



CITY OF TAMPA

Bob Buckhorn, Mayor

CONTRACT ADMINISTRATION DEPARTMENT

David L. Vaughn, AIA, Director

ADDENDUM NO. 1

DATE: October 7, 2014

Contract 14-C-00022; Howard F. Curren AWTP Mixed Sludge Pump Station Pump Replacement

Bidders on the above referenced project are hereby notified that the following addendum is made to the Contract Documents. BIDS TO BE SUBMITTED SHALL CONFORM TO THIS NOTICE.

Item 1: Replace the following Technical Sections with the attached Technical Sections dated 9/9/14.

- 13400 - Instrumentation and Controls
- 16050 - Electrical-General Provisions
- 16075 - Electrical Identification
- 16110 - Conduit, Wire and Grounding
- 16170 - Disconnects and Protective Devices
- 16220 - Electric Motors
- 16445 - Motor Control Center Modifications
- 16484 - Solid State Soft Starter
- 16850 - Control and Wiring for Packaged Units

Item 2: Delete Section 16080 Electrical Testing Requirements in its entirety.

Item 3: Attached for reference is the pre-bid sign-in sheet.

All other provisions of the Contract Documents and Specifications not in conflict with this Addendum shall remain in full force and effect. Questions are to be e-mailed to ContractAdministration@tampagov.net.

Jim Greiner

Jim Greiner, P.E., Contract Management Supervisor

SECTION 13400

INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 SCOPE

- A. The work included in this section consists of furnishing, installing, and placing in operation all the instruments, controls, and appurtenances, including all conduit, wiring, and circuitry necessary to provide the monitoring, alarm, transmitting and controlling functions indicated on the Drawings and herein specified.

1.02 REFERENCES

- A. Codes and Standards referred to in this Section are:
 - 1. NFPA 70 National Electrical Code
 - 2. UL Underwriter's Laboratory
 - 3. NEMA National Electrical Manufacturers Association

1.02 SUBMITTALS

- A. In order to provide an integrated system and undivided responsibility, prior to release for manufacture, it shall be the Contractor's responsibility to coordinate and submit a total package containing the following information:
 - 1. A complete wiring diagram inclusive of all instrumentation, and connections to motor control with appropriate component identification as indicated in subparagraph A.3 below.
 - 2. Component manufacturing data sheets with factory wiring diagrams for all components either in the systems or to which the systems connect.
 - 3. Component manufacturing data sheets shall indicate all pertinent data and identify each component by item number, and nomenclature as indicated on the Drawings and in the Specifications.
- B. All literature and drawings being submitted for approval shall be bound in volumes. Sales bulletins and other general publications are not acceptable as material for approval.

- C. After the material has been forwarded for approval, the manufacturer of the equipment shall make available the services of a project engineer and other qualified personnel as required to assist the Contractor in reviewing the submittal with the Engineer.
- D. Miscellaneous
 - 1. All special tools and test equipment required for the maintenance or adjustment of the mechanism shall be furnished by the Contractor.
- E. Operation and Maintenance Data: Provide operation and maintenance manuals as specified in the Specific Provisions. Include the following information:
 - 1. Recommended spare parts list.
 - 2. Manufacturer approved repair and service centers list.
 - 3. Replacements part sources.
 - 4. Recommended maintenance procedures and frequencies.
- F. Warranty: Provide warranty certificate as described in the Specific Provisions.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes, applicable to construction and installation of electrical wiring, devices, material and equipment.
 - 2. ECA Standards: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation".
 - 3. UL Labels: Provide control panel components, power supplies, controllers, relays, etc., which have been listed and labeled by Underwriter's Laboratories.

- B. The purpose of contract drawings and specifications is to convey information required for complete and functioning systems. The contractor is responsible for all details necessary to properly install, adjust, and place in operation, intended systems. As-Built information, including schedules, elevations and wiring schematics are provided for convenience; their accuracy is not guaranteed.

1.05 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in the Specific Provisions.
- B. Packing and Shipping
 - 1. Acceptance at Site: Inspect all materials and equipment against approved shop drawings at time of delivery. Immediately return for replacement or repair any equipment or materials damaged or not meeting requirements of approved shop drawings.
 - 2. Storage and Protection: Label all equipment and materials after they have been inspected. Store all equipment and materials in dry, covered, ventilated location. Protect from harm in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

- A. All of the equipment shall be the manufacturer's latest 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 instrumentation control system. The completed system shall be compatible with the functions required and with the equipment furnished under the Contract. All electrical components of the system shall operate on 120 volts, single phase, 60 Hertz current, except as otherwise noted in the Specifications or Drawings.
- B. The Contractor shall design, furnish, and install all interior wiring within the control enclosure. The Contractor shall make all connections of exterior wiring between the equipment and the control panel terminals. The Contractor shall furnish complete wiring diagrams showing the electrical circuits inside the panel and interconnections between the panel and the external instruments and components. Interconnecting wiring between the panels and the equipment specified under other sections shall be identified and numbered on the diagrams. All terminals shall be identified and

numbered. All panel wiring shall have numbered tags attached to each wire for identification. All panel wiring shall be as shown on the Drawings. Inside each panel, there shall be provided a copy of interconnecting wiring drawings.

- C. All controls for remote electrically operated or motor driven equipment shall be complete, including all necessary auxiliary relays so as to require only wiring and connections to the equipment control circuit. All contacts for control of remote motor operated or electrically operated equipment shall be rated not less than 10 amperes at 120 volts unless otherwise specified herein.
- D. All remote motor operated or electrically operated equipment shall have a separate 120 volt control circuit. Control wiring for remote operated motors shall be Number 14 AWG, Type THWN unless otherwise noted.
- E. All necessary fuses or switches required by the instrumentation manufacturer for his equipment shall be provided with the equipment. All instruments requiring an external power supply shall have an on-off switch. Any other devices necessary to obtain proper operation of the instrument system from the available energy sources shall be furnished with the control panels.
- F. All pipe, tubing, and hose connections to hydraulic or air operated equipment, appurtenances, and accessories shall be made with a union type fitting. Metal tubing used for instrumentation shall be stainless steel.
- G. Components shall be factory finished to the manufacturer's standard for the service intended.
- H. All components shall be tagged with the item number and nomenclature given in the Specifications or Drawings.
- I. All instruments to be panel mounted shall be of the same appearance as to provide a clean and neat installation.
- J. Drill and cut enclosure doors for the installation of controls and instruments as shown and required. Provide covering and protection for equipment and wiring. If necessary, unwire and dismount devices and relays and remove the doors prior to the work. Remove sensitive items from the enclosure prior to cutting and drilling work. Repair door finishes equivalent to, and to match, manufacturer's finishes.
- K. All instruments shall be constructed to operate, function, and last in a subtropical climate as found in Tampa, Florida.

2.02 CONTROLS

A. General

1. Control components shall comply with the latest ANSI, IEEE, and NEMA standards wherever applicable.
2. Maximum control voltage shall be 120 VAC, 60 Hertz.
3. Control devices shall be of industrial grade, heavy-duty design, utilizing modular construction to increase flexibility.

2.03 SURGE SUPPRESSION DEVICES (SPD)

A. The SPD shall be able to suppress lightning induced voltage surges three times greater than the industry standards. The rated line voltage for SPD shall be 480 VAC, 3-phase, 4-wire. The maximum single impulse current shall be 80kA per phase.

