06 COORDINATION**

- A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 16 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

## **1.07 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Replacement Materials: One replacement relay mechanism for each unique controller and thermostat.

## **PART 2 - PRODUCTS**

### **2.01 ANALOG CONTROLLERS**

- A. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

### **2.02 THERMOSTATS**

- A. Low-Voltage, On-Off Thermostats (UH's 1-2): NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, integral manual on-off-auto selector switch.

- B. Line-Voltage, On-Off Thermostats (EF's 1-4): Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
  - 1. Dead Band: Maximum 2 deg F.
- C. Room Thermostat Cover Construction: All thermostats shall have a rugged, corrosion-resistant, locking cover.
  - 1. Set-Point Adjustment: Exposed.
  - 2. Set-Point Indication: Exposed.
  - 3. Thermometer: Exposed.
  - 4. Color: Manufacturer's standard colors.
  - 5. Orientation: Vertical.
- D. Room thermostat accessories include the following:
  - 1. Insulating Bases: For thermostats located on exterior walls.
  - 2. Thermostat Guards: Locking; heavy-duty, transparent plastic; mounted on separate base, corrosion-resistant.
  - 3. Adjusting Key: As required for calibration and cover screws.
  - 4. Set-Point Adjustment: 1/2-inch diameter, adjustment knob.
- E. Remote-Bulb Thermostats: On-off type, liquid filled to compensate for changes in ambient temperature, with stainless steel capillary and bulb.
  - 1. Scale settings and differential settings shall be clearly visible and adjustable from front of instrument.
  - 2. Provide thermostat with precision snap switches having electrical ratings required by application.

### **2.03 ELECTRICAL POWER AND DISTRIBUTION**

Devices shall be UL listed or FM approved.

- A. Wiring: Provide complete electric wiring for temperature control apparatus. Control circuit conductors which run in the same conduit as power circuit conductors shall have the same insulation level as power circuit conductors. Circuits operating at more than 100 Volts shall be in accordance with Division-16 sections. Circuits operating at 100 Volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways or wire trays; unless wiring is armored cable, or multiconductor cable. Use multiconductor cable for concealed accessible locations only. Provide circuit and wiring protection as required by NFPA 70. Aluminum-sheathed cable or aluminum conduit may be used, but shall not be buried in concrete. Protect exposed wiring from abuse and damage.

1. AC Control Wiring:

- (a) Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and shall be rated for 300 VAC service.
- (b) Wiring for 120 V ac shall be 14 AWG minimum and shall be rated for 600 V ac service.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that duct, pipe, and equipment-mounted devices and wiring and pneumatic piping are do not interfere with other trades involved before proceeding with installation.

### **3.02 INSTALLATION**

- A. Install equipment level and plumb.
- B. Connect and configure equipment to achieve sequence of operation specified.
- C. Verify location of thermostats with plans and room details before installation. Locate all 60 inches above the floor.
- D. Install guards on thermostats.
- E. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."

### **3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION**

- A. Install raceways, boxes, and cabinets according to Division 16 Section.
- B. Install building wire and cable according to Division 16 Section.
- C. Install signal cable according to Division 16 Section.
  - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  - 2. Install exposed cable in raceway.
  - 3. Install concealed cable in raceway.
  - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

### **3.04 CONNECTIONS**

- A. Ground equipment.
  1. 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 and UL 486B.

### **3.05 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including electrical connections. Report results in writing.
  1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
  3. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Engage a factory-authorized service representative to perform startup service.
- C. Replace damaged or malfunctioning controls and equipment.
  1. Start, test, and adjust control systems.
  2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
  3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

### **3.06 SEQUENCE OF OPERATION**

- A. Exhaust Fans (EF): Sequence is typical for all exhaust fans. The exhaust fan shall be energized by its HOA switch. With its HOA switch in the "ON" position, the exhaust fan shall run continuously. With the HOA switch in the "OFF" position, the exhaust fan shall be de-energized. With the HOA switch in the "AUTO" position, operation is such that on a rise in space temperature above the thermostat's setpoint (80°F), the exhaust fan shall be energized. The reverse shall occur when the temperature falls below the thermostat's setpoint.

- B. Unit Heaters (UH): Sequence is typical for all unit heaters. Provide for each unit heater a wall-mounted heating-only thermostat with an “ON-OFF-AUTO” fan switch. With the switch in the “AUTO” position, operation is such that on a fall in space temperature below the thermostat’s setpoint, the unit’s heating element shall be energized and the unit fan shall be indexed to “run”. The reverse shall occur upon a rise in space temperature. With the switch in the “OFF” position, the heating element and fan shall be de-energized, regardless of space temperature. With the switch in the “ON” position, the heating element and fan shall run continuously, regardless of space temperature.

**END OF SECTION 15800**



## **SECTION 15855**

### **SPLIT SYSTEM AIR-CONDITIONING**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 specifications apply to the work of this section.
- B. Division 15 Basic Mechanical Materials and Methods sections apply to work of this section.

##### **1.2 DESCRIPTION OF WORK:**

- A. Extent of air-handling equipment work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of air-handling equipment required for project include the following:
  - 1. Air-to-air heat pump.

##### **1.3 QUALITY ASSURANCE:**

- A. Codes and Standards:
- B. AMCA Compliance: Test and rate air-handling equipment in accordance with AMCA standards.
- C. ARI Compliance: Test and rate air-handling equipment in accordance with ARI 430, "Standard for Central-station Air-Handling Units;" display certification symbol on equipment of certified models.
- D. NFPA Compliance: Provide air-handling equipment internal insulation having flame spread rating not over 25 and smoke developed rating no higher than 50; and complying with NFPA 90A, "Standard for the Installation of Air-conditioning and Ventilating Systems."
- E. UL and NEMA Compliance: Provide electrical components required as part of air-handling equipment, which have been listed and labeled by UL and comply with NEMA standards.
- F. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of air-handling equipment.

**1.4 DELIVERY, STORAGE, AND HANDLING:**

- A. Deliver equipment with factory-installed shipping skids and lifting lugs; pack components in factory-fabricated protective containers.
- B. Handle equipment carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to manufacturer.
- C. Store equipment in clean, dry place and protect from weather and construction traffic.
- D. Comply with manufacturer's rigging and installation instructions for unloading equipment and moving them to final location.

**1.5 SPECIAL PROJECT WARRANTY:**

- A. Provide written warranty, signed by Manufacturer of mechanical equipment and his authorized Installer, agreeing to replace/repair defective materials and workmanship such as failure, compressor fan motor failure and automotive ignition for duct furnaces.
- B. Warranty period is 5 years after final payment.

**PART 2 - MATERIALS**

**2.1 ACCEPTABLE MANUFACTURERS:**

- A. Manufacturer: Subject to compliance with requirements, provide equipment of one of the following, or approved equal:
  - 1. American Air Filter; Allis-Chalmers Co.
  - 2. Carrier Air Conditioning
  - 3. Trane (The) Co.
  - 4. Penn Ventilator Co.
  - 5. Acme Engineering and Manufacturing Corp.

**2.2 AIR-TO-AIR CONDENSER UNIT:**

- A. Provide an air-to-air electric heat pump (outdoor unit) in combination with a direct expansion fan-coil (indoor unit) in the location and manner shown on the plan. The units shall be designed and tested for use with Refrigerant 22 and be equipped with refrigerant line fittings which permit mechanical or sweat connection. All equipment and accessories for operation and control of a complete system shall be included.
- B. Coil shall be constructed with aluminum plate fins mechanically bonded to copper tubing with all joints brazed. Coil shall be 3 rows deep with a nominal fin spacing of 15 fins per inch, and shall have a face area of not less than 7.12 square feet.
- C. Outdoor unit shall contain a scroll compressor with crankcase heater, automatically reversible oil pump, internal and external motor protection. Outdoor fan shall be propeller type, with vertical discharge, and direct driven by a factory-lubricated motor of 1/2 HP or less. Outdoor unit shall be furnished with hail guard.

- D. Compressor shall be furnished with defrost control board for field settable defrost cycle
- E. Controls shall be factory wired and located in a separate enclosure. Safety devices shall consist of high and low pressure switches and compressor overload devices. Unit wiring shall incorporate a positive acting timer to prevent short cycling of compressor if power is interrupted. Timer shall prevent compressor from restarting for approximately 5 minutes after shutoff.

### **2.3 INDOOR UNIT:**

- A. Indoor unit shall contain refrigerant metering device and indoor fan relay. Fan shall have forward-curved double-inlet fan mounted on a common shaft. Fan shall be statically and dynamically balanced and shall run on factory-lubricated bearings. Fan drive shall be U-belt with a variable pitch pulley on the fan motor shaft. Indoor unit shall be supplied with high limit heat detectors for remote mounting in the supply and return duct. Upon activation of sensor, the unit shall be de-energized. Provide with manual reset switch. Unit shall be furnished with electric supplemental heat.
- B. Indoor unit shall be supplied with manufacturer's filter section, complete with 1" throwaway filters. Provide 2 additional sets of filters: 1 set to be installed prior to system testing, adjusting and balancing, and 1 set to be installed after final inspection.

### **2.4 AUTOMATIC TEMPERATURE CONTROLS:**

- A. Provide manufacturer's standard indoor programmable thermostat package for automatic changeover from cooling to heating. Thermostat shall be complete two stage heating and two stage cooling operation with heat, cool, auto, off settings and auto-on fan sub-base. Thermostat shall have emergency heat switch and indicating lights for emergency heat. The thermostat shall be furnished with a lockable clear lexan cover. Temperature control – thermostats by equipment manufacturer.
- B. Cooling Mode: On a rise in space temperature the thermostat shall energize the mechanical refrigeration system with an unloaded compressor. On a further rise in space temperature, the compressor shall load to maintain space temperature at set point. On a fall in space temperature, the reverse shall occur.
- C. Heating Mode: On a continuing fall in space temperature, the thermostat shall automatically switch to the heating mode to maintain space temperature set point by energizing the outdoor unit, AHU fan, for first stage of heating operation, and stages of electric heater shall stage on to meet space temperature on a continuing fall in space temperature.

### **2.5 OUTSIDE AIR INTAKES:**

- A. General: Except as otherwise indicated, provide standard prefabricated units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation.
- B. Bird Screens: Provide removable bird screens, 1/2" mesh, 16-gage aluminum or brass wire.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION:**

- A. General: Install units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices to ensure that unit comply with requirements and serve intended purposes.
- B. Coordination: Coordinate with other work as necessary to interface installation with other work.

### **3.2 SPARE PARTS:**

- A. Provide one complete extra set of filters. Install new filters at completion of work and prior to testing, adjusting, and balancing work.
- B. Provide one spare set of belts.
- C. This system is not complete until the system has been balanced to provide the correct air quantity and has been tested to demonstrate the correct system performance.

### **3.3 ADJUSTING AND CLEANING:**

- A. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

### **3.4 FIELD QUALITY CONTROL:**

- A. Testing: After installation of equipment has been completed, test to demonstrate proper operation at performance requirements specified. When possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

**END OF SECTION**

## **SECTION 16010**

### **ELECTRICAL GENERAL PROVISIONS**

#### **PART 1 - GENERAL**

##### **1.01 RELATED DOCUMENTS:**

- A. The General Conditions, Supplementary General Conditions, and Special Conditions of this Contract form a part of this Division of Specification.
- B. This section forms a part of all sections under Division 16.
- C. Requirements herein augment or clarify articles specified under aforementioned General and Special Conditions.
- D. All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.

##### **1.02 QUALIFICATIONS FOR BIDDERS:**

- A. Before submitting bid, Contractor shall visit the site and examine all adjoining existing equipment and space conditions on which his work is in any way dependent, for the best workmanship and operation according to the intent of specifications and drawings. He shall report to the Owner any condition which might prevent him from installing his equipment in the manner intended.

##### **1.03 CODES AND STANDARDS:**

- A. Latest effective publications of following standards, codes, etc., as they apply, form part of these specifications as if were written fully herein and constitute minimum requirements. Minimum requirements shall not relieve the Contractor of the responsibility of furnishing and installing higher grade materials and workmanship than herein specified. The following will be referred to throughout in abbreviated forms.
  - 1. National Electrical Code, (NFPA 70) (NEC).
  - 2. Standard Rules of Institute of Electrical and Electronic Engineers (IEEE).
  - 3. Rules and Regulations of Local Electric Utility Company
  - 4. Applicable Standards of the National Electrical Manufacturer's Association (NEMA).
  - 5. Applicable Standards of the American National Standards Institute (ANSI).
  - 6. Applicable Local Codes.

7. Virginia Uniform Statewide Building Code.
8. Applicable Standards and Lists of the Underwriter's Laboratories, Inc. (UL).
9. Applicable Standards of the National Fire Protection Association (NFPA).
10. Building Officials and Code Administrators International, Inc. (BOCA) Basic National Building Code.

#### **1.04 SCOPE OF WORK:**

- A. Provide all work required for this Division including all labor, materials, equipment, appurtenances and services to provide complete electrical systems as shown on the drawings and specified in this Division of the specifications. The word "Provide" shall mean "Furnish and Install Complete and Ready for Use". The work includes, but is not limited to the following:
  1. Interior and exterior electrical lighting system including fixtures, lamps, photoelectric cells and other control devices and equipment.
  2. Power wiring system, including outlets, receptacles, switches, wire, conduit, junction boxes, panelboards and new electric service.
  3. Disconnect switches and power wiring up to and including motor connections for all equipment provided under other Divisions of this specification shall be included in this Division. Where manual motor control switches for single phase motors are indicated, they shall be provided and wired complete under this Division. Motor controllers and motor starters furnished under other Divisions shall be set in place and connected to source and load under this Division. In general, motors will be provided with the equipment they drive and are not part of this work under this Division, except that they shall be connected hereunder.
  4. Emergency Power System.
  5. Temporary Construction Power and Lighting.
  6. Perform flash hazard analysis per NFPA 70E and submit analysis report. Report shall include instruction and recommended personnel protective equipment.
  7. Provide potential electric flash hazard warning labels on all control panels, panelboard and meter socket enclosure.

#### **1.05 DRAWINGS AND SPECIFICATIONS:**

- A. The drawings are diagrammatic and indicate the general extent, character and arrangement of equipment, fixtures and conduit and wiring systems. If any departures from the contract drawings are deemed necessary, Contractor shall submit details of such departures and the reasons therefore as soon as practicable after award of contract to the

Owner for approval. Make no such departures without prior written approval of the Owner.

- B. It is the intention of these specifications and drawings to fully cover all work and materials for a complete, first-class electrical installation, and any devices such as pull boxes and disconnect switches, usually employed in this class of work, though not specifically mentioned or shown on the drawings or in this specification, but which may be necessary for the satisfactory completion of the work, shall be furnished and installed by the Contractor as a part of his total work under this Division. Consult the specifications and drawings of all other trades and perform all electrical work required therein. Cooperate with all other contractors or subcontractors to furnish complete workable systems.
- C. In case of conflicting information on the drawings and/or in the specifications, the proper interpretation shall be made by the Owner.
- D. Disagreements occurring between trades covering various phases of the work shall be referred to General Contractor for final decision.
- E. Changes and additions to scope of the work under this contract shall be submitted to the Owner and his written approval obtained before proceeding with the changed work.

#### **1.06 PERMITS, INSPECTION AND TESTS:**

- A. The right is reserved to inspect and test any portion of the installation/equipment during the progress of its erection. This Contractor shall test all wiring for continuity and grounds before connecting any fixtures or devices. This Contractor shall test the entire system when the work is finally completed to insure that all portions are free from short circuits and grounds. All equipment necessary to conduct the above tests shall be furnished at the Contractor's expense.
- B. Secure and pay for all required permits and inspections. Inspection certificates from local authorities having jurisdiction shall be delivered to the Owner before final payment.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURING STANDARDS:**

- A. Materials shall be new and approved and labeled by UL wherever standards have been established by that agency. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired in a manner meeting the approval of the Owner. Materials to be furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design. All items of the same type and rating shall be identical.

## **2.02 TRADE NAMES:**

- A. Unless specifically identified otherwise, manufacturers' names and catalog numbers indicated herein and on the drawings are not intended to be proprietary designations. They are to indicate general type and quality of materials and equipment required. Equipment and materials by other manufacturers which in the opinion of the Owner are of equal quality and which will produce the same results with regard to both their ability to perform the required technical functions as well as to their appearance in the specific location on this project will be considered.

## **2.03 MOTORS:**

- A. Motors shall have disconnecting means, controller, thermal overload protection and phase outage protection relays.

## **2.04 ELECTRICAL SERVICE:**

- A. New permanent building electrical service shall be provided as indicated. All arrangements shall be as indicated with proper extension, terminations, provisions and necessary materials for final connections by Dominion Power Company. Service and all metering shall be provided in accordance with the latest regulations of Dominion Power Company. Dominion Power Company will provide meter and current transformers and may participate in the cost of supplying service to the building. Consult Dominion Power Company and determine limit of this participation. Bid on electrical work shall reflect this participation except that any charges which Virginia Power Company proposes to make for supplying service will be paid directly by Owner and will not be part of this contract.

## **2.05 TEMPORARY PUMP STATION ELECTRICAL SERVICE:**

- A. Temporary electrical service for the pump station shall be the responsibility of the contractor. The Contractor shall be responsible for all costs to install this service and all power bills for the service and all power bills for station operation during construction until the station is accepted as complete by the city and permanent electrical service is operational, in place and placed back into the City's name. Make all necessary arrangements with the Dominion Power Company for this temporary service. The contractor will pay all charges which may be made by Dominion Power Company. The City will pay no power bills during construction.

## **2.06 GROUNDING:**

- A. The entire electrical system, including equipment frames, conduit, switches, controllers, wireways, neutral conductors, and all other such equipment shall be permanently and effectively grounded in accordance with the NEC.
- B. Ground rods shall be copper clad steel, 3/4" diameter by 10'-0" long copper clad steel. The exterior shall be electrolytic copper metallurgically bonded to a round one-piece carbon steel rod. The rod heads shall be fabricated so as to prevent mushrooming of rod head during driving or a steel driving stud, manufactured for such a purpose, shall be used.



- C. Grounding of each transformer secondary shall be provided and each shall be considered as a separate service ground. Provide a separate ground conductor in all branch circuit conduits sized in accordance with the N.E.C.
- D. UL Labels: Provide grounding electrodes and connectors which are UL listed and labeled.
- E. Except where specifically indicated or specified otherwise, exposed noncurrent-carrying metallic parts of electrical equipment, metallic conduit systems and neutral conductors of wiring systems shall be grounded.
- F. Grounding system shall comply with the current edition of the National Electric Code (NEC), the current edition of the National Electrical Safety Code, and as specified herein.
- G. Flexible conduit to motors shall not be used as a ground conductor.
- H. All ground conductors shall be copper and sized according to the requirements of the NEC, Tables 250-94 and 250-95 as applicable.
- I. All conduits used for electrical power feed, branch circuit, and control wiring shall be furnished with a separate ground conductor. Conduits shall not be used as a ground conductor.
- J. All metallic electrical conduits shall be bonded to the equipment ground terminal, ground wire, or ground bus using an insulated ground bushing and jumpers sized as required by the NEC. Bond shall be provided at all conduit terminations.
- K. Ground conductors shall be green, insulated stranded type where installed in conduit. All other ground conductors shall be bare type unless otherwise noted on the drawings or in the specifications.
- L. Provide building ground ring. Ground ring and all associated conductors shall be soft drawn stranded copper, size 2/0.
  - 1. Unless otherwise indicated on the drawings or in the specifications, all copper-to-copper or copper-to-steel splices and terminations for ground ring and connections to the ground ring shall be made by controlled exothermic reaction welding process using the appropriate fittings for the process employed. Ground connections shall be exothermic type cadweld or thermoweld, when direct buried. Steel shall be ground or filed, and copper conductors shall be cleaned to ensure all surfaces are clean, dry, and free from oxide before welding process is performed.
  - 2. System ground ring and top of ground electrodes shall be direct buried to a minimum depth of 24 inches and a maximum depth of 30 inches. Electrodes shall be driven straight down, perpendicular to the finished grade, or, if this is not possible, as allowed by NEC Article 250-83,c,3.

3. Concrete rebar systems, structural steel system, piping systems, gratings, handrails, or any process equipment shall be grounded but shall not be used as a ground conductor for any of the other equipment or systems required to be connected to ground by these specifications.
4. Ground electrodes in the ground ring shall be installed at no less than 10 feet intervals nor greater than 20 feet intervals.
5. All metallic piping systems shall be connected to the building's associated ground ring at two locations. Where flow meters, valves, flexible piping, or any type of nonmetallic connection occur in a piping system, a bonding jumper shall be installed around the device to ensure ground continuity. Jumpers installed under other portions of these specifications, such as reference grounds for process flow meters, etc., shall not be used to replace or be considered as grounding system jumpers.
6. The ground ring shall be furnished with one inspection point unless otherwise indicated on the drawings. The inspection point shall consist of a six (6) inch diameter, schedule 40 PVC conduit brought flush with finished grade and extending down to four (4) inches below point on ground rod where ring conductor is attached. The PVC shall be notched as required to prevent stress on the ground ring conductor if the PVC is pushed downward from grade for any reason. Provide threaded end cap on top of PVC conduit. End cap shall be labeled "Ground Inspection Point."
7. Testing of actual ground resistance shall be made by the Contractor before any finish landscaping is accomplished. Testing shall not be performed until all underground connections are made and buried and all structural steel has been connected to the ground ring. Test shall be made at the ground ring using a megger type ground tester and the "fall of potential" test method. Maximum resistance at the test point shall be five ohms unless otherwise noted. Where measured values exceed the above figures, the Contractor shall install additional electrodes at no additional cost to the owner until further tests indicate the ground resistance has been reduced to the specified limit.

### **PART 3 - EXECUTION**

#### **3.01 SCHEDULE OF WORK:**

- A. The schedule of the electrical work shall be arranged to suit the progress of work by the other trades and shall in no way retard progress of construction of the project.
- B. Work under this Division shall proceed in advance of the work of others whenever possible, eliminating all cutting and patching. When such procedure is impossible, cutting and patching shall be done in an approved manner. Cutting shall not endanger structural integrity in any way. Patching shall exactly match contiguous work. Actual work of cutting and patching of existing surfaces shall be performed by the subcontractor who originally prepared these surfaces, e.g., cutting and patching of masonry wall will be

performed by the masonry subcontractor. Costs of such cutting and patching shall be borne by the Electrical contractor. Cutting shall be carefully done and damage to building, piping, wiring or equipment as a result of cutting shall be repaired by skilled mechanics of trade involved.

### **3.02 STORAGE AND MATERIALS:**

- A. Space will be assigned to the Contractor by the Owner for the storage of materials. This Contractor will be responsible for the protection and safekeeping of materials, tools, and equipment. All materials and equipment shall be kept in its assigned place until the time of its installation. Excess materials, dirt and refuse shall be promptly removed from the work site.

### **3.03 LABELING OF EQUIPMENT:**

- A. All panelboards, cabinets, safety switches, motor disconnect switches, and motor controllers shall be identified by machine engraved laminated plastic designation plates permanently attached thereto with self-tapping screws or rivets. All component parts of each item of equipment or device shall bear the manufacturer's nameplate, giving name of manufacturer, description, size, type, serial and model number and electrical characteristics in order to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable.

### **3.04 OTHER TRADES:**

- A. Excavation shall be performed in accordance with the section of these specifications which cover excavating, filling and backfilling.
- B. Concrete work shall be performed in accordance with the section of these specifications which cover concrete.
- C. Painting shall be performed in accordance with the section of these specifications which cover painting. Paint all exposed conduit as well as cabinets and related items which are not supplied with a factory finish. Touch up all factory finishes damaged during installation or by adjacent construction work.

### **3.05 COORDINATION:**

- A. Cooperate and coordinate efforts with all Contractors on the project. This is especially important in determining exact locations of all switches, receptacles and lighting fixtures. Coordinate lighting fixture locations with other equipment. Verify ceiling and wall construction and material prior to ordering lighting fixtures or other devices to ensure proper fixture or device is furnished to match construction. This verification must be executed regardless of information placed on the drawings. Any cost incurred which in the opinion of the Owner, could have been avoided by this step shall be the responsibility of the Contractor. Coordinate switch locations with thermostats, control switches, etc.
- B. Carefully check space requirements with the other subcontractors to insure that electrical equipment can be installed in the spaces allotted for them. Consult all applicable

drawings for details. Where interferences occur and work must be relocated, relocate without additional cost.

- C. No conduit, outlet box, conduit stub-up, or any other electrical devices shall be installed until the exact location has been determined by the coordinated effort of all Subcontractors and other parties concerned. Any relocating of devices or cutting or patching which becomes necessary due to improper coordination shall be done at this Contractor's expense.
- D. Determine electrical requirements of other Divisions in order to fully understand wiring, and provide as required for complete and satisfactory operation of project. Make connections for other Divisions where indicated.
- E. Obtain approved shop drawings showing wiring diagrams, connection diagrams, roughing-in and hookup details, from other involved contractors for all equipment and comply therewith.
- F. Any delays to construction scheduling due to improper coordination with utility companies will be the responsibility of the contractor and at the contractor's expense.

### **3.06 GUARANTEE OF WORK:**

- A. Contractor guarantees by his acceptance of the contract that all work installed is free from any and all defects in workmanship and/or materials, and that the apparatus will develop capacities and characteristics specified, and that if, during the period of one year or as otherwise specified, from date of certificate of completion and acceptance of the work any such defects in workmanship, material or performance appear, he will, without cost to the Owner, remedy such defects within a reasonable time to be specified in notice from Owner. In default thereof, the Owner may have such work done and charge cost to Contractor. Equipment guarantees from date of "start-up" will not be recognized.
- B. Comply, also, with the General Conditions and the Supplementary Conditions and the applicable Sections of Division 1 General Requirements.
- C. This Contractor shall provide service for the installation for one year from date of final acceptance. This shall include all emergency service and adjustment. Contractor shall show evidence upon request by Owner that factory authorized local service organization is in existence to service and furnish spare and replacement parts for all equipment under this Division of the specifications.

**END OF SECTION**

## SECTION 16210

### RACEWAY, FITTINGS AND BOXES

#### PART 1 - GENERAL

- 1.01 Provide raceways and fittings for all electrical and related systems where indicated, specified or required to form continuous raceways from the service entrance to the various outlets.
- 1.02 Provide each outlet in the raceway system with an outlet box to suit the conditions encountered. Each box shall have sufficient volume to accommodate the number of conductors and conduits entering the box.
- 1.03 All wiring shall be in conduit.
- 1.04 All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.

#### PART 2 - PRODUCTS

##### 2.01 RACEWAYS:

- A. Conduit shall be hot-dipped, PVC (polyvinyl chloride) coated rigid steel (RS), or schedule 80 polyvinyl chloride (PVC).
- B. Flexible conduit shall be galvanized, continuous spiral, single strip type. Flexible conduit shall be covered with PVC jacket. Provide suitable fittings with ground connector.

##### 2.02 FITTINGS:

- A. All conduit entering or leaving outlet, junction or pull boxes, and cabinets and all conduit stubs shall have bushings. Provide insulating bushings where required by NEC.
- B. Fittings for RS shall be threaded type.
- C. Fittings for PVC shall be PVC, primed and glued.

##### 2.03 SLEEVES:

- A. All electrical system conduit shall have sleeves where conduit passes through concrete slabs except concrete slabs in contact with grade. All conduit running exposed and passing through masonry concrete, tile and gypsum wall construction shall be provided with sleeves.
- B. Sleeves shall be constructed of galvanized steel pipe, Schedule 40.

- C. Provide escutcheon plates for all exposed conduit passing through walls, floors and ceilings. Plates shall be nickel plated, of the split ring type of size to match the pipe or conduit. Where plates are provided for conduits passing sleeves which extend above the floor surface, provide deep recessed plates to conceal the sleeves.

#### **2.04 OUTLET BOXES AND JUNCTION BOXES:**

- A. Outlet boxes shall be pressed steel, electro-galvanized or cadmium plated with clean cut, easily removable knockouts. Except as noted hereinafter minimum size outlet box shall be 4" square, 1-1/2" deep, and shall be increased in dimensions to accommodate conductors, conduits, and devices as required by the NEC. Shallower boxes may be used where required by structural conditions and when specifically approved by the Owner. Provide suitable plaster-rings to match wall construction and device. Ceiling and bracket outlet boxes shall be not less than 4" octagonal, 1-1/2" deep except that smaller boxes may be used where required by particular fixture to be installed.
- B. Non metallic outlet boxes may be provided in PVC raceway systems.
- C. Outlet boxes in wet or damp locations shall be cast-metal, threaded hub-type with gaskets.
- D. Outlet boxes in masonry-block or tile walls shall be square-cornered masonry-type with tile type covers.
- E. Junction or pull boxes not over 100 cubic inches in volume shall be standard outlet boxes. Junction boxes over 100 cubic inches in volume shall be constructed of code gage, galvanized sheet steel. Junction boxes shall have removable covers and shall be accessible after completion of buildings. No Junction boxes shall be allowed in the wet well.

#### **2.05 CABINETS:**

- A. Cabinets shall be zinc-coated sheet steel, constructed with interior dimensions not less than those indicated on drawings, arranged for flush or surface mounting as indicated. Removable trim shall be provided with a hinged door and flush latch and lock. Locks shall be keyed same as panelboards.

### **PART 3 - EXECUTION**

#### **3.01 RACEWAY AND FITTING INSTALLATION:**

- A. Run conduits in concrete slabs where possible, if not, run conduits surface mounted on walls. It is the intent of this project to conceal the conduit when possible. No conduits shall be exposed on the exterior of the building. Conduit shall be supported at intervals of not more than 8'. Run exposed conduit parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceiling. Conduit larger than 1" nominal diameter run in floor slab shall be run under the slab and shall be encased in a 3" concrete envelope. Conduit 1" and smaller may be run in the floor slab where practicable. Run the conduit as close to one of the supports of the slabs as possible. Locate conduit in

concrete slabs so as not to affect the structural strength of slab. Changes in direction of runs shall be made with symmetrical bends or cast metal fittings.