1. The SPD shall have line to ground protection on all phases.
2. The SPD shall have a 5 YEAR warranty. Under that warranty, the TVSS shall be replaced if it is destroyed by lightning or other impulses.
3. The SPD shall have an LED failure indicator on all three phases.
4. The clamp voltage on the SPD for lines "A", "B", or "C" to ground shall be 600 volts. The neutral to ground clamp voltage shall be 600 volts.
5. The SPD shall be Advanced Protection Technologies Model TE/4XF, or equal.

2.04 CONTROL RELAYS

A. Multicontact - Unless otherwise noted, relays shall have a minimum of two (2) form C contacts rated at 10 amperes, 120 volts A.C. They shall be of the type which utilizes the circular plug system with hold down springs. Each relay shall be provided with an indicator lamp to show its status. The covers shall be dustproof, and manufactured of a clear polycarbonate material. The relays shall be Model KRPA as manufactured by Potter & Brumfield, Struthers Dunn, Square D, or equal.

- B. Timing relays shall have DPDT, 10 amperes, 120 VAC contacts. Timers shall be solid-state and adjustable as required. They shall utilize a plug in base mounting system. Timing relays shall be Model 328 as manufactured by ATC, Potter & Brumfield, or equal.

2.05 INSTRUMENTATION SIGNAL MULTICONTACT RELAYS

- A. Relays for switching instrumentation level signals shall have the following features: 120 VAC coil; 4PDT gold-flashed silver, gold-silver nickel, or gold bifurcated crossbar contacts; socket mount; sealed plastic cover; and hold-down spring.
- B. The contact ratings shall exceed the requirements for the application, and shall be no less than 1 ampere at 120 VAC. The expected life shall be a minimum of 100,000 operations at rated load.
- C. The socket shall be of the surface or rail-mount design with screw terminals to facilitate circuit connections.
- D. The relay and socket shall be Omron Model MYQ4, or equal.

2.06 LIMIT SWITCHES

- A. Limit switches shall be oiltight, 10 amperes contacts, 120 volts, DPDT as manufactured by Square D, Honeywell, or equal.

2.07 PILOT LIGHTS

- A. Pilot lights shall be heavy duty, oiltight, watertight, NEMA Type 4X, corrosion resistant, push-to-test, LED type, and intended for industrial applications. The operator shall mount in a 1.20-inch diameter opening and be provided with the proper legend plate and lens color.
- B. Pilot lights shall be as manufactured by Square D, Cutler-Hammer, General Electric, Allen-Bradley, or equal.

2.08 SWITCHES AND PUSHBUTTONS

- A. Switches and pushbuttons shall be heavy duty, oiltight, watertight, NEMA Type 4X, corrosion resistant units intended for industrial applications. The operator shall mount in a 1.20-inch diameter opening and be provided with the proper legend plate.
- B. Switches and pushbuttons shall be as manufactured by Square D, Cutler-Hammer, General Electric, Allen-Bradley, or equal.

2.09 CONTROL TERMINAL BLOCKS

- A. Control terminal blocks shall have the following features: NEMA rated; open construction; solderless box lug; 30 amperes, 300 volts rating; suitable for channel mounting; and will accommodate wires from #22 to #10 AWG. The terminals shall have a built-in marking area to facilitate system interconnection. The control terminals shall be Square D, Class 9080, Model GM3, or equal.

2.10 CIRCUIT BREAKERS

- A. Circuit breakers shall be of the molded case, air-break type designed for 600 volts, 60 Hertz service or as shown on the Drawings. They shall have both thermal and magnetic elements on all three poles. These elements will actuate a common tripping bar to open all poles when an overload or short circuit occurs. The load terminals shall comprise power distribution type connectors (PDC) to facilitate wiring.
- B. The circuit breakers shall have an AIC rating greater than the available fault current at the panel, but no less than 25 KAIC.
- C. The equipment shall be as manufactured by Cutler-Hammer, Square D, General Electric, or equal.

2.11 CONTROL TRANSFORMERS

- A. Control transformers shall be individual output type for primary and secondary voltages as shown on the Drawings. The primary shall be fused, and the secondary shall be grounded and fuse protected. The control transformers shall have sufficient capacity to provide the energy demands for all related control components. This shall include relays, solenoids, and other indicated items.

- B. The electrical performance shall exceed the requirements of ANSI/NEMA ST-1. The transformers shall be as manufactured by General Electric, Cutler-Hammer, Square D, or equal.

2.12 ELAPSED TIME METERS

- A. Elapsed time meters shall be furnished and installed where shown. Time meters shall register up to 9999.9 hours, be non-resettable, have square cases suitable for panel mounting, and have coils for 120 volts, 60 Hertz operation. The units shall be as manufactured by Eagle Signal, Crammer, or equal.

2.13 SOLID STATE SOFT STARTER

- A. Refer to specification section 16484 for Solid State Soft Starter requirements.

2.14 PRESSURE SWITCHES

- A. The pressure switches shall be adjustable, with stainless steel wetted materials and hermetically sealed electrical contacts. The pressure switches shall have the following features:
 1. 316 stainless steel port and heliarc welded diagram.
 2. Adjustment range : 15 PSIG decreasing to 80 PSIG increasing.
 3. SPDT contacts rated 11 amps, 125 VAC.
 4. Underwriters Laboratories, Inc. listed.
 5. Pressure connection to be 1/2" NPT female port.
 6. Enclosure to be stainless steel and shall meet or exceed the requirements of NEMA 4X.
 7. Conduit box with terminal strip and 3/4" hubs.
 8. Shall be provided with annealed stainless steel port screws for H2S environments.
 9. Shall be U.L. approved.

- B. The pressure switches shall be as required ITT Neo-Dyn series 132P. Model # 132P59C3GIJX

2.16 SEAL WATER SOLENOID VALVE

- A. The seal water solenoid valve shall be of 2-way normally closed operation and shall be of brass body construction. The valve shall be mountable in any position and shall operate on 120V AC power. The valve shall have the following features:
 - 1. Valve body shall be constructed of Brass.
 - 2. Seals and Disc shall be Nitrile Butadiene Rubber (NBR).
 - 3. The Core Tube shall be 305 Stainless Steel.
 - 4. The Core and Plugnut shall be 430F Stainless Steel.
 - 5. All springs shall be 302 Stainless Steel.
 - 6. The shading coil shall be copper.
 - 7. The solenoid enclosure shall be watertight, type 4X with a 1/2" conduit hub.
 - 8. Valve shall have a rating of 5-150 PSI.
- B. The seal water valve be as required ASCO Red-Hat solenoid catalog # EF8016G1 with valve catalog # EFHT8210G002.

2.17 SAFETY SWITCH

- A. Refer to specification section 16170 for Disconnect and Protective Device requirements.

2.18 GRINDER MOTOR CONTROLLER

- A. The sludge grinder controller shall utilize a programmable logic design, with ladder logic programming, protected from line transients to 1,000 volts. The operating voltage shall be 460 volts (+) or (-) 5%, 3ph, 60 Hz. The controller shall provide thermal overload, single phase, and phase imbalance protection for the motor. The controller shall be provided with a locally

mounted overload reset operator; automatic restart is not desired. Overload status shall be retained during a power outage and controls returned to prior conditions when power is returned.