- B. Support conduits by pipe straps, wall brackets, strap hangers, or ceiling trapeze.
- C. Conduit run outside of building shall be buried a minimum of 24" below finished grade.
- D. Service entrance conduit shall be PVC. Convert PVC to RS before rising out of soil.
- E. Flexible conduit shall be used to connect all motors, transformers and all equipment subject to vibration.
- F. PVC conduit shall be utilized to the maximum extent allowed by code.
- G. Concealed conduit leaving the junction box behind the control panel shall be rigid PVC coated.
- H. All conduit from VFD's to pump motor shall be PVC coated rigid steel conduit.

### **3.02 SLEEVE INSTALLATION:**

- A. Check floor and wall construction and finishes to determine proper length of sleeves for various locations. Make actual lengths to suit the following:
  - 1. Terminate sleeves flush with wall, partitions and ceilings.
  - 2. In areas where conduits are exposed, extend sleeves  $\square$  inch above finished floor, except in rooms having floor drains extend sleeves 1 inch above floor.
- B. Fasten sleeves securely in floors and walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the spaces between conduit and sleeve during construction.

### **3.03 BOX INSTALLATION:**

- A. Support boxes for fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

**END OF SECTION**

## SECTION 16220

### CONDUCTORS

#### PART 1 - GENERAL

- 1.01 Provide a complete system of conductors as indicated or necessary to accomplish the required connections. All conductors shall be installed in a neat and workmanlike manner, with care being taken that conductors are not kinked, scarred, or damaged during installation.
- 1.02 All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.

#### PART 2 - PRODUCTS

##### 2.01 CONDUCTORS AND INSULATION:

- A. Wire and cable shall be soft drawn, annealed copper with 600 volt insulation. Minimum wire size shall be #12 AWG. Insulation for conductor sizes #12 and #10 shall be type THHN-THWN, THW or RHW for installation in ordinary dry locations and type THWN or RHW-2 for installation in wet locations. Wet locations shall include service conduits, conduit underground, raceways installed in concrete floor slabs in direct contact with the earth and raceways regularly subject to moisture or condensation. Conductors sizes larger than #10 shall have type XHHW-2 insulation. Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote-control and signal circuits, classes 1, 2, and 3, may be stranded.
- B. Branch circuit conductors in fluorescent fixture raceways and drops to single fluorescent fixtures shall be type THHN or XHHW.
- C. Provide a separate ground conductor in all raceways sized in accordance with the N.E.C.

##### 2.02 COLOR CODING:

- A. All branch circuit, feeder and control wiring shall be color coded in accordance with NEC. Color shall be integral with sheath for sizes 12 through 8. Provide minimum 1/2 inch wide color coded plastic tape strips for conductors size 6 and larger. Strips shall be placed minimum 6 inches on center in all panelboards, junction boxes, pull boxes, conduit fittings, disconnect switches and anywhere the conductors are accessible and visible. Wire shall be color coded as noted below. All other conductors shall be of other colors. Color schedule shall be as follows:

480/277 Volt  
System

Phase A      Brown  
Phase B Orange  
Phase C Yellow

120/240 Volt  
System

Phase A      Black  
Phase B Red  
Neutral White



Neutral Grey  
Ground Green

Ground Green

### **2.03 JOINTS AND TERMINATIONS:**

- A. Leave at least 6 inches of free conductor in each outlet- or junction- box for making up joints and making connections to fixtures, devices or equipment.
- B. For conductors #12 and #10 all fixture and branch circuit joints in junction and outlet boxes shall be made with UL listed pressure type connectors rated at 600 volts and 105 degrees C. Connector body shall consist of a cone-shaped, expandable, square-edged, coil-spring insert, insulated with a color-coded, self-extinguishing nylon shell with two wings placed opposite to each other to serve as a "built-in" wrench. Shell shall be molded of one piece. Connectors shall be IDEAL INDUSTRIES "Wing-Nut" or BUCHANNAN "B-CAP", 3M "SCOTCH-LOK" connectors or equal. Wire #8 and larger shall be joined or terminated with solder less pressure connectors properly taped in layers to form a moisture-tight joint.

## **PART 3 - EXECUTION**

### **3.01 CONDUCTOR INSTALLATION, GENERAL:**

- A. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Junction boxes shall be provided where required. Home runs may be combined in one conduit, provided all connections are in accordance with NEC requirements and the maximum unbalanced current in the neutral does not exceed the capacity of the conductor. Conductors shall be pulled by hand and without aid of block and tackle or other mechanical device. Only approved pulling compounds which will in no way damage the insulation on the conductors or hasten its aging may be used to facilitate pulling of wire into conduit. Circuiting shown shall be followed unless specific changes are approved by the Owner.
- B. Where several feeders pass through a common pull box or junction box, the feeders shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation. This same information shall be permanently marked on cover of the box.
- C. All conductors shall be in conduit unless otherwise indicated.
- D. All conductors and cables shall be labeled.

**END OF SECTION**

## **SECTION 16230**

### **WIRING DEVICES**

#### **PART 1 - GENERAL**

- 1.01 Provide wiring devices complete with all necessary trim rings or wall plates as shown or as required.
- 1.02 All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.

#### **PART 2 - PRODUCTS**

- 2.01 Wiring devices shall be as manufactured by GENERAL ELECTRIC, SLATER (MEDALIST), ARROW-HART, BRYANT, HUBBELL or PASS & SEYMOUR. All wiring devices provided on this project shall be by the same manufacturer and shall be "specification grade".
- A. Local switches shall be single pole as shown on the drawings, black plastic cup with red plastic cover and brown plastic handle, back or side wired, 20 ampere, 120-277 volts.
  - B. Duplex convenience receptacles shall be brown plastic, 20 ampere, 125 volts, 2 pole, 3 wire NEMA and ASA Standard, grounding type.
  - C. Weatherproof receptacles shall be in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Caps shall be provided with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations."
  - D. Ground fault circuit interrupting receptacles shall conform to NEC, shall be UL listed, brown plastic, shall have a "push-to-test" button and visible indication of a tripped condition, and shall detect a current imbalance in device or equipment plugged-in of approximately 5 milliamperes and trip out under that condition.
  - E. Device plates on walls and on fittings, shall be zinc-coated sheet steel having rounded or beveled edges. Plates shall be of one piece type to suit device or devices covered. Sectional plates will not be permitted.

#### **PART 3 - EXECUTION**

- 3.01 Devices shall be installed in a rigid manner in outlet boxes. Device plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically and with an alignment tolerance of 1/16 inch.

**END OF SECTION**

## **SECTION 16250**

### **SAFETY SWITCHES**

#### **PART 1 - GENERAL**

- 1.01 Provide safety switches wherever shown and whenever required whether specifically shown or not.
- 1.02 All materials and work shall be in conformance with the City of Newport News, Department of Engineering, "Standard Specifications", dated August 1983, as amended, except as noted herein.

#### **PART 2 - PRODUCTS**

- 2.01 Safety switches shall be rated at 600 or 240 volts with number of poles and current rating as indicated. Switches shall be fused or non-fused type as indicated, NEMA type GD or HD as required, with full cover interlocks and quick-make, quick-break mechanism.
- 2.02 All fused switches shall be provided complete with fuses and shall have horsepower ratings when serving motor loads.
- 2.03 FUSES:
  - A. All fuses 600 amperes and below shall be true dual-element time delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees Fahrenheit or less when subjected to a non-load oven test. RK-1 fuses shall be Littelfuse fuses, type LLN-RK or LLS-RK. RK-5 fuses shall be Littelfuse "Slo-Blo" fuses, type FLN-R or FLS-R. Fuses shall be sized as indicated on the drawings or as required by the equipment provided, whichever provides maximum protection.

#### **PART 3 - EXECUTION**

- 3.01 Switches shall be securely mounted to wall, structure or equipment. Provide miscellaneous accessories for mounting switches, including steel angles or channels where required.
- 3.02 Spare fuses. At the completion of the project the contractor shall deliver to the Owner (and obtain receipt for) spare fuses of each size and type equal to 20 percent of the number installed but not less than 3 or more than 9 of any size and type.

**END OF SECTION**

## SECTION 16255

### ENCLOSED CIRCUIT BREAKERS

#### PART 1 - GENERAL

1.01 Provide enclosed circuit breakers with ratings as indicated.

#### PART 2 - PRODUCTS

##### 2.01 CIRCUIT BREAKERS:

- A. Circuit breakers shall be molded case type having over-center, trip free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle indication. Two and three-pole breakers shall be common trip. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. The circuit breaker shall be constructed to accommodate the supply connections at either end. Circuit breaker operating handles shall assume a center position when tripped.
- B. Breakers shall have removable lugs. Lugs shall be UL listed for copper conductors. Breakers shall be UL listed for installation of mechanical screw type lugs or crimp lugs.

##### 2.02 ENCLOSURES:

- A. Enclosures shall be NEMA 12.
- B. NEMA 12 gasketed enclosures shall be furnished without knockouts. The external operating handle must be an integral part of the box, not the door, so that the external operating handle is always in control of the breaker. Enclosures shall have provisions for padlock to lock breaker. Enclosures shall have provisions for padlock to lock breaker in the OFF position and dual interlock to prevent unauthorized opening of the breaker door in the ON position or closing the breaker with the door open. Enclosures shall include prominent trip indication. Enclosures shall be fabricated from sheet steel in accordance with UL 98. Enclosures shall be UL listed.

#### PART 3 - EXECUTION

##### 3.01 CIRCUIT BREAKERS:

- A. Circuit breakers shall be securely mounted to wall, structure or equipment. Provide miscellaneous accessories for mounting breakers, including steel angles where required.

**END OF SECTION**

## SECTION 16310

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.01 PANELBOARDS:

- A. Panelboards shall be provided with number and size of mains and branch circuits as shown on drawings, shall be mounted as indicated and shall have incoming lugs arranged to receive the conductors shown. Panelboards shall conform to latest UL and NEMA standards and shall bear UL labels.

#### PART 2 - PRODUCTS

##### 2.01 PANELBOARDS:

- A. Panelboards shall be dead-front, circuit breaker type equipped with single, double, or three pole thermal magnetic quick-make, quick-break trip-free on overload or short circuit alternating current circuit breakers with trip ratings and frame size as shown on the drawings. Main and branch circuit breakers shall provide inverse time delayed tripping on overloads and instantaneous tripping on short circuits. Trip indication shall be clearly shown by the breaker handle taking position between ON and OFF when the breaker is tripped. Two and three pole breakers shall be common trip type. Bussing shall be such that any three adjacent single-pole breakers are individually connected to each of the three different phases in such a manner that two to three-pole breakers can be installed at any location. All current-carrying parts of the bus assembly shall be plated. Sub-feed breakers are not acceptable.
  - 1. Where a "space" is indicated on the drawings or elsewhere, the space shall be "fully equipped" and ready for the direct insertion of a circuit breaker. Additional hardware, bus extension kits, strap kits, and so forth shall not be required in order to properly add a circuit breaker to a designated "space".
- B. Each panel shall be equipped with typewritten directory card, card holder, transparent protection and complete identifying data on inside of door.
- C. Provide an isolated neutral bus for each panel for connection of both feeder and branch circuit neutral wires. Neutral bus shall have same current ratings as panel mains.
- D. Provide a separate equipment ground bus, bonded to the steel cabinet for each panel for connection of all ground wires and mark with a green stripe along the front of the bus. Equipment ground bus shall have same rating as panel mains.
- E. Ground fault circuit interrupting breakers shall be sized as indicated, shall conform to NEC, shall be UL listed, shall have a "push-to-test" button and visible indication of a tripped condition, and shall detect a current imbalance of approximately 5 milliamperes.
- F. Panelboards shall be equal to SQUARE-D, Type NQOD, NEHB, NAIB or NHIB.

## **PART 3 - EXECUTION**

### **3.01 PANELBOARDS:**

- A. Panelboards shall be so mounted that operating handle of top breaker is not more than 78" above the floor. Load on each panel shall be divided as evenly as possible between the phases in the panel.

**END OF SECTION**

## **SECTION 16330**

### **TRANSFORMERS**

#### **PART 1 - GENERAL**

- 1.01 Provide dry-type transformers as shown to step the main incoming service voltage down to the utilization voltage required for small motor and other loads as shown.

#### **PART 2 - PRODUCTS**

- 2.01 Transformers shall be self-cooled, dry type, single or three phase as indicated. Primary and secondary voltages, and KVA ratings shall be as indicated. Insulation shall be 600 volt class "H" rated for 150 degrees centigrade rise. Transformer shall be quiet type with noise levels per NEMA. Transformer shall have two 2 1/2 percent taps above and four 2 1/2 percent taps below normal rated voltage.

#### **PART 3 - EXECUTION**

- 3.01 Mount transformers on suitable vibration isolating foundations or support brackets and provide short lengths of flexible metallic conduit in all connections thereto to prevent transmission of transformer hum to building structure and to conduit systems.

**END OF SECTION**

## **SECTION 16410**

### **LIGHTING FIXTURES**

#### **PART 1 - GENERAL**

##### **1.01 LIGHTING FIXTURES:**

- A. Fixtures shall be UL approved, listed and labeled for the particular installation. Lighting fixtures shall be provided complete with lamps, mounting hardware, accessories, canopies, necessary guards, straps, supports or hangers and other miscellaneous materials and devices to assure satisfactory installation and desired function where installed and shall be approved before installation.

#### **PART 2 - PRODUCTS**

##### **2.01 FIXTURES:**

- A. Fixtures shall be as indicated in schedule on drawings. Cuts and descriptions of all fixtures shall be submitted for approval before ordering. When requested, samples of the fixtures, shall be provided.

##### **2.02 LAMPS:**

- A. Provide as indicated on schedule.

##### **2.03 BALLASTS:**

- A. Fluorescent ballasts shall be ETL and UL approved and shall be energy saving electronic type compatible with lamps specified. Fixtures shall be designed for use with these electronic ballasts and shall have thermal characteristics that will minimize operation of ballast over-heat devices under all normally expected operation conditions. Ballasts shall have a Class A sound rating.
- B. HID ballasts shall be of the constant wattage, high power factor type. HPS ballasts shall have solid state igniter/starter.
- C. Ballasts which are not quiet and hum-free will be rejected and shall be replaced by the Contractor at no additional cost to Owner.
- D. Ballasts in unconditioned spaces or outdoors shall be rated for operation in high or low temperature environments.



## **PART 3 - EXECUTION**

### **3.01 LIGHTING FIXTURES:**

- A. Contractor's attention is directed to coordinating with lighting fixtures and equipment in all spaces. This shall include all changes resulting from substitute items, change orders, etc.
  
- B. All surface mounted fluorescent lighting fixtures shall be mounted independent of ceiling construction. All fluorescent lighting fixtures mounted in or on plaster ceiling shall also be mounted independent of ceiling construction.