- B. The sludge grinder controller shall be installed in a stainless steel enclosure with rolled lips at the closing surfaces. Power-On, Run, and Overload pilot lights shall be mounted on the front door of the enclosure. The following controls shall be mounted on a dead front face plate inside the enclosure:

1 – Local/Off/Remote selector switch
1 – Stop/Reset pushbutton switch
1 – Start pushbutton switch

- C. Run relay and overload relay dry contacts shall be available for interfacing with the remote control station as shown on the Plans.

- D. The following is a description of the desired control features:

1. The controller shall be equipped with a “Local/Off/Remote” switch. In the “Off” position, the electrical motor shall not run. In the “Local” position, the panel controls are used. In the “Auto” position, the grinder shall start when two (2) terminals on the controller are closed and stop when they are opened.
2. In the “Local” position, the stop command shall override the start.
3. Upon the grinder encountering a jam or overload condition, the controller shall stop the grinder and reverse its rotation to clear the obstruction. If the jam is cleared, the controller shall return to normal operation. If the jam condition still exists, the controller shall go through two additional reversing cycles within 30 seconds (three times total) before signaling a grinder overload condition. Upon a grinder overload condition, the controller shall shut the grinder off and activate an alarm relay with dry contacts.

- E. The grinder controller shall be a Model Series PC2200, as manufactured by JWC Environmental, Inc., or equal.

2.19 SLUDGE PUMP AND GRINDER CONTROL STRATEGY

- A. Currently there are three (3) sludge pump and grinder systems in the Mixed Sludge Pumping Station. They are referred to as No.1, No.2 and No.3 in the Plans and elsewhere herein. Sludge pump No.1 is currently rated 25HP, and pump No. 2 and No. 3 are rated 60HP. Sludge pump and

grinder system No.1 shall be removed and replaced under this Contract with a new sludge pump rated 60HP and associated grinder and controls as shown in the Plans and specified herein.

- B. The following is a summary of the desired control scheme:
1. There is a “Hand-Off-Auto” (H-O-A) switch for each sludge pump and each grinder (six total) located on the Instrumentation Control Panel. When the switch is in the “Hand” position the associated motor will start regardless of the automatic command or pump interlocks— safety interlocks (overload, etcetera) will shut off the motor. When the switch is in the “Off” position the associated motor is locked-out. When the switch is in the “Auto” position the associated motor will start according to the prescribed automatic sequence.
 2. Select the desired “lead” pump/grinder; No.1, No.2, or No.3; via selector switch. If No.1 is selected, No.2 is automatically the “stand-by” pump. If No.2 is selected, No.3 is automatically the “stand-by” pump. If No.3 is selected, No.2 is automatically the “stand-by” pump.
 3. The “pump run” command controls are existing, and operate in one of two Operator selectable modes:
 - a. Auto Level – Selected pumps are turned on and off by the wet well level control system only.
 - b. Auto Sequence and Level – Selected pumps are turned on and off each time the batch controller selects another digester. The wet well level controls operate the same as in “a” above and override any conflicting batch controller pump commands.
 4. The seal water solenoid shall be energized each time the pump is started. A 30 second “time on” delay relay will be started at the same time. If the relay “times out” before the proper seal water pressure is reached, “SEAL WATER-LOW PRESSURE” will be annunciated and the pump will stop. The pump can be restarted only after the seal water system is repaired and the circuit is reset by pushbutton.
 5. If the grinder H-O-A switch is in the “Auto” position, the grinder will start with the associated sludge pump and an interlock system shall exist

between the two, as shown on the Plans and specified herein.

6. The sludge pump and grinder alarms shall be combined for annunciation, as shown on the Plans.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General

1. Install all instruments and equipment in strict compliance with manufacturer's instructions.
2. Mount all gages and indicators in upright position.
3. Provide sufficient space around equipment for maintenance and removal of equipment.
4. Cover front panels, gages and indicators during construction for protection from dust, weld and paint splatter.
5. Unless otherwise impractical, mount all indicating instruments at eye level (5 feet).
6. Unless otherwise impractical, support instruments independent of process piping.

B. Installation Hardware

1. Provide stainless steel nuts and bolts.
2. Provide aluminum or stainless steel support channels.
3. Provide 1/4-inch thick minimum, clear anodized aluminum equipment mounting plates.
4. Provide gaskets to prevent galvanic reaction between dissimilar metal surfaces.

C. Equipment Identification and Instrument Tags

1. Provide embossed stainless steel tags.

2. Provide an engraved laminated plastic plate at each wall-mounted instrument panel, indicating panel and instrument function and tag.
3. Engraved laminated tag colors: Provide black lettering on white background. Mount tags at eye level.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspection: Provide tests as required in the Specific Provisions.
- B. Inspection: Demonstrate that instruments, switches, pilot lights, etc. :
 1. Have not been damaged by transportation or installation,
 2. Have been properly installed,
 3. Have no mechanical defects,
 4. Are in proper alignment, and
 5. Have been properly connected.
- C. Tests: Perform the following tests:
 1. Field-calibrate all field instruments.
 2. Test all external alarm contacts by placing jumpers across normally open contact inputs, or by physically disconnecting wiring on normally closed contact inputs. These procedures shall be done at location of field contacts.
 3. Test digital inputs and outputs by actual starting and stopping of equipment when possible, or with jumpers at field equipment terminals.
 4. Conduct all tests in presence of Owner personnel or Engineer.
- D. Manufacturers Field Service: Provide manufacturer field service for calibration, initial setup, programming and commissioning of each instrument.

END OF SECTION

SECTION 16050

ELECTRICAL – GENERAL PROVISIONS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required for the Mixed Sludge Pumping Station Rehabilitation at the City of Tampa's Howard F. Curren Advanced Wastewater Treatment Plant as hereinafter specified and shown on the Drawings. The work includes, but is not limited to, the following :
1. Demolition and removal of existing equipment
 2. Installation of a new Solid State Soft Starter for the new Mixed Sludge Pump to be provided under this contract.
 3. Installation of a new Grinder Pump Control Panel and associated disconnect for the new Grinder Pump to be provided under this contract.
 4. Installation of pressure switch, solenoid valve, relays, and pushbuttons as indicated .
 5. Installation of various conduit and conductors as indicated.
- B. The work, apparatus and materials, which shall be furnished under these Specifications and accompanying Drawings, shall include all items listed hereinafter and/or shown on the Drawings. Certain equipment, which will require wiring thereto and/or complete installation, is indicated. All materials necessary for the complete installation shall be furnished and installed by the CONTRACTOR to provide complete power, instrumentation, wiring and control systems as indicated on the Drawings and/or as specified herein.
- C. The CONTRACTOR shall furnish and install the necessary cables, protective devices, conductors, supports, raceways, exterior electrical system, etc., to serve loads as indicated on the Drawings and/or as specified.
- D. The work shall include complete testing of all equipment and wiring at the completion of the work and making any minor connection changes or adjustments necessary for the proper functioning of the system and equipment. All workmanship shall be of the highest quality; sub-standard work will be rejected.

- E. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required. All material and all work, which may be reasonably implied as being incidental to the work of this Section, shall be furnished at no extra cost.
- F. Furnish and install a complete system of conduit as herein specified and shown on the drawings.