**END OF SECTION**

**SECTION 16420**  
**TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General, Supplementary and Special Conditions, and other Division 1 Specification sections, apply to the work of this section.
- B. Requirements of Section 16010, "Electrical - General Provisions" form part of this section.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's data and catalog cuts for each type of transient voltage surge suppression (TVSS) device.
- B. Shop Drawings: Submit dimensional drawings for each type of transient voltage surge suppression (TVSS) device.
- C. Installation Instructions: Submit installation instructions for each type of transient voltage surge suppression (TVSS) device.
- D. Field Acceptance Test Reports: Submit as specified herein.
- E. Operation and Maintenance Manuals: Submit as specified in Division 1.
- F. Warranties: Submit manufacturer's warranty.

**PART 2 - PRODUCTS**

**2.1 GENERAL**

- A. Manufacturers:
  - 1. Ditek Corp.
  - 2. Surge Suppression, Inc.
  - 3. Advanced Protection Technologies
  - 4. Approved equal

- B. All TVSS shall be designed and tested in accordance with ANSI/IEEE C62.41 and ANSI/IEEE C62.45. High energy parallel design for Categories A, B and C3 applications. All TVSS shall be listed by UL 1449 Second Edition and UL 1283. All TVSS shall comply with NEMA LS1.
- C. All TVSS devices shall be provided by a single manufacturer.

## **2.2 SERVICE ENTRANCE**

- A. Designed for service entrance applications, utilizing multiple stage suppression circuit consisting of fast acting, field replaceable, surge current diversion modules (Metal Oxide Varistors - MOV's). Each surge suppression module shall be individually fused with field replaceable 200,000 AIC rated fuses, and shall be capable of suppressing multiple events. Fusing shall be present in all modes, including neutral to ground.
- B. The peak single impulse surge current shall be rated 240,000 amperes in each of the listed pathways of protection: Line to Line, Line to Neutral, Line to Ground, and Neutral to Ground.
- C. Protection mode and UL1449 Clamping Voltage for grounded wye circuits shall be as follows:
  - 1. 800V for 480Y/277 volts: Line to Line, Line to Neutral, Line to Ground, Neutral to Ground.
- D. Provide Noise Filtering System capable of managing EMI/RFI interference to ensure wave shape smoothing and noise attenuation. The filtering shall be provided in line to Neutral and Line to Ground modes.
- E. Provide LED type operational indicators, to indicate normal operation and failure of protection. Provide audible alarm with silence switch, to indicate when protection has failed.
- F. System shall feature monitoring circuit, external test port, and diagnostic test equipment for determining the actual protection levels remaining in the system.
- G. Suppression shall be mounted in a NEMA 12 enclosure adjacent to the service entrance equipment.

## **PART 3 - EXECUTION**

### **3.1 SERVICE ENTRANCE**

- A. Install one service entrance suppression device at main service entrance.
- B. Install suppression device on the load side of the service entrance equipment.
- C. Keep conductors between the suppression device and the point of attachment short and straight.
- D. Bond suppression device ground to the service entrance ground.
- E. Install suppressor in accordance with manufacturer's instructions. Provide all components and appurtenances as required for proper installation and operation.

### **3.2 SPARE PARTS**

- A. Provide one complete set of replaceable surge current diversion modules (MOV's) for each surge protection device.

### **3.3 TESTING**

- A. Testing: After installation is complete, and before energizing circuitry, test for compliance with manufacturer's and industry standards. Complete start-up check according to manufacturer's instructions.
- B. Field Acceptance Test Report: Upon successful test completion, a written test report shall be provided showing the tests performed and the results of each test. The report shall include a list of and description of test equipment and data measuring instruments and calibration dates for these data measuring instruments. It shall be certified that the test data taken from the equipment during the field test falls within the manufacturer's recommended limits and that each installation is acceptable. The report shall be dated, certified and submitted to the Architect for approval.

### **3.4 TRAINING**

- A. Provide the services of a factory-authorized representative to train selected Owner personnel at the site on operation and maintenance of each surge protection device.

**END OF SECTION 16420**

## SECTION 16460

### DRY-TYPE TRANSFORMERS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General, Supplementary and Special Conditions, and other Division 1 Specification sections, apply to the work of this section.
- B. Requirements of Section 16010, "General Electrical Provisions" form part of this section.

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's data for each dry-type transformer.
- B. Shop Drawings: Submit the following as a minimum:
  - 1. Dimensioned drawings of each dry-type transformer.
  - 2. KVA ratings.
  - 3. Voltage and phase, primary and secondary.
  - 4. Impedance.
  - 5. Sound ratings.
  - 6. Mounting accessories.
- C. Field Acceptance Test Reports: As specified herein.
- D. Operation and Maintenance Manual: Submit as specified in Division 1.

##### 1.3 GENERAL

Provide transformers of the type and ratings indicated on drawings with necessary mounting accessories.

#### PART 2 - PRODUCTS

##### 2.1 DRY-TYPE TRANSFORMERS

- A. Manufacturers:
  - 1. Square D Co.
  - 2. General Electric Co.
  - 3. Eaton Corp., Cutler-Hammer
  - 4. Approved equal.

##### 2.2 TRANSFORMERS, GENERAL

- A. Dry Type Transformers: Factory assembled and tested, air cooled, 60 Hz.

- B. Ratings: As indicated on drawings.
- C. Enclosure: Comply with NEMA 250 for the environment in which installed.
- D. Sound Level: Comply with NEMA ST 20. Where low sound level units are specified, provide at a minimum of 3 dBA less than NEMA ST 20 standard sound levels.

## 2.3 GENERAL PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

- A. Comply with NEMA ST 20, UL 1561.
- B. Insulation: Insulation shall be 115°C temperature rise above 40°C ambient and shall be capable of carrying a 15% continuous overload without exceeding 150°C rise in a 40°C ambient. All insulating materials to be in accordance with NEMA ST 20 standards for a 220°C UL component recognized insulation system.
- C. Mounting: Core and coil assemblies mounted on rubber isolation pads to reduce sound transmission.
- D. Enclosure: Ventilated for indoor locations and ventilated, raintight, NEMA 3R for outdoor locations, unless noted otherwise. Standard manufacturer's gray finish.
- E. Taps:
  - 1. 3 through 10 KVA – Two 5% taps below normal primary voltage.
  - 2. 15 through 500 KVA – Six 2.5% taps, two above and four below normal primary voltage.

## 2.4 CONTROL AND SIGNAL TRANSFORMERS

- A. Comply with NEMA ST 1 and UL 506.
- B. Self cooled, continuous duty. If no rating is indicated, provide capacity to exceed peak load by no less than 50%.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, ANSI and IEEE standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.
- B. Locate to provide adequate access and circulation of cooling air.
- C. Provide neoprene isolation pads between transformer enclosure and mounting support, minimum 1/2-inch uncompressed thickness.
- D. Connect transformers on primary and secondary with flexible conduit not less than 18 inches in length.

- E. Ground each transformer in accordance with the NFPA 70 requirements for a separately derived system.
- F. After the application of permanent voltage to the transformer, determine the voltage supplied and connect transformer taps to supply optimum voltage conditions at utilization equipment.

### 3.2 TESTING

- A. Upon completion of installation of transformers and after circuitry has been energized, perform visual and mechanical inspection. Inspect accessible components for cleanliness, mechanical and electrical integrity. Inspect bolted connections for tightness. Measure and adjust taps for proper voltage, record primary and secondary voltages and tap settings. Correct or replace malfunctioning units, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
- B. Field Acceptance Test Report: Upon successful test completion, a written test report shall be provided showing the tests performed and the results of each test. It shall be certified that the test data taken from the equipment during the field test falls within the manufacturer's recommended limits and that each transformer installation is acceptable. The report shall be dated, certified and submitted to the Architect for approval.

END OF SECTION 16460

## **SECTION 16480**

### **MOTORS, MOTOR STARTERS AND CONTROL RELAYS**

#### **PART 1 - GENERAL**

##### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General, Supplementary and Special Conditions, and other Division 1 Specification sections, apply to the work of this section.
- B. Requirements of Section 16010, "General Electrical Provisions" form part of this Section.
- C. Requirements for Section 15800, "HVAC Instrumentation and Controls" form part of this section.

##### **1.2 SUBMITTALS**

- A. As required by other divisions furnishing the equipment.
- B. Field Acceptance Test Report: Submit as specified herein.

##### **1.3 GENERAL**

Motors shall be provided under other divisions of the specifications in accordance with this section. Motor starters will be furnished under other Divisions of the specifications in accordance with this section or section in which furnished and installed under this section of specifications. Except as indicated, control wiring shall be provided under Division 15 in compliance with the requirements of this division, Division 16. All motor starters, and motor relays, shall be provided by a single manufacturer.

#### **PART 2 - PRODUCTS**

##### **2.1 MOTOR STARTERS**

- A. Manufacturers:
  - 1. Square D Co.
  - 2. General Electric Co.
  - 3. Allen-Bradley Co.
  - 4. Eaton Corp., Cutler-Hammer
  - 5. Approved equal.



## **2.2 MANUAL MOTOR STARTERS**

- A. Manual starters shall consist of a manually operated toggle switch equipped with melting alloy type thermal overload relays. Switch contacts shall be double break, silver alloy and shall be visible from both sides of starter.
- B. Enclosures for manual motor starters: NEMA 4X unless noted otherwise.

## **2.3 MOTORS**

All motors shall conform to the latest applicable NEMA standards for type, size and duty, as specifically applied. All motors shall be suitable for operation on 60 cycles A.C. and with voltage and other characteristics as specified in other divisions of these specifications. Except as specifically noted otherwise, all motors 1 horsepower and larger shall be three phase and all smaller shall be single phase. Provide power factor correction capacitors for all motors 1 horsepower and larger having a power factor of less than or equal to 85%. All motors 50 horsepower and larger shall be provided with a vibration switch to shut down pump motors with excessive vibration and rated for inverter duty. Provide phase protection for all three-phase motors.

## **2.4 CONTROL RELAYS**

- A. All relays shall be electrically held multi-circuit industrial type. Coil shall be rated for 120VAC 60HZ and contacts shall be rated 300V maximum. All contacts shall be field convertible.
- B. Relays not installed in control cabinet shall be provided with NEMA 12 enclosure, unless noted otherwise.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF MOTOR STARTERS**

- A. Coordinate exact locations of motor starters and relays with Division 15.
- B. Install fuses in fusible disconnect switches, as necessary.
- C. All motor starters and relays mounted on the same bed plates as the equipment served by the motor shall be set in place by the contractor supplying the equipment. Where the motor starter or relay is not mounted on the same bed plate as the equipment served by the motor, the electrical contractor shall receive the motor starter or relay from the contractor supplying the equipment and mount it in place by approved methods in an exact location as directed by the other contractor.

### **3.2 MOTOR INSTALLATION**

All motors shall be furnished and set in place by the contractor supplying the equipment requiring the motor, except that they shall be connected electrically by the electrical contractor.

### **3.3 CONTROL RELAY INSTALLATION**

All control relays shall be furnished by contractor supplying equipment requiring the relay and installed by the electrical contractor.

### **3.4 TESTING**

- A. Upon completion of installation of motor controls, and after electrical circuitry has been energized with permanent power source, test each motor controller to demonstrate compliance with requirements. Correct malfunctioning units, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
- B. Field Acceptance Test Report: Upon successful test completion, a written test report shall be provided showing the tests performed and the results of each test. The report shall be dated, certified and submitted to the Architect for approval.

**END OF SECTION**

## SECTION 16480

### MOTORS, MOTOR STARTERS AND CONTROL RELAYS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General, Supplementary and Special Conditions, and other Division 1 Specification sections, apply to the work of this section.
- B. Requirements of Section 16010, "General Electrical Provisions" form part of this Section.
- C. Requirements for Section 15800, "HVAC Instrumentation and Controls" form part of this section.

##### 1.2 SUBMITTALS

- A. As required by other divisions furnishing the equipment.
- B. Field Acceptance Test Report: Submit as specified herein.

##### 1.3 GENERAL

Motors shall be provided under other divisions of the specifications in accordance with this section. Motor starters will be furnished under other Divisions of the specifications in accordance with this section or section in which furnished and installed under this section of specifications. Except as indicated, control wiring shall be provided under Division 15 in compliance with the requirements of this division, Division 16. All motor starters, and motor relays, shall be provided by a single manufacturer.

#### PART 2 - PRODUCTS

##### 2.1 MOTOR STARTERS

- A. Manufacturers:
  - 1. Square D Co.
  - 2. General Electric Co.
  - 3. Allen-Bradley Co.
  - 4. Eaton Corp., Cutler-Hammer
  - 5. Approved equal.

## 2.2 MANUAL MOTOR STARTERS

- A. Manual starters shall consist of a manually operated toggle switch equipped with melting alloy type thermal overload relays. Switch contacts shall be double break, silver alloy and shall be visible from both sides of starter.
- B. Enclosures for manual motor starters: NEMA 4X unless noted otherwise.

## 2.3 MOTORS

All motors shall conform to the latest applicable NEMA standards for type, size and duty, as specifically applied. All motors shall be suitable for operation on 60 cycles A.C. and with voltage and other characteristics as specified in other divisions of these specifications. Except as specifically noted otherwise, all motors 1 horsepower and larger shall be three phase and all smaller shall be single phase. Provide power factor correction capacitors for all motors 1 horsepower and larger having a power factor of less than or equal to 85%. All motors 50 horsepower and larger shall be provided with a vibration switch to shut down pump motors with excessive vibration and rated for inverter duty. Provide phase protection for all three-phase motors.

## 2.4 CONTROL RELAYS

- A. All relays shall be electrically held multi-circuit industrial type. Coil shall be rated for 120VAC 60HZ and contacts shall be rated 300V maximum. All contacts shall be field convertible.
- B. Relays not installed in control cabinet shall be provided with NEMA 12 enclosure, unless noted otherwise.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF MOTOR STARTERS

- A. Coordinate exact locations of motor starters and relays with Division 15.
- B. Install fuses in fusible disconnect switches, as necessary.
- C. All motor starters and relays mounted on the same bed plates as the equipment served by the motor shall be set in place by the contractor supplying the equipment. Where the motor starter or relay is not mounted on the same bed plate as the equipment served by the motor, the electrical contractor shall receive the motor starter or relay from the contractor supplying the equipment and mount it in place by approved methods in an exact location as directed by the other contractor.

### 3.2 MOTOR INSTALLATION

All motors shall be furnished and set in place by the contractor supplying the equipment requiring the motor, except that they shall be connected electrically by the electrical contractor.

### 3.3 CONTROL RELAY INSTALLATION

All control relays shall be furnished by contractor supplying equipment requiring the relay and

installed by the electrical contractor.

### 3.4 TESTING

- A. Upon completion of installation of motor controls, and after electrical circuitry has been energized with permanent power source, test each motor controller to demonstrate compliance with requirements. Correct malfunctioning units, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.
- B. Field Acceptance Test Report: Upon successful test completion, a written test report shall be provided showing the tests performed and the results of each test. The report shall be dated, certified and submitted to the Architect for approval.

END OF SECTION 16480

## SECTION 16550 - EMERGENCY POWER SYSTEM

### PART 1 – GENERAL

#### 1.01 SCOPE:

Provide, install, and acceptance test a complete and operable Emergency/Standby electric generating system, including all devices and equipment specified herein, as shown on the drawings, or required for the service. Equipment shall be new, factory tested, and delivered ready for installation.

#### 1.02 WARRANTY:

A comprehensive parts and labor warranty shall be provided for all components of the generator set and automatic transfer switch, against defects in materials and workmanship for a five year period from the start-up date.

### PART 2 - PRODUCTS

#### 2.01 DIESEL ENGINE-GENERATOR SET:

4-cycle, 1800 rpm, diesel engine generator set. Generator set ratings: 200 kW, 250 kVA at 0.8 PF, standby rating, based on site conditions noted below. System voltage of: 277/480 Volts AC, Three phase, Four-wire, 60 hertz. Site Conditions: Altitude 50 ft., ambient temperatures up to 100 degrees F. Generator set shall be ONAN 200 DGFC or approved equal. The Generator shall be supplied on a 40 inch wide skid package.

Note that this project was designed around an ONAN generator. The contractor may substitute the following approved generator manufacturers but is responsible for the suitability for this application and shall verify that the generator will supply adequate power to the station and satisfies all space/dimensional requirements. The contractor is solely responsible for any and all necessary modifications required to the station as a result of substituting an alternate generator. Acceptable manufacturers are:

1. Caterpillar
2. Onan
3. Western Branch Diesel

#### A. Performance:

Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.

Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.

The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.

B. Engine:

The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at it's minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Engine accessories and features shall include:

An electronic governor system shall provide automatic isochronous frequency regulation.

Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F ambient as measured at the generator air inlet. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact per OSHA requirements.

Positive displacement, mechanical, full pressure, lubrication oil pump.

Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator. Supply oil drain hose with valve and oil pan.

An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element.

Replaceable dry element air cleaner with restriction indicator.  
Flexible supply and return fuel lines.

Engine mounted battery charging alternator, and solid-state voltage regulator.

Acceptable engine manufacturers are:

1. Caterpillar
2. Cummins
3. Detroit Diesel
4. Western Branch Diesel-Spectrum Detroit Diesel
5. John Deere
6. Ford

C. AC Generator:

The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 80 degrees Centigrade.

The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds

D. Engine-Generator Set Control:

The generator set shall be provided with a microprocessor-based control system which is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

The control shall be UL508 listed, CSA282-M1989 certified, and meet IEC8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std 801.2, 801.3., and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions. The entire control shall be tested and meet the requirements of IEEE587 for voltage surge resistance.

The generator set mounted control shall include the following features and functions:

1. Three position control switch labeled RUN/OFF/AUTO.

In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.



2. Red "mushroom-head" push-button EMERGENCY STOP switch.

Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

3. Push-button RESET switch.

The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

4. Push-button PANEL LAMP switch.

Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

5. Generator Set AC Output Metering:

The generator set shall be provided with a metering set including the following features and functions:

Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters.

Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.

6. Generator Set Alarm and Status Message Display:

The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:

- low oil pressure (alarm)
- low oil pressure (shutdown)
- oil pressure sender failure (alarm)
- low coolant temperature (alarm)
- high coolant temperature (alarm)
- high coolant temperature (shutdown)
- engine temperature sender failure (alarm)
- low coolant level (alarm or shutdown--selectable)
- fail to crank (shutdown)

- overcrank (shutdown)
- overspeed (shutdown)
- low DC voltage (alarm)
- high DC voltage (alarm)
- weak battery (alarm)
- low fuel-daytank (alarm)
- high AC voltage (shutdown)
- low AC voltage (shutdown)
- under frequency (shutdown)
- over current (warning)
- over current (shutdown)
- short circuit (shutdown)
- over load (alarm)
- emergency stop (shutdown)
- generator run (alarm)
- generator fail (alarm)
- generator exercise (alarm)

NOTE: generator run alarm shall be active when generator is running, regardless of the position of the transfer switch.

7. Engine Status Monitoring:

The following information shall be available from a digital status panel on the generator set control :

- engine oil pressure (psi or kPA)
- engine coolant temperature (degrees F or C)
- engine oil temperature (degrees F or C)
- engine speed (rpm)
- number of hours of operation (hours)
- number of start attempts
- battery voltage (DC volts)

The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

8. Control Functions:

The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.

The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure condition.

9. Alternator Control Functions:

The generator set shall include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches.

Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.

Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating in excess of 5 seconds.

An AC over/under voltage monitoring system which responds to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is below or above acceptable levels. During engine starting, the low voltage limit shall be disabled.

10. Control Interfaces for Remote Monitoring:

All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field

connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:

Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.

One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.

E. Base:

The engine-generator set shall be mounted on a heavy duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

F. Generator Set Auxiliary Equipment and Accessories:

1. Coolant heater

Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the drawings.

The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using ball valves and quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

The coolant heater shall be provided with thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power plug in type connection to the coolant heater system. The heater shall not be hard wired.

The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F in a 40F ambient, in compliance with NFPA110 requirements.

2. Vibration Isolators

Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.

3. Starting and Control Batteries

Starting battery bank, calcium/lead antimony type, 24 volt DC, sized as recommended by the generator set manufacturer, shall be supplied for each generator set with battery cables and connectors.

#### 4. Exhaust Silencer(s)

Exhaust muffler(s) shall be provided for each engine, size and type as recommended by the generator set manufacturer. The mufflers shall be side inlet and residential grade. Exhaust system shall be installed according to the generator set manufacturers recommendations and applicable codes and standards.

#### G. Battery Charger

A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be wall mounted, at the discretion of the installer. Input AC voltage and DC output voltage shall be as required. Battery charger shall be factory mounted within the automatic transfer switch enclosure. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:

Loss of AC power

Low battery voltage

High battery voltage

Power ON - green light (no relay contact)

Analog DC voltmeter and ammeter, 12 hour equalize charge timer, AC and DC fuses shall also be provided on the charger.

### 2.02 TRANSFER SWITCH EQUIPMENT:

Provide complete factory assembled transfer equipment with electronic controls designed for surge voltage isolation, and including voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts. Transfer switch shall be ONAN, ASCO or ZENITH.

#### A. Transfer Switch Ratings:

Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, number of poles, voltage and ampere ratings, enclosures, and accessories.

All transfer switches and accessories shall be UL listed and labeled, tested per UL Standard 1008, and CSA Approved.

Main contacts shall be rated for 600 Volts AC minimum.

Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure, in ambient temperatures of -40 to +50 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet.

Transfer switch equipment shall have a withstand and closing rating (WCR) in RMS symmetrical amperes greater than the available fault current. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third-party listed and labeled for use with the specific protective device(s) installed in the application.

B. Construction:

Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in both positions.

Transfer switches shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms suitable for safe manual operation under load.

Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent interphase flashover. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

Transfer switches shall be provided with a neutral bus and lugs, sized to carry 100% of the current designated on the switch rating.

Enclosures shall be UL listed. The enclosure shall provide NEC wire bend space. The cabinet door shall be key-locking.

Transfer switches shall be mounted in enclosures as designated on the drawings. Separate enclosures shall be the NEMA type specified.

C. Automatic Controls:

Transfer switches that are designated on the drawing as automatic shall be provided with a fully automatic control system, and provisions for manual operation as described in this section.

1. Control shall be solid-state and designed for a high level of immunity to power line surges and transients, demonstrated by test to IEEE Standard 587-1980. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs.

Solid-state undervoltage sensors shall simultaneously monitor all phases of both sources. Pick-up and drop-out settings shall be adjustable. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage.

Controls shall be provided with solid-state overvoltage sensors, adjustable from 100-130% of nominal, to monitor all phases of both source(s). Provide adjustable time delay of 0.5 to 2.2 sec.

Controls shall be provided with a solid-state over and under frequency sensor to monitor both source(s). Pickup bandwidth shall be adjustable from a minimum of +/-4% to a maximum of +/- 20% of nominal frequency. Dropout shall be +/-5% of nominal wider than pickup frequency bandwidth. Adjustable time delay shall be from 0.1 to 15 sec. Automatic controls shall signal the engine-generator set to start upon signal from normal source sensors. Solid-state time delay start, adjustable from 0 to 5 seconds shall avoid nuisance start-ups. Battery voltage starting contacts shall be gold, dry type contacts factory wired to a field wiring terminal block.

Provide Phase Sequence Monitor and Balance module to protect against inadvertent phase rotation hookup and monitor for voltage phase imbalance between phases.

The switch shall transfer when the emergency source reaches the set point voltage and frequency. Provide a solid-state time delay on transfer, adjustable from 0 to 120 seconds.

The switch shall retransfer the load to the normal source after a time delay retransfer, adjustable from 0 to 30 minutes. Retransfer time delay shall be immediately bypassed if the emergency power source fails.

Controls shall signal the engine-generator set to stop after a time delay, adjustable from 0 to 10 minutes, beginning on return to the normal source.

Power for transfer operation shall be from the source to which the load is being transferred.

The control shall include remote transfer inhibit and area protection features.

Transfer switches shall be equipped with a field adjustable controls to allow the operator to control the transfer switch operating time during switching in both directions. The controls shall control the time the load is isolated from both power sources, to allow load residual voltage to decay before closure to the opposite source. The transfer switch operating speed control feature shall have an adjustable range of 0 to 7.5 seconds.

## 2. Front Panel Devices:

Provide devices mounted on cabinet front consisting of:

A selector switch to provide the following positions and functions:

Test - Simulates normal power loss to control for testing of generator set. Controls shall provide for a test with or without load transfer.

Normal - Normal operating position.

Retransfer - Momentary position to override retransfer time delay and cause immediate return to normal source, if available.

Transfer switch position and source available lamps.

#### D. Accessory Items

Transfer switches shall be equipped with accessories as follows:

1. Exerciser Clock: Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period. Clock to be 14 day/24 hour programmable.
2. Provide exercise light on front panel.
3. Contacts for all specified generator alarms (generator run, generator exercise, generator fail, utility power failure, station power failure). Generator run alarm to be active whenever generator is running regardless of transfer switch position. All modules required for integration of these alarms shall be included in the transfer switch.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION:

Equipment shall be installed by the contractor in accordance with contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction.

Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

Equipment shall be initially started and operated by representatives of the manufacturer.

All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

#### 3.02 FACTORY TESTS:



Equipment supplied shall be fully tested at the factory for function and performance.

Generator set factory tests on the equipment shall be performed at rated load and rated PF. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

Transfer equipment factory tests: Each transfer switch supplied shall be factory tested before shipment. Factory tests shall include a complete functional test of the transfer switch controls, including calibration of the voltage sensors.

### 3.03 ON-SITE ACCEPTANCE TEST:

The complete installation shall be tested for compliance with the specification following completion of construction. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. Contractor shall completely fill fuel tanks upon completion of all testing and acceptance by the Owner.

Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, as required.

### 3.04 TRAINING

The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. Training date shall be coordinated with the facility owner.

**END OF SECTION**

**SECTION 16675  
PUMP CONTROL PANEL**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General, Supplementary and Special Conditions, and other Division 1 Specification sections, apply to the work of this section.
- B. Requirements of Section 16010, "Electrical - General Provisions" form part of this section.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's data for pump controller and all components.
- B. Shop Drawings: Submit the following as a minimum:
  - 1. Dimensioned drawings.
  - 2. Voltage ratings.
  - 3. Current ratings.
  - 4. Short circuit interrupting ratings.
  - 5. Device arrangements.
  - 6. Trip characteristic curves of main circuit breaker.
- C. Field Acceptance Test Report: Submit as specified herein.
- D. Operation and Maintenance Manual: Submit as specified in Division 1.

**1.3 GENERAL**

Furnish and install one complete Pump Control Panel and related auxiliary control components to provide for control of three (3) shaft driven centrifugal sewage pumps. The control panel shall be complete and include all components and wiring as shown on the Drawings and as specified herein.

**1.4 QUALITY ASSURANCE**

- A. Regulations and Standards:
  - UL Underwriters' Laboratories
  - NEC National Electrical Code
  - NEMA National Electrical Manufacturers Association
  - ANSI American National Standards Institute
  - IEEE Institute of Electrical and Electronic Engineers

ISA Instrument Society of America

- B. All control panel components shall be of the most current and proven design. Specifications and drawings call attention to certain features but do not purport to cover all details entering into the design of the control panels. The components provided by the Panel Supplier shall be compatible with the functions required and shall form a complete working system.
- C. The control panels shall be UL listed as a complete assembly in accordance with UL-508.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. The Pump Control Panel shall be designed and manufactured by one of the following companies. No other panel manufacturers will be accepted.
  - 1. Automation Controls, Inc.  
Newport News, VA
  - 2. Electric Motor and Contracting Co., Inc.  
Chesapeake, VA
  - 3. Process Control Services  
Seaford, VA
  - 4. Systems East, Inc.  
Newport News, VA
  - 5. Thermo-Trol Corp. of Tidewater, Inc.
  - 6. University Controls  
Chesapeake, VA

### **2.2 PUMP CONTROL PANEL COMPONENTS**

- A. Control Panel Enclosure:
  - 1. The pump control panel enclosure shall be a NEMA 12 type control enclosure fabricated of 10 gauge steel with continuously welded seams. Enclosure door shall be gasketed with neoprene and shall be equipped with a heavy-duty 3-point latching mechanism. The inside of the control panel shall be painted white, and the exterior color of the panel shall be "Vista Green". Control panel shall be designed to operate on 120 volt, 1 phase service.
  - 2. All control panel components shall be properly identified with an engraved nameplate mounted on the inside of the panel. All components not mounted on the front of the panel shall be mounted on a removable back panel secured to the enclosure with collar studs. All wiring and tubing shall be installed in a neat, workmanlike manner and shall be grouped, bundled, supported and routed horizontally and vertically to provide a neat appearance. All wires leaving the panel shall be terminated at the terminal strips inside the enclosure. All tubing inside the panel shall be run to bulkhead fittings. Terminals and wires shall be identified in

- accordance with the Supplier's panel wiring diagrams.
3. Provide a copper grounding plate inside the control panel for terminating all ground wires.
- B. Main Circuit Breaker: Provide a properly sized thermal-magnetic molded case main circuit breaker in the control panel. The circuit breaker shall have a quick-make, quick-break mechanism. The main circuit breaker shall be Square D Type QOU, or approved equal.
  - C. Transient Voltage Surge Suppressor: Provide a transient voltage surge suppressor in the pump control panel to protect the panel components from damage which may occur from transient voltages caused by lightning or surges on the incoming power line. The TVSS shall protect all single-phase and three-phase loads. The surge suppressor shall have an indication light to indicate the unit is functioning. Surge suppressor shall be Advanced Protection Technologies Model TE/110, or approved equal.
  - D. Relays: Relays shall be heavy-duty, general purpose type, with 6 amp contacts. Relays shall have blade type terminals which plug-in to a socket, mounted to the inside of the panel enclosure. Contact configuration shall be as required for proper operation of the control logic. Relay coils shall operate on 120 volts AC unless noted otherwise. Relays shall have an indicator light to indicate the relay coil is energized. Relays shall be IDEC RU, or approved equal.
  - E. Intrinsically Safe Barrier: Provide an intrinsically safe barrier in the control panel for the five (5) wet well non mercury float switch. The intrinsically safe barrier shall be MTL Series 7700, or approved equal.
  - F. Programmable Controller:
    1. Pump control panel shall consist of a PLC base with an operator interface. The PLC shall be an Allen Bradley 1769-L32E. The following I/O modules shall be used, quantities as required to meet I/O and spare requirements:
      - Analog Input 1769-IFB
      - Analog Output 1769-OF4CI
      - Digital Input 1769-IQ32
      - Relay Output 1769-OW16
      - Power Supply 1768-PA3
    2. Additional components:
      - Compact Flash Card 1784-CF64 Loaded with final start up program and parameters
    3. Programming software:
      - Provide RSLINX Single Node software 9355-WABSNENE by Allen Bradley
    4. Spare Parts
      - Provide one (1) 1769-L32 processor programmed to final start up parameters.
      - Provide one (1) of each power supply and module listed above.
  - G. 24 VDC Power Supplies: Provide two 24 VDC power supplies in the control panel to provide power for the 24 VDC programmable controller inputs and for the discharge

pressure and level transmitter as well as the Operator Interface. The power supplies shall be wired in an on-line/back-up configuration. The power supplies shall be Allen Bradley, or approved equal.