1.02 CODES

- A. All material and installation shall be in accordance with the latest edition of the National Electrical Code and all applicable national, local and state codes, laws and ordinances.

1.03 TESTS

- A. Test all systems and repair or replace all defective work. Make all necessary adjustments to the systems and instruct OWNER's personnel in the proper operation of the systems.
- B. The following minimum tests and checks shall be made prior to the energizing of electrical equipment. Test shall be by the CONTRACTOR and a certified test report shall be submitted providing all test results and stating that the equipment meets and operates in accordance with the Manufacturer's and job specifications, and that equipment and installation conforms to all applicable Standards and Specifications:
 - 1. Test all 600-volt wire insulation with a megohm meter after installation. Make tests at not less than 1000 volts. Submit a written test report of the results to the engineer.
 - 2. Mechanical inspection of Solid State Soft Starter and Grinder Control Panel to assure proper operation.
- C. The Engineer shall be notified seventy-two (72) hours before tests are made to enable the Owner to have designated personnel present.
- D. Tests to be accomplished as a minimum are as follows:
 - 1. Control Panels/Soft Starter : provide temporary power source to all control circuits and check for proper operation prior to energizing equipment served.

2. Motor Test: Motor rotation will be checked by momentary energizing of motor. Correction of rotation shall be made by changing leads on the motor. Motors shall only be energized in the presence of a representative of the OWNER.

1.04 CUTTING AND PATCHING

- A. All cutting and patching shall be done in a thoroughly workmanlike manner.

1.05 INTERPRETATION OF DRAWINGS

- A. The Drawings are not intended to show exact locations of conduit runs.
- B. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings.
- C. Unless otherwise approved by the Engineer, conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed.
- D. Where circuits are shown as "home-runs," all necessary fittings and boxes shall be provided for a complete raceway installation.
- F. The locations of equipment, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- G. Circuit layouts shown are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment.
- H. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can be determined in advance of the purchase of equipment.
- I. All connections to equipment shall be made as shown, specified and directed and in accordance with the approved shop drawings, regardless of the number of conductors shown on the Electrical Drawings.

1.06 RECORD DRAWINGS

- A. As the work progresses, legibly record all field changes on a set of project Contract Drawings. When the project is complete, furnish a complete set of reproducible "As-built" drawings for the Project Record Documents.

1.07 COMPONENT INTERCONNECTIONS

- A. Component equipment furnished under this Specification will not be furnished as integrated systems.
- B. Analyze all systems components and their shop drawings; identify all terminals and prepare drawings or wiring tables necessary for component interconnection.

1.08 SHOP DRAWINGS

- A. As specified under other Sections, shop drawings shall be submitted for approval for all materials, equipment, apparatus, and other items as required by the Engineer.
- B. Shop drawings/cutsheets shall be submitted for all electrical equipment including, but not limited the following:
 - 1. Solid State Soft Starter and control power transformer
 - 2. Grinder Pump Control Panel
 - 4. XHHW copper conductors
 - 5. Conduit/Fitting
 - 6. Unistrut
 - 7. Enclosures
 - 8. Labeling Equipment
 - 9. Relays
 - 10. Pressure Switches
 - 11. Pushbuttons
 - 12. Solenoid Valves
 - 13. Sludge Pump Soft Starter Circuit Breaker
 - 14. New MCC cubicle components
- C. Prior to submittal by the CONTRACTOR, all shop drawings shall be checked for accuracy and contract requirements. Shop drawings shall bear the date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted shall be returned.

- D. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Drawings. The responsibility of, or the necessity of, furnishing materials and workmanship required by the Specifications and Drawings, which may not be indicated on the shop drawings, is included under the work of this Section.
- E. The responsibility for all dimensions to be confirmed and correlated at the job site and for coordination of this work with the work of all other trades is also included under the work of this Section.
- F. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

1.09 WARRANTY

- A. Provide a warranty for all the electrical equipment in accordance with the requirements of other Sections. Under no circumstances shall the warranty be for less than one year starting from substantial completion.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for providing materials for the identification of electrical equipment, components, conduits, cables and wiring, and furnishing and installing safety signs.
- B. Related Work Specified in Other Sections Includes:
 - 1. Section 24 - Painting
 - 2. Section 16050 - Basic Electrical Materials and Methods

1.02 REFERENCES

- A. Codes and standards referred to in this Section are:
 - 1. ANSI C2 - National Electrical Safety Code (NESC)
 - 2. ANSI Z535.1 - Safety Color Code
 - 3. ANSI Z535.2 - Environmental and Facility Safety Signs
 - 4. ANSI Z535.3 - Criteria for Safety Symbols
 - 5. OSHA - Occupational Safety and Health Act

1.03 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in the Specific/General Provisions.
- B. Product Data and Information: Furnish manufacturer's catalog data for safety signs, nameplates, labels and markers.
 - 1. Furnish manufacturer's instructions indicating application conditions and limitations of use; and storage, handling, protection, examination and installation of product.
- C. CONTRACTOR's Record Drawings: Furnish CONTRACTOR's record drawings accurately showing actual location of markers for underground ducts, handholes and manholes, at completion of the Project.

1.04 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in the Specific/General Provisions.

1.05 SPARE PARTS

- A. General: Furnish the following spare parts.
 - 1. Ten safety signs of each size and wording.
- B. Packaging: Package spare parts in containers bearing labels clearly designating contents. Identify all spare parts with information needed for reordering. Deliver spare parts in original factory packages.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
 - 1. W. H. Brady Company
 - 2. Seton
 - 3. Thomas & Betts

2.02 MATERIALS AND COMPONENTS

- A. General: Provide identification materials listed and classified by UL or tested by an acceptable Electrical Testing Company certifying the equivalence of the materials to UL listing requirements and OSHA approved.
- B. Laminated Plastic Nameplates: Provide engraved three layer laminated plastic nameplates with black letters on white background and fastened with corrosion-resistant screws. Do not use mounting cement for fastening nameplates.
 - 1. Provide nameplates with 1-inch high lettering for motor control center, Methanol Pump Control Panels, automatic transfer switch, mini power-zone, panelboard, and similarly grouped equipment, transformers and disconnect switches.
 - 2. Provide nameplates with 1/2-inch high lettering for individual components of a group such as main breakers, motor control center units and similar devices.

3. Provide nameplates for each motor identifying service or function and lettering of an appropriate size to suit each motor.
 5. Provide approved laminated directories of circuits with typewritten designations of each branch circuit in each panelboard.
 6. Provide smaller lettering for a neat, legible nameplate where the amount of lettering causes excessively large nameplates.
- C. Wire Markers: Identify wire bundles and each individual wire.
1. Wire bundles: Provide a brass or rigid fiber identifying tag attached with nylon self locking "Ty-Raps".
 2. Wire identification markers: Provide a printed white, heat-shrink, seamless tubing type with black bold lettering for wires size No. 10 AWG and smaller. Provide a printed self-laminating white, vinyl type with black bold lettering for wires No. 8 AWG and larger.
- D. Safety Signs: Provide safety signs in accordance with OSHA standard meeting the requirements of ANSI C2, ANSI Z535.1, ANSI Z535.2 and ANSI Z535.3.
1. Provide safety signs manufactured from vinyl having a minimum thickness of 60 mils with red and black letters and graphics on a white background.
 2. Size: 10 inches by 14 inches except signs 7-inch by 10-inch may be provided where the larger size cannot be applied.
 3. Mount safety signs using corrosion-resistant screws. Do not use mounting cement.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Preparation: Degrease and clean surfaces to receive nameplates, labels and marking paint.