H. Terminal Blocks:

1. Terminal blocks shall be provided in the control panel for all field wiring. Terminal blocks shall be NEMA type, rated for 600 volts AC, and shall be identified with a permanent machine printed marking in accordance with the terminal numbers shown on the panel wiring diagrams. Provide 20% spare terminal blocks in the control panel.
2. Provide separate terminal block assemblies for all wiring to the radio alarm transmitter, pumps 1, 2, & 3, as well as float switch backup control.

I. Wiring:

1. The pump control panel as furnished by the manufacturer shall be completely wired.
2. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electrical Code (NEC). All wiring and terminal blocks shall be isolated by voltage levels to the greatest extent possible
3. All wiring shall be stranded copper, Type MTW or THW, 600 volts, and shall be color coded as follows:

a.	Line and Load Circuits, AC power	Black
b.	AC Control Circuit Less than Line Voltage	Red
c.	DC Control Circuit	Blue
d.	Interlock Control Circuits, from External Source	Yellow
e.	Radio Alarm Transmitter Wiring	Purple
f.	Equipment Grounding Conductor	Green
g.	Current Carrying Ground (Neutral)	White

All control wiring shall be tagged at each end in the control panel with a legible permanent coded wire marking sleeve. Sleeves shall be white PVC tubing with machine printed black marking. Markings shall be in accordance with the wire numbers shown on the control wiring diagrams and shall match terminal strip numbers.

### 2.3 LIQUID LEVEL TRANSMITTER

- A. Supply for contractor installation one (1) submersible level transmitter to measure Wet Well Liquid Level. The transmitter shall be 2 wire in design producing a linear 4/20mA dc signal in relation to Wet Well level. Excitation voltage shall be 9-30vdc. Transducer accuracy shall be .25%. Materials of construction shall be 316SS. Polyethylene cable shall be of sufficient length to extend transducer from 12" off floor of Wet Well to the Pump Control panel. Transducer shall be supplied with optional lightning protection warranty. Provide bellows type breather for the vent tube integral to the transducer cable. Locate

bellows in the Pump Control panel. The transducer shall be KPSI model 705.

## **2.4 WET WELL FLOAT SWITCHES**

- A. Furnish and install five (5) non-mercury float switches in the wet well for back-up control of the pumps and to detect a high and low wet well level condition. The five (5) float switches shall be designated as follows:
  - 1. Low level.
  - 2. Pump stop.
  - 3. Lead pump start.
  - 4. Lag Pump start
  - 5.. High level.
- B. The pump off, lead, and lag pump start float switches shall have DPDT contacts. The float switches shall be Conery 2902-B3-S2-C1 or approved equal.
- C. Provide a 316 stainless steel wall mounting bracket for mounting the float switches. The mounting bracket shall be model Conery 5FB, or approved equal.

## **2.5 OPERATOR INTERFACE**

- A. Provide a 10" minimum VGA color touch screen operator interface. The interface shall be powered from 24vdc. Connection to PLC shall be Ethernet based. Memory shall be large enough to contain at least 10 pages of pump control modes with operator entered set points. Operator shall be EZAUTOMATION EZ-10C-FE or approved equal. The Operator Interface shall include the following components:
  - 1. 1 MB flash Ram Card EZ RAM-2
  - 2. Programming software EZ-PANELEDIT
  - 3. Ethernet cable for programming and connection to PLC
- B. Operator setpoints shall not be able to be entered incorrectly. (Example: Lead or lag pump setpoints lower than All Pumps Off setpoint)
- C. Operator interface page information:
  - 1. Pump / VFD-1 page
    - a. Power status on-off
    - b. Hand-Off-Auto selector switch status
    - c. VFD Failure
    - d. VFD control speed signal (analog bar graph and digital indication)
    - e. VFD operating speed (analog bar graph and digital indication)
    - f. VFD run time meter (hours)
    - g. Pump Flow Failure
    - h. Pump Over Temperature
    - i. Pump Seal Failure

2. Pump / VFD-2 & 3 pages shall contain the same information as above.
3. Flow control operator selection page
  - a.. Operator selections
  - b. Flow control mode - On/off
  - c. Off – Lead Pumps On – Lag Pump On set points
  - d. Flow Set Point (Range to be determined)
  - e. Lag Flow Set Point (Range to be determined)
  - f. Discharge Pressure Limit (Range to be determined)
  - g. Station Flow Indication status (analog bar graph and digital indication)
  - h. Station Discharge Pressure Indication status (analog bar graph and digital indication)
  - i. Wet well level status (analog bar graph and digital indication)
4. Level control operator selection page
  - a. Level control mode – on/off
  - b. Off – Pumps On
  - c. Level Set Point (Range to be determined)
  - d. Discharge Pressure Limit (Range to be determined)
  - e. Station Flow Indication status (analog bar graph and digital indication)
  - f. Station Discharge Pressure Indication status (analog bar graph and digital indication)
  - g. Wet well level status (analog bar graph and digital indication)
5. Pressure control operator selection page
  - a. Pressure control mode – on/off
  - b. Off – Lead Pumps On – Lag Pump On set points
  - c. Pressure Set Point (Range to be determined)
  - d. Lag Pressure Set Point (Range to be determined)
  - e. Discharge Pressure Limit (Range to be determined)
  - f. Station Flow Indication status (analog bar graph and digital indication)
  - g. Station Discharge Pressure Indication status (analog bar graph and digital indication)
  - h. Wet well level status (analog bar graph and digital indication)
6. Power/Generator status page
  - a. Generator status – on/off
  - b. Generator failure
  - c. Generator on exerciser
  - d. Utility power status
  - e. Station power status
  - f. Generator run time
7. Control transmitter status page

- a. Flow meter indication and failure
- b. Level transmitter indication and failure
- c. Discharge pressure transmitter and failure
- d. Level Transmitter Set Point Control / Float switch control
- e. Float switch status

- 8. Station miscellaneous page
  - a. High Wet Well Level Alarm
  - b. Low Wet Well Level Alarm
  - c. Dry Well Float Flood Alarm
  - d. PLC battery status
  - e. PLC health status

- 9. Alarms: The operator interface shall incorporate an alarm banner in which to alert operator of all alarms described above. A history of alarms will be generated on a separate screen.

- D. Spare Parts: One Operator Interface shall be spare shall be supplied. This interface shall be programmed as operator interface requirements above to provide a complete unit swap out in emergency situations.
- E. Software: Operator Interface programming software and programming cable shall be supplied. Operator Interface program shall be saved to EEPROM after start up to record and any program changes that are required during start up period.

## 2.6 AUXILIARY CONTROL COMPONENTS

- A. Check Valve Limit Switches: Furnish and install a limit switch on each pump check valve to indicate whether the check valve has lifted off its seat. The check valve limit switches shall be wired to the programmable controller and used for pump failure monitoring. The check valve limit switches shall consist of a corrosion-resistant pre-wired limit switch with a 12-inch long nylon rod lever. The limit switches shall be Allen-Bradley Bulletin 802MC-AY5, or approved equal.
- B. Lock-Out Stop Push Button Stations:
  - 1. Furnish and install a lock-out stop push button station at each pump. The lock-out stop push button stations shall consist of a stop push button with padlocking attachment mounted in a corrosion resistant NEMA 4X non-metallic enclosure. The lock-out stop push buttons shall be Allen-Bradley Bulletin 800H-1HA4RLW, or approved equal.
  - 2. Each stop push button shall be furnished with two contacts. One contact shall be wired to the VFD control panel and the other contact shall be a logic level contact wired to the programmable controller. Pressing the stop push button for the lead pump will index the lag pump to become the lead pump and start if called for.



- C. Magnetic Door Switch: Furnish and install a magnetic door switch at the station entry door to detect that someone has entered the pumping station. The magnetic door switch shall be hermetically sealed and shall be Sentrol, or approved equal.
  
- D. Magnetic Flow Meter: See Contract Drawings for manufacturer and model. The meters shall have the following features:
  - 1. 16" 150lb. carbon steel flanges
  - 2. 304 stainless steel sensing tube
  - 3. Hard rubber tube liner
  - 4. Replaceable 316 SS electrodes
  - 5. Suitable for water and wastewater.
  - 6. Process temperature up to 176°F.
  - 7. For pressure up to 580 psig.
  - 8. IP67 protection equivalent to NEMA 6, suitable for short-time submersion.
  - 9. Provide all cables required to connect flow meter with flow converter with length's to suit installation. See contract drawings for locations of devices.
  - 10. Provide remote flow signal converter to match flow meter. Converter shall be:
    - a. Nema 4X enclosure suitable for wall mount.
    - b. 120vac power supply.
    - c. Local LCD display.
    - d. 4/20madc output linear with flow rate.
    - e. Pulse output calibrated for 1 pulse per 100 gals.

Magnetic Flow Meter shall be Krohne IFC 4000 or approved equal. Flow signal converter shall be Krohne IFC 010 or approved equal.

- E. Discharge Pressure Transmitter: See Contract Drawings for manufacturer and model. The transmitter shall have the following features:
  - 1. Two wire 4/20madc output
  - 2. Pressure range 0-100 psig
  - 3. 316SS wetted parts
  - 4. Manual calibration from external pushbuttons or HART protocol
  - 5. Chemical Seal with 1" process connection. Seal and transmitter shall be fitted together using 316SS fittings. Unit shall be liquid filled with Flurolube or other fluid regularly used in this application.
  - 6. Pressure transmitter shall be Rosemount 1151GP or approved equal. Chemical seal shall be Wika or approved equal.

## **2.7 PROGRAMMABLE CONTROLLER INPUTS AND OUTPUTS**

- A. Digital Inputs (24 VDC):

	<u>Description</u>	<u>Origination Point</u>
(1)	Pump No. 1 H/O/A Switch “Auto” Position	Pump H/O/A Switch on Pump 1 VFD Control panel
(2)	Pump No. 2 H/O/A Switch “Auto” Position	Pump H/O/A Switch on Pump 2 VFD Control panel
(3)	Pump No. 3 H/O/A Switch “Auto” Position	Pump H/O/A Switch on Pump 3 VFD Control panel
(4)	Pump No. 1 VFD Run Status	VFD Run Relay in Pump 1 VFD Control Panel
(5)	Pump No. 2 VFD Run Status	VFD Run Contact in Pump 2 VFD Control Panel
(6)	Pump No. 3 VFD Run Status	VFD Run Contact in Pump 3 VFD Control Panel
(7)	Back-up VFD Run Status	VFD Run Contact in Back-up VFD Control Panel
(8)	Pump No. 1 Fault Status	VFD Fault Contact in Pump 1 VFD Control Panel
(9)	Pump No. 2 Fault Status	VFD Fault Contact in Pump 2 VFD Control Panel
(10)	Pump No. 3 Fault Status	VFD Fault Contact in Pump 3 VFD Control Panel
(11)	Pump No. 1 Lock Out Stop Station	In Dry Well
(12)	Pump No. 2 Lock Out Stop Station	In Dry Well
(13)	Pump No. 3 Lock Out Stop Station	In Dry Well

- |      |                                 |   |
|------|---------------------------------|---|
| (14) | Pump No. 1<br>Over Temperature  | Over Temperature Relay<br>in Pump 1 VFD Control Panel |
| (15) | Pump No. 2<br>Over Temperature  | Over Temperature Relay<br>in Pump 2 VFD Control Panel |
| (16) | Pump No. 3<br>Over Temperature  | Over Temperature Relay<br>in Pump 3 VFD Control Panel |
| (17) | Pump No. 1<br>Seal Failure      | Seal Failure Relay<br>in Pump Control Panel           |
| (18) | Pump No. 2<br>Seal Failure      | Seal Failure Relay<br>in Pump Control Panel           |
| (19) | Pump No. 3<br>Seal Failure      | Seal Failure Relay                                    |
| (20) | All Pumps Off<br>Float Switch   | Float Switch in Wet Well                              |
| (21) | Lead Pump On<br>Float Switch    | Float Switch in Wet Well                              |
| (22) | Lag Pump On*<br>Float Switch    | Float Switch in Wet Well                              |
| (23) | Low Level*<br>Float Switch      | Float Switch in Wet Well                              |
| (24) | High Level*<br>Float Switch     | Float Switch in Wet Well                              |
| (25) | Dry Well Flood*<br>Float Switch | Float Switch in Dry Well                              |
| (26) | Station Power*                  | Under Voltage Relay<br>in Generator ATS               |
| (27) | Generator Run*                  | Contact in Generator Control Panel                    |
| (28) | Generator Failure*              | Contact in Generator Control Panel                    |
| (29) | Utility Power Failure*          | Under Voltage Relay<br>in Generator ATS               |
| (30) | Generator on Exercise *         | Time Clock Contact in                                 |

in Generator ATS

B. Analog Inputs (4-20mA):

	<u>Description</u>	<u>Origination Point</u>
(1)	Wet Well Level	Submersible Transmitter in Wet Well
(2)	Discharge Pressure	Discharge Transmitter in common Discharge Header
(3)	Station Flow	Flowmeter located in station common discharge header
(4)	VFD 1 Speed	VFD 1
(5)	VFD 2 Speed	VFD 2
(6)	VFD 3 Speed	VFD 3
(7)	Back-up VFD 4 Speed	Back-up VFD 4

C. Analog Outputs (4-20mA)

	<u>Description</u>	<u>Origination Point</u>
(1).	VFD 1 Control Output	VFD 1
(2).	VFD 2 Control Output	VFD 2
(3).	VFD 3 Control Output	VFD 3
(4).	Back-up VFD 4 Control Output	Back-up VFD 4

D. Digital Outputs (Relay):

	<u>Description</u>	<u>Destination Point</u>
(1)	Pump No. 1 Start/Stop	Pump VFD Control Panel
(2)	Pump No. 2 Start/Stop	Pump VFD Control Panel
(3)	Pump No. 3	Pump VFD Control

	Start/Stop	Panel
(6)	Pump No. 1 Flow Failure	RTU
(7)	Pump No. 2 Flow Failure	RTU
(8)	Pump No. 3 Flow Failure	RTU
(9)	Pump No. 1 VFD Fault	RTU
(10)	Pump No. 2 VFD Fault	RTU
(11)	Pump No. 3 VFD Fault	RTU
(12)	Standby VFD Fault	RTU

E. Analog Outputs (4-20mA):

	<u>Description</u>	<u>Destination Point</u>
(1)	Pump No. 1 VFD Speed Reference Signal	Pump VFD
(2)	Pump No. 2 VFD Speed Reference Signal	Pump 2 VFD
(3)	Pump No. 3 VFD Speed Reference Signal	Pump 3 VFD
(4)	Pump Back-up VFD 4 Speed Reference Signal	Back-up VFD 4

Optic isolator shall be supplied for I/O points above marked with an asterisk \*. The isolator shall be DC/DC with 12vdc input and 10-30vdc solid state out. Isolators will be connected in parallel with the RTU inputs powered by the RTU. Interposing relays will not operate in a power outage condition and therefore shall not be used.

## 2.8 SEQUENCE OF OPERATION

- A. Control Strategy – The PLC shall be programmed to include these strategies. Any additional requirements to provide the sequence below shall not constitute a change order to the contract. The control panel shall utilize 3 control modes:
1. Flow Control: Control panel shall start and stop pumps based on wet well level. Two (2) sewage pumps shall start when the wet well level reaches the operator entered “Lead Pump On” set point. The Variable Frequency Drives (VFD) shall start at a minimum speed set from VFD keypad and increase pump speed until the operator entered “Flow” set point has been met and shall maintain flow at set point until the “All Pumps Off” set point has been met. In the event that the station inflow is greater than the “Flow” set point the level will rise in the wet well until the operator entered “Lag Pump On” set point is met. At this time the third (3<sup>rd</sup>) pump VFD will start and all three (3) pumps will increase speed to match the new operator entered “Lag Pump Flow Rate”, the pumps shall maintain flow at set point until the “Lead Pump On” set point has been met at which time the third pump shall stop and the two (2) running pumps shall return to their original “Flow” set point. When the wet well level drops to the “All Pumps Off” set point the pumps shall stop. Pumps shall alternate as described in “Pump Alternator” paragraph 2.8.B below:
    - a. In the flow control mode, the discharge pressure transmitter shall limit the pump flow rate not to exceed the operator entered “Discharge Pressure Limit” set point. In case of discharge pressure transmitter failure, the control panel will ignore this limit and an alarm will be generated by the control panel. In the event of a flow meter transmitter failure the control panel will operate in the “Level Control” mode until flow meter is repaired and the operator once again chooses the “Flow Control” mode. In the event of a level transmitter failure the control panel will operate utilizing the wet well float switches for level set points until level transmitter is repaired. Float switch control will remain until operator entered “Level Transmitter Set Point Control” has been selected and the operator once again chooses the “Flow Control” mode.
  2. Level Control: The Control panel shall start and stop pumps based on wet well level. Two (2) sewage pumps shall start when the wet well level reaches the operator entered “Lead Pump On” set point. The Variable Frequency Drives (VFD) shall start at a minimum speed and increase in speed to maintain a wet well level based on operator entered “Level” set point. When the wet well inflow decreases the pumps speed will decrease

until the operator entered “Minimum Flow Set Point” detected by the flow meter has been met. The pumps will run until the operator entered “All Pumps Off” set point has been met. In the event the pump speed output reaches ninety (90) percent plus 5 seconds, the control panel will start the third pump and all three pumps will run at the same speed controlled by operator entered “Level” set point. When the speed output drops to forty (40) percent, the third pump will stop and the pumps will return to the lead pump sequence described above. Pumps shall alternate as described in “Pump Alternator” paragraph 2.8B below:

a. In the level control mode, the discharge pressure transmitter shall limit the pump flow rate not to exceed the operator entered “Discharge Pressure Limit” set point. In case of discharge pressure transmitter failure, the control panel will ignore this limit and an alarm will be generated by the control panel. In the event of a level transmitter failure the control panel will operate in the “Flow Control” mode utilizing the wet well float switches for level set points until level transmitter is repaired. Float switch control will remain until operator entered “Level Transmitter Set Point Control” has been selected and the operator once again chooses the “Level Control” mode.

3. Pressure Control: The control panel shall start and stop pumps based on wet well level. Two (2) sewage pumps shall start when the wet well level reaches the operator entered “Lead Pump On” set point. The Variable Frequency Drives (VFD) shall start at a minimum speed and increase in speed to maintain a discharge pressure based on operator entered “Discharge Pressure” set point. In the event that the station inflow is greater than the “Pressure” set point the level will rise in the wet well until the operator entered “Lag Pump On” set point is met. At this time the third (3<sup>rd</sup>) pump VFD will start and all three (3) pumps will increase speed to match the new operator entered “Lag Discharge Pressure” set point, the pumps shall maintain pressure at set point until the “Lead Pump On” set point has been met at which time the third pump shall stop and the two (2) running pumps shall return to their original “Discharge” set point. When the wet well level drops to the “All Pumps Off” set point the pumps shall stop. Pump discharge pressures will be based on key operating points on pump curve. Pumps shall alternate as described in “Pump Alternator” paragraph 2.8B below:

- a. In the event of a discharge transmitter failure the control panel will operate in the “Flow Control” mode until discharge transmitter is repaired and the operator once again chooses the “Pressure Control” mode. In the event of a level transmitter failure the control

panel will operate utilizing the wet well float switches for level set points until level transmitter is repaired. Float switch control will remain until operator entered "Level Transmitter Set Point Control" has been selected and the operator once again chooses the "Pressure Control" mode.

B. Pump Alternator: Control panel shall alternate pumps after each successful pump cycle or maximum of 2 hours continuous use. When all three pumps are operating, maximum run time timers will not accumulate time. Operator shall be allowed to set an alternation sequence due to pumps that are in need of maintenance but could run in the event of a lag pump situation.

C. Provide dry contacts and terminal strips as required in the Pump Control Panel for each of the following field points/conditions to be wired to the alarm transmitter:

1. Wet well high water.
2. Wet well low water.
3. Dry well high water.
4. Pump #1 run.
5. Pump #1 flow FD:1.
6. Pump #1 VFD FD:1.
7. Pump #1 in bypass mode.
8. Pump #1 motor overload.
9. Pump #1 seal fail.
10. Pump #1 overtemp.
11. Pump #1 flow pulses-gals.x100 (totalized flow from Magmeter)
12. Air Pump #1 failure.
13. Pump #2 run.
14. Pump #2 flow FD:1.
15. Pump #2 VFD FD:1.
16. Pump #2 in bypass mode.
17. Pump #2 motor overload.
18. Pump #2 seal fail.
19. Pump #2 overtemp.
20. Pump #2 flow pulses-gals.x100 (totalized flow from Magmeter)
21. Air Pump #2 failure.
22. Utility power failure.
23. Station power failure.
24. Generator run. (to be active whenever generator is running regardless of transfer switch position)
25. Generator exercise.
26. Generator failure.
27. Intrusion.
26. PLC failure.
28. RTU failure.



29. Low fuel alarm.
  30. Fuel Tank leak detection alarm.
- D. Provide analog signals (4/20 mdc) and terminal strips as required in the Pump Control Panel for each of the following field points/conditions to be wired to the alarm transmitter:
1. Pump Flow Rate
  2. Pump Discharge Header Pressure (0-100 psi)
  3. Wet Well Level (0-30 feet)
- E. The Contractor shall coordinate alarm transmitter requirements with Systems East, POC Buck McLaughlin at 757-766-8400
- F. The pump control panel cover shall include, but are not limited to, the following:
1. Operator Interface

### **PART 3 – EXECUTION**

#### **3.1 INSTALLATION**

- A. The Control Panel Supplier shall provide on-site supervision and advice to the installing contractor to insure that the Pump Control Panel, transducer level control system, and auxiliary control components are installed in accordance with the specifications and the manufacturer's requirements.

#### **3.2 TRAINING**

- A. The pump control panel supplier shall provide a minimum of 4 hours of training at the site for City personnel on the operation and maintenance of the control panel.

#### **3.3 TESTING AND START-UP**

- A. All testing and start-up shall be in accordance with the procedures of the Control Panel Supplier and as required by the City.
- B. All start-up and testing shall be scheduled, performed in an orderly sequence, and conducted in the presence of and to the satisfaction of the City.
- C. Start-up the pump control system by energizing the system equipment and testing the operation of all hardware, software, and process control logic.
- D. Field Acceptance Test Report: Provide a letter of certification, certifying that the system has been tested and approved by the Control Panel Supplier and by the City, and that the

system is operating in accordance with all required criteria.

- E. Controls Supplier shall provide three (3) copies of programs for PLC and Operator Interface in an “as installed” condition on Compact Disc format. Include all start up parameters.

**END OF SECTION 16675**

**SECTION 16690  
VARIABLE FREQUENCY DRIVES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General, Supplementary and Special Conditions, and other Division 1 Specification sections, apply to the work of this section.
- B. Requirements of Section 16010, "Electrical - General Provisions" form part of this section.

**1.2 SUBMITTALS**

- A. Product Data: Submit manufacturer's data for each variable frequency drive and all components including, but not limited to, the following:
  - 1. Variable Frequency Drives.
  - 2. Drive Enclosure Layout.
  - 3. Line Reactors.
  - 4. Contactors.
  - 5. Control Transformer.
  - 6. Selector Switches.
  - 7. Pilot Lights.
  - 8. Elapsed Time Meters.
  - 9. Relays.
  - 10. Ammeters.
  - 11. Manual Speed Potentiometer
  - 11. Wiring Diagrams and Connection Diagrams.
  - 12. Nameplate Schedules.
  - 13. Spare Parts.
- B. Shop Drawings: Submit the following as a minimum:
  - 1. Dimensioned drawings.
  - 2. Weight.
  - 3. Elevations and sections.
  - 4. Integral controls.
  - 5. Voltage ratings.
  - 6. Current ratings.
  - 7. Short circuit interrupting ratings.
  - 8. Device arrangements.
  - 9. Trip characteristic curves of all circuit breakers and fuses, on transparent medium.  
All curves shall be plotted to the same scale.
  - 10. Installation instructions.
- C. Field Acceptance Test Report: Submit as specified herein.

- D. Operation and Maintenance Manual: Submit as specified in Division 1.

### 1.3 DESCRIPTION

A. VFD Pump Control

The following equipment shall be used to operate and control three (3) 200HP 460V 3 phase 60 Hz motors used to drive sewage pumps. To provide a complete system, the Pump control panel, VFD's and the VFD control panels shall be manufactured or supplied by the same system integrator.

1. Four (4) Variable frequency drives (VFD)
2. Four (4) VFD Pump Power Breakers
3. Four (4) line contactors
4. Three (3) electrically and mechanically interlocked load/bypass contactors
5. Four (4) VFD control panels to house items 2, 3, and 4 above as well as sequencing logic as described below.

B. Variable Frequency Drives (VFD)

1. Four (4) VFD's shall be properly sized based on motor full load and service factor data and shall not be based on horsepower. Coordination with pump motor sized for this bid shall be required. The VFD shall be suitable for wall mount with a NEMA 1 rating. VFD shall include all accessories required to allow separate conduit entry into VFD chassis for incoming 480vac line power wiring, VFD motor load power wiring, and control logic wiring. The VFD shall be equipped with cooling fan(s) required to allow continuous load motor usage without failure due to over temperature of VFD. VFD shall utilize external heat sink properly spaced from wall that it is mounted to ensure proper air flow.
2. VFD shall include a keypad in which to properly setup and manually control drive. The keypad shall display as a minimum pump speed, frequency in hertz, load current in amps, remote speed input, speed output in percent, pump motor data, accel and decel rates as well as a VFD fault history.
3. VFD shall include control logic inputs for starting and stopping motor, fault reset, local keypad control, as well as an input that when initiated will start and ramp VFD to a keypad entered setpoint. Logic outputs shall include VFD run, VFD fault, and VFD at speed. Analog signals required shall be analog (4/20mADC) and shall include remote speed command input and motor speed output.
4. VFD shall be set to auto recover from faults except critical faults which could lead to equipment damage or harm to personnel.

C. VFD Pump Power Breakers

1. Four (4) VFD breakers shall be included in Power Panel MP as shown on the contract electrical one line and specified in division 16 in these specifications. The breaker shall be sized to the VFD amperage per NEC Code. Supply pad lock attachment for each breaker to allow lock out of each VFD. The breakers shall be supplied by division 16 supplier.

D. Line Contactors

1. Four (4) line contactors properly sized to control incoming power to the VFD. The contactor shall be motor rated to open load of VFD at motor full load without damage. The contactor shall have 3 power poles, auxiliary contacts as required to satisfy logic control, and 120vac coil voltage. Contactor shall be mounted in VFD control panel described below.

E. Electrically and mechanically interlocked load/bypass Contactors

1. Three (3) contactors shall be required to isolate and allow standby (fourth VFD) to control any of the three (3) sewage pump motors. The contactors shall be two (2) mechanically and electrically interlocked three (3) pole contactors sized to pump motor amperage. The contactors shall be motor rated to open load of VFD at motor full load without damage. Contactors shall be fitted with auxiliary contacts to satisfy logic control. Coil voltage shall be 120vac. Contactor shall be mounted in VFD control panel described below. Note: VFD's shall be isolated by using this construction only.

F. VFD Control Panels

1. Three (3) VFD control panels shall be required to house VFD 1,2,& 3 controls. The control panel shall be NEMA 12 in design and contain the following equipment:
  - a. One (1) incoming line contactor
  - b. One (1) load/bypass contactor
  - c. One (1) control transformer w/ fusing properly sized to power contactor coils and logic circuits.
  - d. Logic to control contactors by sequence listed below.
  - e. Properly sized power wiring required to provide complete control system. The VFD control panel shall include connections for incoming power, bypass VFD input, and motor leads.
  - f. Relay logic to allow fourth (4<sup>th</sup>) VFD to control any of the three (3) sewage pump motors in the event of the dedicated VFD failure.
  - g. Control terminal strips for all connections to or from external devices such as VFD's and Pump control panel.
  - h. Control transformer sized to load requirements with 100va extra capacity. Provide line and load fusing as required by NEC code.
  - i. Hand-Off-Auto selector switch for manual control of VFD and contactor logic.
  - j. Speed potentiometer for manual speed control.
  - k. Power on, VFD run, and VFD fault indicators. Indicators shall be push to test 120vac, 30.5mm in size.
  - l. Elapsed time meter.
  - m. Ammeter.
2. One (1) VFD control panel shall be required to house VFD 4 controls. The control panel shall be NEMA 12 in design and contain the following equipment:
  - a. One (1) incoming line contactor
  - b. Logic to control contactor by sequence listed below.