3.02 INSTALLATION

- A. General: Install nameplates on the front of equipment, parallel to the equipment lines and secured with corrosion resistant screws.

1. Install laminated nameplates identifying:
 - a. Each electrical equipment enclosure
 - b. Individual equipment and devices
- B. Wire Markers: Identify wire bundles and each individual wire with identification tags as follows:
 1. Wire Bundles: Install an identifying tag engraved with the conduit number where conduits enter motor control centers, switchgear, switchboards, control panels, terminal boxes and the like.
 2. Wire identification markers: Provide wire identification markers on each wire at all termination points.
 - a. On power and lighting circuits: The branch circuit or feeder number as indicated on drawings
 - b. On control circuits terminated in motor control center, control panels and alike: The field device and terminal number of the opposite end connection.
 - c. On control circuits at each field device: The panel or compartment number and terminal number of the opposite end connection.
 3. Oversize wire markers so that after heat shrinking the wire marker can be rotated on the wire. Rotate wire markers so that wire identification number is visible.

END OF SECTION

SECTION 16110

CONDUIT, WIRE AND GROUNDING

PART 1 - GENERAL

1.01 SCOPE

- A. Conduit, wire, and grounding includes furnishing and installing all conduits, underground ducts, bus ducts, wires, cables, and grounding systems as shown, specified, and required for a complete installation. The work includes the furnishing and installation of wires and cables in flexible and rigid conduits, underground ducts, all as required, shown, and specified.
- B. Descriptive literature and technical information relative to conduits, wires, and grounding shall be submitted by the Contractor in conformance with the requirements of the General Provisions.
- C. The Contractor shall, with reference to approved drawings of equipment being installed, prepare detailed plans showing the layout and size of all conduits, ducts, bus ducts, cables and wires, connections between the point of service connection and all utilizing equipment. These plans shall be in sufficient detail to serve as working drawings for the installing electricians. The drawings shall be to scale not less than the Plans and be prepared as the work develops with approval by the Engineer before major steps of work are undertaken.
- D. During construction, careful notes shall be kept of all deviations or changes in the layout or connection diagrams. Upon completion of the work, all working drawings shall be corrected and then marked "Record Drawings". Four sets of final prints, along with an equal number of bound instruction manuals and parts lists shall be given to the Engineer at the end of the job.
- E. Excavation, backfill, form work, concrete, and reinforcing shall be in accordance with the applicable Workmanship and Materials sections.

1.02 WIRES AND CABLES - GENERAL

- A. Wires and cables required for all systems shall be complete, connecting all equipment and control components. Conductors shall be of ample size, with suitable insulation as specified hereinafter.

PART 2 – PRODUCTS

2.01 600-VOLT WIRE AND CABLE - CONDUCTORS

- A. All ground conductors and power, control, and lighting conductors shall be soft-drawn or annealed stranded copper wire meeting the requirements of ASTM B 3 or B 33. For lighting fixture and convenience outlet wiring only, conductors No. 10 AWG and smaller may be solid conductor. Conductors shall be sized to limit the maximum conductor temperature to less than 75°C, except where specifically stated otherwise. Table 310.15(B)(16) of the NEC shall be the guide in determining 600-volt conductor sizes. The minimum size of conductor for power and lighting wiring shall be No. 12 AWG.
- B. Conductors for motor feeders shall be diesel locomotive cable (DLO) shall manufactured from stranded tinned annealed copper.

2.02 600-VOLT POWER AND CONTROL CABLE -INSULATION

- A. Low voltage circuits shall be wired with 600-volt insulated conductors, sized as shown, or as required by the actual load to be served, whichever is larger.
- B. Single Conductor : Insulation for single 600-volt copper conductors shall be cross-linked polyethylene compound, U.L. Inc. listed, NEC Type XHHW-2, with surface print cable identification; as manufactured by Okonite, American, Southwire or equal.
- C. Multiconductor Cables : Individual conductors shall be insulated with 15 mils of polyethylene or PVC and 4-mil nylon jacket. The bundle of conductors shall be wrapped with tape binder and an outer jacket of not less than 45 mils of PVC. Use ICEA Method 1 for color coding wires.
- D. Insulation for 600-volt copper conductors No. 8 AWG and larger shall be cross-linked polyethylene compound, U.L. Inc. listed, NEC Type THWN, and shall be Okonite X-Olene, American, or equal.
- E. Insulation for 600-volt copper conductors No. 10 AWG and smaller shall be cross-linked polyethylene compound, U.L. Inc. listed, NEC Type XHHW, and shall be Okonite, American, or equal.

2.03 INSTRUMENTATION/DATA CABLES - INSULATION

- A. 4-20mA Analog: Shielded two-conductor No. 16 AWG cables for instrumentation shall be properly stranded 600-volt insulated copper wire twisted cables as shown. Conductor insulation shall be polyethylene. Shields shall be overlapped metalized tape providing 100 percent coverage with tinned copper drain wire. Cable outer jacketing shall be of polyvinyl chloride. Cables shall be as manufactured by Belden #8719, or equal.
- B. Three Conductor: Stranded No. 16 wire, 600 volt polyethylene insulation, twisted conductors, tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage and outer jacket of PVC. Belden Cat. No. 8618.
- C. Category 5: Provide cable having third party verification to TIA/EIA 568-A Category 5 requirements and constructed of 4 pair stranded No. 24 AWG solid copper wire, polyethylene or polypropylene insulation, stranded No. 24 AWG tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage and outer jacket of gray PVC. Belden Cat. No. 1624R.
- D. Twinaxial (Data Highway): Provide stranded No. 20 AWG tinned copper wire (9.5 ohms/mile), 78 ohm nominal impedance, 300 volt polyethylene insulation, tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage and 55 percent tinned copper braid shield (4.1 ohms/mile) and outer jacket of blue PVC. Belden Cat. No. 9463.
- E. 1-1/2 Pair (RS-485): Provide three stranded No. 22 AWG tinned copper wires with 300 volt FHDPE insulation, a tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage, 90 percent tinned copper braid shield and a PVC outer jacket. Insulated wires shall be configured as one twisted pair and one reference conductor – 120 Ohms characteristic impedance. Belden Cat. No. 3106A.

2.04 UNDERGROUND DUCTS:

- A. Underground ducts for feeders, instrumentation wiring, control wiring, and communication wiring shall be plastic conduit and shall be encased in reinforced concrete as shown. In general, the plastic conduit shall be PVC Schedule 80, NEMA TC-2, as manufactured by Carlon, Triangle, Allied Tube, or equal. Ducts shall be installed as shown and shall be sloped uniformly between the elevations shown. Manufactured fitted plastic duct spacers shall be used for installation spacing.