- c. Properly sized power wiring required to provide complete control system. The VFD control panel shall include connections for incoming power, power distribution block for connections to bypass contactors located in VFD-1, 2, & 3 control panels.
- d. Relay logic to allow fourth (4<sup>th</sup>) VFD to control any of the three (3) sewage pump motors in the event of the dedicated VFD failure.
- e. Control terminal strips for all connections to or from external devices such as VFD's and Pump control panel.
- f. Control transformer sized to load requirements with 100va extra capacity. Provide line and load fusing as required by NEC code.

3. Logic Sequence

- a. Normal sequence:  
Upon receiving a run signal from the Pump control panel the load contactor shall energize connecting the motor leads to the VFD. Upon indication from load contactor auxiliary contact the incoming power contactor will energize. The VFD will power up and respond to the run signal from the Pump control panel as well as the interlocks of the incoming power contactor and load contactor auxiliary contact. The VFD will respond to the analog speed signal from the Pump control panel. Upon losing the run signal from the Pump control panel, the VFD will decelerate until the run signal contact from the VFD opens, which will cause the incoming and load contactors to open.
- b. Bypass sequence  
Upon receiving a run signal from the Pump control panel, the load contactor will energize connecting the motor leads to the VFD. Upon indication from load contactor auxiliary contact the incoming power contactor will energize. If the VFD initiates a fault signal the incoming power contactor and load contactors will open. At this time the bypass contactor will energize and the 4<sup>th</sup> VFD line contactor will energize. The 4<sup>th</sup> VFD will power up and respond to the run signal from the Pump control panel as well as the interlocks of the incoming power contactor and load contactor auxiliary contact. The VFD will respond to the analog speed signal from the control panel. Upon losing the run signal from the Pump control panel, the VFD will decelerate until the run signal contact from the VFD opens, which will cause the incoming and load contactors to open.

**Note that 4<sup>th</sup> VFD will only be allowed to run one (1) pump motor at any time.**

Upon a call from the Pump control panel the failed VFD will retry to start as if the fault did not occur. This is allowed due to the fault could be of an external nature such as a power spike and not a direct fault of the VFD, also known as a recoverable fault.

4. Hand-Off-Auto selector switch

- a. Off Mode

The Hand-Off-Auto selector switch in off position will not allow either dedicated or the 4<sup>th</sup> pump to power the pump motor.

b. Hand Mode

The Hand-Off-Auto selector switch in the Hand mode the load contactor shall energize connecting the motor leads to the VFD. Upon indication from load contactor auxiliary contact the incoming power contactor will energize. The VFD will power up and respond to the run signal from the selector switch as well as the interlocks of the incoming power contactor and load contactor auxiliary contact. The VFD will respond to the analog speed signal from the speed potentiometer. Upon turning the Hand-Off-Auto switch to Off, the VFD will decelerate until the run signal from the VFD opens, which will cause the incoming and load contactors to open.

c. Auto Mode

The Hand-Off-Auto selector switch in the Auto mode and upon receiving a run signal from the Pump control panel the load contactor shall energize connecting the motor leads to the VFD. Upon indication from load contactor auxiliary contact the incoming power contactor will energize. The VFD will power up and respond to the run signal from the Pump control panel as well as the interlocks of the incoming power contactor and load contactor auxiliary contact. The VFD will respond to the analog speed signal from the Pump control panel. Upon losing the run signal from the Pump control panel, the VFD will decelerate until the run signal from the VFD opens, which will cause the incoming and load contactors to open. The selector switch shall also provide two (2) contacts to the Pump control panel, one contact for PLC input and the other for the RTU.

5. Misc.

a. Status signals

The VFD control panel and VFD shall provide all signals required by Pump control panel as well as RTU.

b.

Control relays

Relays shall be 4PDT design, 120vac coil as manufactured by Idec, series RUH. Timers shall be 4PDT design, 120vac coil as manufactured by Idec, series GT5Y. The relays and timers shall be interchangeable as the pin configurations are the same.

6. Special Requirements: The variable frequency drives shall be furnished by the Pump Control Panel Supplier, who shall be responsible for coordinating the drive start/stop and speed controls with the controls in the Pump Control Panel.

## 1.4 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

1. UL - Underwriter's Laboratories, Inc.
  2. NEC - National Electrical Code.
  3. NEMA - National Electrical Manufacturers Association.
  4. ANSI - American National Standards Institute.
- B. The drive shall be built to applicable NEMA standards and be suitable for use as a component to meet NEC requirements. Drive is to be listed by Underwriter's Laboratories (UL).
- C. Quality Control: All variable frequency drives shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.
1. All incoming material shall be inspected and/or tested for conformance to quality assurance specifications. All chips (CMOS, TTL, LINEAR, etc.) shall be functionally tested.
  2. All subassemblies shall be inspected and/or tested for conformance to vendors engineering and quality assurance specifications.
  3. All control printed circuit boards shall be dynamically tested for a minimum of 22 hours while heat cycled 1 hour at each temperature setting from 32 degrees F (0 degrees C) to 140 degree F (60 degrees C) and back to 32 degrees F (0 degrees C).
  4. All drives shall be burned-in for a minimum of 72 hours, cycling load to simulate no load/full load and exercise drive power components.
  5. The complete drive shall be functionally tested with a motor before shipment to assure proper operation per specification.

## **1.5 MANUFACTURER**

- A. The Variable Frequency Drives shall be Allen-Bradley Bulletin 1336 Plus 2 Drive or Square D. No other manufacturer will be accepted.

## **PART 2 – PRODUCTS**

### **2.1 VARIABLE FREQUENCY DRIVES**

- A. General:
1. The variable frequency drives shall convert a fixed frequency, three phase input power to an adjustable AC frequency and voltage source for controlling the speed of a standard, AC induction motor. Variable frequency drive shall be fully compatible with the pump motors supplied.
  2. The drives shall be fully digital, microprocessor controlled and shall incorporate a diode bridge rectifier and a transistorized inverter section. IGBT type power transistor modules shall be utilized in the inverter section to invert a fixed DC bus voltage to a symmetrical three-phase pulse-width modulated (PWM) output voltage.



3. The drives shall accept incoming 480 VAC, 60 Hz line power, and shall not be affected by voltage fluctuations of  $\pm 10\%$  or frequency fluctuations of  $\pm 2\%$ . The drive shall include phase-to-phase and phase-to-ground protection.
  4. Each variable frequency drive and bypass drive shall be designed to operate an AC induction motor in an ambient temperature of 32° to 104°F as specified in sewage pump specifications and on contract drawings.
- B. Drive Enclosure:
1. Each variable frequency drive and bypass drive shall be mounted in a NEMA 1 enclosure supplied with drive. Provide additional hardware as required to allow conduit connections to the VFD.
- C. Drive Power Disconnects and Isolation Contactors:
1. Four (4) VFD breakers shall be included in Power Panel MP as shown on the contract electrical one line and specified in division 16 in these specifications. The breaker shall be sized to the VFD amperage per NEC Code. This breaker shall be supplied by division 16 supplier.
  2. Line Contactors  
Four (4) line contactors properly sized to control incoming power to the VFD. The contactor shall be motor rated to open load of VFD at motor full load without damage. The contactor shall have 3 power poles, auxiliary contacts as required to satisfy logic control, and 120vac coil voltage. Contactor shall be mounted in VFD control panel described below.
  3. Electrically and mechanically interlocked load/bypass Contactors  
Three (3) contactors shall be required to isolate and allow standby (fourth VFD) to control any of the three (3) sewage pump motors. The contactors shall be two (2) mechanically and electrically interlocked three (3) pole contactors sized to pump motor amperage. The contactors shall be motor rated to open load of VFD at motor full load without damage. Contactors shall be fitted with auxiliary contacts to satisfy logic control. Coil voltage shall be 120vac. Contactor shall be mounted in VFD control panel described below. Note: VFD's shall be isolated by using this construction only.
- D. Drive Operating Characteristics:
1. The drive operation shall be fully digital with microprocessor control of frequency, voltage and current. All drive set-up operations and adjustment shall be digital and stored in a non-volatile memory (EEPROM).
  2. To control the rate of change of output frequency for a step change in input reference, the drive shall have two independently adjustable acceleration and deceleration rates.
  3. The drive shall have a foldback current limiting circuit. During acceleration, the circuit shall automatically reduce the acceleration rate to a slower rate should the load inertia cause excessive currents.

4. The drive shall have a selectable deceleration voltage limiting circuit. The circuit shall extend the set deceleration ramp should the bus voltage approach high limits due to regeneration.
5. The drive output frequency shall be adjustable from 0-60 Hz.
6. The drive shall have a fully programmable volts per Hertz ratio.
7. The drive shall maintain set frequency to within 0.6 Hz during power line fluctuations.
8. The drive speed reference signal shall be an analog 4-20 mA signal from a PLC output module or a signal received from the human interface module.
9. The drive shall be capable of maintaining 100% of rated output current continuously, and shall be capable of delivering 115% of rated output current for up to one minute.
10. The drive shall be capable of restoring motor operation after a 0.5 second line loss without shutting down on a fault.
11. The drive input circuitry shall not generate line notches or large voltage transients on the incoming line.
12. The drive shall present a displacement power factor of 0.95 or better to the AC line at any speed or load.
13. The drive efficiency at rated load and frequency shall be 97.5% or better.

E. Drive Controls:

1. Each variable frequency drive shall be furnished with start-stop controls and speed controls as indicated on the drawings and in the Sequence of Operation.
2. The controls shall include, but not be limited to, the following:
  - a. Drive Run Contact.
  - b. Common Drive Fault Contact.
  - c. Isolated Analog Input Board.
  - d. 120 VAC Control Interface Board.
3. The drive run contact shall be wired to a “run” relay located in the drive enclosure. This relay shall have four normally open contacts that will close when the relay is energized. One contact shall be wired to the elapsed time meter on the drive enclosure, one contact shall be wired to a VFD run indication light located on the Pump Control Panel, and the third contact shall be wired to the programmable controller for VFD run status monitoring.

F. Human Interface Module: A Human Interface Module (HIM) shall be mounted on the drive enclosure for digital set-up of the drive, drive parameter review and drive fault annunciation. The module shall have a LCD display and a digital speed pot for local control of the drive speed.

G. Drive Protection and Diagnostics:

1. Each variable frequency drive shall incorporate internal diagnostic and fault sensing circuits as an integral part of the drive. The following drive protection functions shall be monitored:
  - a. Momentary Overload Protection – Adjustable from 20 to 115% of Drive Rating.

- b. Motor Overload Protection.
  - c. Undervoltage Sensing.
  - d. Overvoltage Sensing.
  - e. Phase Protection.
  - f. Drive Overtemperature.
  - g. Ground Fault Detection
2. Each of the above fault conditions shall be annunciated on the digital display panel, and shall shut down the drive.

## **2.2 DRIVE CONTROL COMPONENTS**

- A. Line Reactors: Provide line reactors for each drive to eliminate nuisance overvoltage tripping and to reduce harmonic distortion. The line reactors shall be iron core, 5% impedance, Class H insulation, 115 degree C rise, cooper wound. The line reactors shall be sized for the motor horsepower and shall be manufactured by TCI or equal.
- B. Control Transformers: Provide a control power transformer for each drive control circuit. Control transformers shall be 480 volts to 120 volts and shall be protected according to code. Size shall be as required plus 250 VA additional capacity.
- C. Selector Switches: Selector switches shall be non-illuminated. Switches shall be 30.5 mm, heavy-duty, oil tight. Switches shall have double-break silver contacts. All switches shall be maintained contact type unless otherwise indicated on drawings. Provide auxiliary contact blocks as indicated on the drawings or in the Sequence of Operation. Selector switches shall be Allen-Bradley Bulletin 800H or equal, NEMA Type 4X.
- D. Pilot Lights: Pilot lights shall be push-to-test, transformer type. They shall be 30.5 mm, heavy-duty, oil tight. Voltage rating shall be 120 volts. Color caps shall be green for "run". Pilot lights shall be Allen-Bradley Bulletin 800H or equal, NEMA Type 4X.
- E. Elapsed Time Meters:
  1. Elapsed time meters shall be Redington #711-0190, or equal.
  2. Voltage rating shall be 120 volts. The elapsed time meter shall be interlocked with the drive run relay and the bypass starter.
- F. Relays: Relays shall be heavy-duty general purpose type with 10 amp contacts. Relays shall have terminals which plug-in to a socket, mounted to the inside of the drive enclosure. Contact configuration shall be 4PDT. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the drawings. Relays shall have an indicator light to indicate the relay coil is energized.
- G. Ammeters: Provide an analog ammeter with an A/B/C/Off selector switch on the drive control panel enclosure to indicate the motor amperage when running in either the drive or bypass mode. The ammeter shall have a range of 0-200 amps. Provide required current transformers and wiring with the ammeter.

- H. Control Terminal Block: Provide a control terminal block in the drive enclosure to terminate all control wiring from the field.
- I. Nameplates: Provide an engraved nameplate on each drive enclosure. Nameplate shall be white with black letters and shall be engraved as follows: "PUMP NO. 1 (2, 3) VFD".

## **PART 3 – EXECUTION**

### **3.1 INSTALLATION**

- A. Installation shall be provided under the direct supervision of a representative of the manufacturer to ensure that the variable frequency drives and controls are installed in accordance with the manufacturer's requirements.

### **3.2 TRAINING**

- A. Provide minimum of eight (8) hours of training for City personnel on the variable frequency drives. Training shall be specific for the VFDs provided and shall include theory of operation, maintenance, and troubleshooting procedures. The manufacturers drive specialist shall perform all training.

### **3.3 START-UP AND TESTING**

- A. Start-up and Testing: Provide the services of a manufacturer's representative to start-up, adjust and test each variable frequency drive. Demonstrate start/stop control, fault diagnostics and variation of motor speeds in response to both the manual and automatic variable speed controls. Verify accuracy of speed variation and speed indication by means of a strobotach which utilizes a light beam focused on the motor shaft. Strobotach shall be furnished by the manufacturer's representative.
- B. All start-up and testing shall be performed in the presence of the Owner.
- C. Field Acceptance Test Report: Provide a letter of certification, certifying that the system has been tested and approved by the manufacturer and by the City, and that the system is operating in accordance with all required criteria.

### **3.4 SPARE PARTS**

- A. The following items shall be supplied:
  - 1 One (1) VFD as supplied above for ease of replacement.
  - 2 Five (5) of each type and amperage fuse used in design.
  - 3 One (1) cooling fan(s) as required for each VFD.
  - 4 One (1) of each type of relay and time delay used.
  - 5 Five (5) of each type of light bulb used.
- B. Spare parts shall be the same type and size utilized in the drives provided for this Contract. All spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturers part number.

**END OF SECTION**