- B. Concrete for the encasement shall be Class B using aggregate not exceeding 3/4 inch and shall be reinforced as shown. Ducts shall drain to the manholes or end structures. End bell fittings shall be provided on the ducts in the manholes.
- C. Appropriate expansion fittings or other approved methods shall be used in the installation of plastic ducts so as to avoid expansion and distortion prior to encasement in concrete. Spacers shall be located a maximum of 8 feet, 0 inches on-centers and the duct spacings center-to-center shall not vary in excess of 1/16 inch from the specified spacings shown, prior to and after encasement.
- D. Each duct shall be carefully cleaned before and after installation. All inside surfaces shall be free from imperfections likely to injure the cable. After installation of complete duct runs in sizes 2 inches and larger, ducts shall be snaked with an approved tube cleaner equipped with an approved cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the duct. Ducts through which the mandrel will not pass shall not be incorporated in the work. After snaking, the ends of dead-ended ducts shall be protected with standard conduit caps to prevent the entrance of water or other foreign matter.
- E. Where ducts enter buildings or at stub-ups to equipment, transitions to aluminum conduits shall be made as noted and detailed. Where it is not otherwise shown, all ducts entering buildings and structures, exclusive of manholes, shall have transitions to aluminum conduit at least 5 feet from the outermost edge of the pile cap or footing supporting the outermost vertical wall of the building or structure.
- F. Transition from above-grade rigid aluminum conduit to nonmetallic conduit shall be accomplished with a threaded adapter. Rigid aluminum conduit installed above grade and extending below grade shall include the first 90° elbow. All rigid aluminum conduit extending below grade shall be coated with two coats of an asphaltum-type paint along its entire length below grade and extending 6" above grade or above the top of the finished slab. The asphaltum-type paint shall conform to Fed. Spec. TT-V-51 and equivalent to Koppers Bitumastic Super Service Black.

2.05 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (Size 2 Inch or Less)

- A. All flexible conduits size 2 inch or less in non-classified areas shall be nonmetallic, liquidtight, and have a circular cross section. The conduit shall be resistant to oil, water, heat, sunlight, corrosion, most acids, ozone, alkali, strains, abrasions, and crushing. The conduit shall be rated for continuous use at 140°F and be U.L. Inc. listed. Compatible liquidtight nonmetallic fittings shall be used for conduit installation. The flexible conduit and fittings shall be as manufactured by Carlon, Kellems, K-Flex, or equal.

2.06 METALLIC CONDUIT (Greater than 2 Inch)

- A. All flexible conduits greater than 2 inch in non-classified areas shall be nonmetallic, liquidtight, and have a circular cross section. The conduit shall be of a light-weight aluminum core, coupled with a PVC jacket. The conduit shall be resistant to sunlight, acid, and oil. The conduit shall be rated for a working temperature between -20°C to 80°C and be U.L. Inc. listed. Compatible liquidtight metallic fittings shall be used for conduit installation. The flexible conduit and fittings shall be as manufactured by Thomas & Betts or equal.

2.07 METALLIC CONDUIT AND BOXES

- A. All conduit shall comply with the requirements of the U.L. Inc. Standards. Conduit shall be delivered to the job site in standard bundles having each length suitably marked with the manufacturer's name or trademark and bearing the label of the U.L. Inc. inspection service. The minimum size conduit shall be 3/4 inch.
- B. Unless otherwise noted, all conduit shall be rigid heavy wall, Alloy 6063T-42 aluminum conduit. Aluminum conduit shall conform to Federal Specification WW-C-540 and ANSI C80.5.
- C. Cast aluminum shall be used for outlet boxes and fittings in aluminum conduit systems. Outlet and junction boxes shall be of proper dimensions for each application. Cast metal boxes shall have watertight gaskets and covers secured with nonferrous screws.
- D. PVC coated boxes and fittings shall be used in PVC coated conduit systems.

- F. Conduit fittings, such as elbows, tees, couplings, caps, bushings, nipples, and locknuts shall be threaded to provide watertight connections.
- G. Where it is necessary to use electrical unions, Universal, Erikson, or equal conduit couplings shall be used.

2.08 EXPANSION FITTINGS

- A. Expansion fittings shall be installed at all expansion joints and where required by codes. Conduit expansion fittings shall be Crouse-Hinds Type XD, O.Z./Gedney Type DX, or equal.

2.09 TERMINAL, JUNCTION AND PULL BOXES

- A. Junction and pull boxes shall be installed as shown and as required.
- B. Surface-mounted junction and pull boxes, unless specified otherwise herein, shall be of cast aluminum complete with mounting lugs, threaded entry bosses and flange or rabbeted gasketed covers.
- C. Surface-mounted junction and pull boxes which would exceed 50 pounds weight if cast or which are shown as fabricated sheet metal boxes shall be made of 1/8-inch sheet aluminum with sides return channel flanged around the cover opening or with approved welded angle or channel supporting frames. Sheet aluminum boxes shall be provided with mounting lugs or channels and with conduit termination hubs. All seams in sheet aluminum boxes shall be continuously welded and ground smooth. All surface boxes larger than 6 inches square shall be mounted a minimum of 3/4 inch clear of the mounting surface by means of offset lugs or support channels.
- D. Fabricated junction and pull boxes which are partially or fully encased in concrete shall be made of 10-gauge sheet stainless steel and fabricated in a similar manner to the sheet aluminum pull boxes specified herein, complete with mounting lugs or channels and conduit termination hubs. Cast steel boxes shall be provided in smaller sizes where required for full or partial encasement in concrete.
- E. All junction and pull boxes shall be provided with covers or doors as shown or required. Covers and doors shall be fabricated of materials equal in weight, gauge, structure, and metallic composition as the basic box. All covers shall be gasketed and held in place with nonferrous captive knurled head screw slot bolts. All pull and junction boxes shall be provided with hinged doors.

- F. Enclosures with doors shall have continuous hinges, and 3-point catches with nylon rollers at the top and bottom and external handles and hasps for padlocks. All doors shall utilize an overlapping design and shall be gasketed.
- G. All boxes shall be provided with partitions as shown and as required.
- H. Fabricated boxes shall be NEMA 12 enclosures for indoor, above grade areas; rated NEMA 4X enclosures for outdoor or corrosive areas. Fabricated boxes shall be as manufactured by Hennessy Products, Inc., Hoffman, Hope or equal.

PART 3 – EXECUTION

3.01 CONDUIT INSTALLATION

- A. All conduits shall be installed as required. The conduit system shall be installed complete with all accessories, fittings, and boxes, in an approved and workmanlike manner to provide proper raceways for electrical conductors.
- B. The Contractor shall note that conduit runs shown are for the purpose of outlining the general method of routing the conduits to avoid interferences.
- C. All conduit shall be run exposed, except where shown otherwise.
- D. Sizes not shown shall be one size larger than indicated in Tables 1 or 4, Chapter 9, of the NEC. Exposed conduit shall be run parallel to or at right angles from walls or beams and plumb on columns and on walls. Conduit shall not be run through beams except where approved by the Engineer or specifically detailed. Where possible, conduit shall be pitched slightly to drain to the outlet boxes or otherwise installed to avoid trapping of condensate. Where necessary to ensure drainage, Appleton Type ECD, Crouse-Hinds or equal, 1/4-inch drain fitting shall be installed in the trapped conduit at low points.
- E. Factory made bends or elbows shall be used wherever possible. Field bends shall be carefully made to prevent conduit damage or reduction in the internal area. The bending radius shall be not less than six times the nominal diameters of the conduit with carefully matched bends on parallel runs to present a neat appearance. The number of crossovers shall be kept to a minimum.

- F. All conduit shall be reamed to remove burrs before installation. Aluminum conduit shall be cut with a saw to prevent reduction in internal area. All threads in steel conduit shall be given a coat of zinc dust in oil or other approved corrosion-preventive compound before making connections. Threads on aluminum conduit shall be given a coat of graphite or other approved compound. All connections and joints in all conduit runs shall be watertight and ensure a low resistance ground path in the conduit system. All conduit runs shall be swabbed to remove foreign matter before wires are pulled in. Conduit terminations in boxes, panels, switchboards, motor control centers, and other sheet metal enclosures shall be bonded together for grounding and be fitted with insulating bushings, O.Z./Gedney Type A, Thomas and Betts, or equal. Where grounding bushings are required by code or shown, O.Z./Gedney Type SBLG, Thomas and Betts, or equal shall be furnished.
- G. Conduit shall be neatly grouped where several lines follow a parallel course, and shall be well supported, using galvanized clips or hangers of the ring or trapeze type. Clips, hangers, and support rods shall be held by self-drilling anchors, power-driven fasteners, or steel channel insets in the concrete ceilings or walls. Perforated strap hangers will not be accepted.
- H. Conduit runs that enter the building from outdoors, or that pass through refrigerated or air-conditioned areas, are subject to moisture accumulation due to condensation. A pull box shall be provided in the conduit run near the point of temperature change to prevent trapping of moisture within the conduit system. A 1/4-inch weep hole shall be drilled in the bottom of the pull box. After the wires and cables are installed, the end of the conduit continuing into the warmer area shall be packed with a nonsetting sealing compound.

3.02 CONDUIT CONNECTIONS TO EQUIPMENT

- A. The conduit system shall terminate at the terminal box or at the conduit connection point of electric motors, devices, and equipment. Terminations of conduits at such locations shall permit direct wire connections to the motors, devices, or equipment.
- B. Conduit connections shall be made with rigid conduit if the equipment is fixed and not subject to adjustment, mechanical movement, or vibration. Myers water-tight/dust-tight hubs shall be used for outdoor, below grade or wash down areas. Rigid conduit connections shall have union fittings to permit removal of equipment without cutting or breaking the conduit.

- C. Conduit connections shall be made with approved flexible nonmetallic conduit if the equipment is subject to adjustment, mechanical movement, or vibration. Flexible conduit connections shall be watertight.

3.03 HAZARDOUS AREAS

- A. All conduit and equipment installed in or run through hazardous areas, as well as other electrical appurtenances installed therein, shall be installed to conform in every respect to Chapter 5 of the NEC for Class I, Division 1, Group D hazardous locations. All material installed in hazardous areas shall be listed as complying with the requirements of Underwriters Laboratories for use in Class I, Group D atmospheres.
- B. Sealing shall be provided for all conduits within and leaving hazardous areas as required.

3.04 GROUNDING SYSTEM

- A. A complete grounding system shall be in accordance with applicable ANSI, IEEE, and NEC Standards and local codes.
- B. All noncurrent-carrying metal parts of the electrical wiring system shall be grounded. The grounding system shall include, but not be limited to, the following:
 - 1. Motor control center controllers, ground bus, and enclosures.
 - 2. All motor frames.
 - 3. All conduit systems.
 - 4. All mechanical equipment and structures.
 - 5. Distribution and lighting panelboards.
 - 6. Control, relay, and instrumentation panels.
 - 7. Lighting fixtures and receptacles.
 - 8. Fans, blowers, pumps, and similar equipment.
 - 9. Hoist beams, cranes, and similar items.
- C. A grounding connection from the transformer to the City water pipe shall be provided. The wire and conduit shall be attached to the City water pipe with an U.L. Inc. listed cast bronze U-bolt connector with silicon bronze bolts and nuts.
- D. Motor frames shall be grounded by means of stranded, 600-volt insulated copper cables installed within the motor feeder conduit system. The cable shall be lug bolted to the motor terminal box and the ground bus of the motor control center serving the motor.

- E. An equipment grounding conductor shall be installed in all electrical raceways, and shall be sized in accordance with Article 250.122 of the National Electrical Code (NEC).
- F. Exposed or buried ground conductors shall be bare copper wires or bars of the proper sizes.
- G. All exposed ground cables or bars shall be firmly and neatly supported in place at proper intervals. Where subjected to mechanical abuse, protective enclosures shall be provided.
- H. Grounding conductors run in conduits with circuit conductors shall be stranded cable with 600-volt green XHHW, TW, THW, THWN or RHW Code insulation.
- I. Stainless steel ground rods shall be 3/4-inch diameter with the length as required, and made up of a 10-foot section with 5-foot sections added as required. Rods shall be driven to permanently moist soil.
- J. Connections to ground rods, transformer case ground bus bars, case grounds, bare ground grid conductors, and the like, shall be made by an exothermic welding process or by clamps specifically designed for this application.
- K. Ground conductor connections to ground bus bars in motor control centers, and the like, shall be cable lug bolted terminations equal to line conductor terminations specified hereinafter.
- L. Welds embedded in the ground or concrete shall be cleaned and painted with an asphaltum base paint.
- M. Tests shall be conducted by the Contractor and witnessed by the Engineer to determine the ground impedance for the entire system. The test shall be accomplished by using a ground loop impedance tester. The result shall not exceed 2 ohms at any point of test. If necessary, additional ground rods shall be installed at locations approved by the Engineer.
- N. Care shall be exercised to ensure good electrical connections between the conduits and metallic enclosures of switchgear, control centers, and the like, Grounding jumpers shall be installed where necessary to accomplish this purpose.

3.05 600-VOLT WIRE AND CABLE - INSTALLATION

- A. The 600-volt wires and cables pulled into ducts and conduit shall be installed without the use of lubricants, except where such use is necessary and approved by the cable manufacturers and the Engineer. Wires and cables shall be carefully handled to avoid twists and kinks in the conductors or damage to the insulation. All trapped conduit and duct lines shall be swabbed to remove any accumulated moisture or debris before wires or cables are pulled in.
- B. Cable reels shall be stored on concrete or other hard surface, or shall be lagged with 2 x 4 wood laggings providing 100 percent coverage.
- C. No splicing will be permitted, except in junction boxes.
- D. Lug bolting at terminals, devices, or bus bars shall be made up with a flat washer, a Belleville washer, and a locknut.
- E. Lines of nylon or polypropylene, propelled by carbon dioxide or compressed air, shall be used to snake or pull wire and cable into conduits. Flat steel tapes or steel cables shall not be used.

3.06 600-VOLT WIRE AND CABLE – SPLICES AND TERMINATIONS

- A. Splices between copper conductors, Size No. 10 AWG and smaller, shall be made up with compression type butt connections. Splices between copper conductors, Size No. 8 AWG and larger, shall be made up with U.L. Inc. listed compression type tube connectors. Lug bolting at devices or bus bars shall be made up with a flat washer, a Belleville washer, and a locknut.
- B. Splices and pigtail connections for lighting and receptacle wiring inside the buildings, No. 10 AWG and smaller, shall be made with a pre-insulated spring connectors, or equal.
- C. Splices and lug terminations in 600-volt insulated cables shall be carefully taped and covered, using materials recommended by the cable manufacturer, to provide watertight insulation equal to that of the conductors.
- D. Splices shall not be made within manholes unless specifically approved by the Engineer.

3.07 600-VOLT WIRE AND CABLE - TESTS

- A. The 600-volt insulated cables shall be factory tested prior to shipment in accordance with IPCEA standards for the insulation specified.
- B. The following 600-volt wires and cable shall be tested after installation but before final connections are made up:
 - 1. All feeders from motor control centers to motors 30 horsepower and larger.
 - 2. All feeders from variable speed drive units.
 - 3. All feeders from motor control centers to lighting panels and dry-type transformers.
- C. For the above listed cables, a test voltage of 1,500 volts ac shall be applied for a period of 1 minute between all conductors in the same conduit, and between each conductor and ground.
- D. All tests shall be made at the Contractor's expense, and certification of the tests shall be submitted to the Engineer. If any failures occur during the tests, the Contractor shall replace the cable.

3.08 IDENTIFICATION OF CIRCUITS

- A. All wires and cables shall be banded with an identifying number and color code at each end termination and at each splice point in junction boxes. The identifying number of each wire shall be determined at the point of circuit origin, and shall continue unchanged to the point of circuit termination. In each conduit system, the wire identifying numbers shall include the conduit designation with a numeral suffix. The numeral suffix shall start with No. 1 and continue as required.
- B. Where conduits enter motor control centers, switchgear terminal cabinets, and the like, the identification tag shall be fastened to the wire bundle near the conduit termination. The tag shall be held by an adjustable, self-locking nylon "Ty-Rap" as manufactured by Thomas and Betts Co., or equal. The identifying tag shall be of aluminum, brass, rigid fiber, and shall be engraved, stamped, or painted with the scheduled conduit number.
- C. The wire identifying numbers and color code shall be applied as PVC slip-on sleeves, properly fitted to the wire diameter. The sleeves shall be as manufactured by Brady Co., Thomas and Betts Co., or equal. Wires shall be color coded in conformance with the requirements of applicable codes.

3.09 WIRE AND CABLE CONNECTIONS TO EQUIPMENT

- A. Electrical connections shall be made to all equipment in strict accordance with the manufacturer's approved wiring diagrams, the Plans, or as approved by the Engineer. The Contractor shall be responsible for the accuracy of his work, and shall repair any damage and replace any damaged equipment resulting from erroneous connections.

3.10 COATING

- A. Where aluminum surfaces such as boxes, conduit, or structural supports come in contact with incompatible metals, lime, mortar, concrete, or other masonry materials, the contact areas shall be given one field coat of Koppers Metal Passivator No. 40 and one coat of Koppers Bitumastic Super Service Black or two coats of asphalt varnish conforming to Fed. Spec. TT-V-51.

END OF SECTION

SECTION 16170

DISCONNECTS AND PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide a disconnecting means meeting the requirements of the NEC at the new Grinder Pump Control Panel to be installed under this contract. The disconnecting means shall be a non-fused disconnect switch.

PART 2 - PRODUCTS

2.01 SAFETY SWITCH

- A. Safety Switch: Safety switch shall be heavy-duty type "HD". The blades of switches shall be quick-make, quick-break operating type. All lugs on the switch shall be equal to Burdy's solderless quick lugs or shall be compression type. Switch shall be 3-pole with a minimum rating of 30 amperes. Enclosure shall be NEMA 4X, stainless steel. The switch shall conform to NEMA Standards and shall be UL listed. Switches shall be equal to General Electric, Square-D, or Cutler-Hammer.

2.02 CIRCUIT BREAKERS

- A. Circuit Breakers: Circuit breakers for all branch circuits shall be molded-case unit breakers with thermal-magnetic trips designed to open all phases simultaneously under overload and/or fault conditions. Breakers shall be of adequate rating for the actual duty required. The breaker shall have quick-make, quick-break, toggle mechanism, inverse-time trip characteristics, and shall be trip-free on overload or short-circuit. Automatic release is to be secured by a bimetallic thermal element releasing the mechanism latch. In addition, a magnetic armature shall be provided to trip the breaker instantaneously for short circuit currents above the overload range. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. The trip mechanism shall be a combination thermal-magnetic type. Thermal elements shall inverse time characteristics for overload conditions and magnetic trip element shall protect against short circuits by providing instantaneous trip.
- B. Circuit Breaker for Sludge Pump #1 soft starter shall be 600V, 150 ampere frame, 150 ampere trip, 600V, 3-pole General Electric (GE) type THED suitable for installation in 1-1/2 unit space. There shall be no substitutions allowed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install disconnects as recommended by the manufacturer, required by Code, and as shown on the drawings.
- B. Install circuit breaker per requirements of Section 16445.

END OF SECTION

SECTION 16220

ELECTRIC MOTORS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for electric motors as specified.
- B. Related Work Specified in Other Sections Includes:
 - 1. Section 16050 - Electrical – General Provisions
 - 2. Section 16110 – Conduit, Wire and Grounding
 - 3. Section 16075 - Electrical Identification

1.02 REFERENCES

- A. Codes and standards referred to in this Section are:
 - 1. AFBMA 10 - Metal Balls
 - 2. NEMA MG1 - Motors and Generators
 - 3. NEC - National Electrical Code

1.03 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in the Specific/General Provisions and Section 16050.
- B. Product Data and Information: Furnish manufacturer's catalog data for each motor.
- C. Shop Drawings: Furnish shop drawings for each motor detailing arrangement, wiring, conduit boxes, and motor application.
- D. Certificate of Compatibility: For each motor controlled by an adjustable frequency drive, furnish a certificate that the motors are compatible with the adjustable frequency drives and the equipment loads to be driven.
- E. Quality Control: Furnish test reports for motors as follows:
 - 1. Certified standard commercial test reports for motors 5 hp through 200 hp.

2. Witnessed test reports as specified.
- F. Operations and Maintenance Manuals: Furnish operation and maintenance manuals for all motors.

1.04 QUALITY ASSURANCE

- A. Codes: Comply with local codes and all other applicable codes.
- B. Regulatory Requirements: Comply with requirements of the Regulatory Agencies having jurisdiction over this Project.

1.05 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified the Specific/General Provisions.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Electric motors shall be of the high energy efficient and high power factor type mounted on the equipment being driven. Motor characteristics shall be as specified under the Workmanship and Materials sections for equipment.

2.02 DESIGN

- A. Motors shall conform to the latest ANSI Standards for rotating electrical machinery and in matters not covered therein, the latest NEMA Standards for motors and generators shall apply.

2.03 RATINGS

- A. Motors shall have suitable output torque and speed characteristics to operate the driven equipment under design load conditions without exceeding their nameplate ratings. They shall have a 1.15 service factor. Definite purpose motors shall be used on specialized equipment requiring them.
- B. Motors supplied for use with adjustable frequency drives (AFD) and solid-state soft starters shall be rated for inverter duty.

- C. Ratings shall be based on NEMA Class B, 80 degrees C, temperature rise at rated conditions above an ambient of 40°C and shall have Class F moisture resistant insulation. This temperature rise shall be for continuous operation unless otherwise specified or approved.

2.04 OPERATING TYPES

- A. Motors of 1/2 HP or larger shall be of the squirrel-cage induction type, designed for 3-phase, 60-Hertz, 460-volt operation, unless shown or specified otherwise. Smaller motors shall be of the capacitor induction type designed for single-phase, 115-volt, 60-Hertz operation unless otherwise noted or approved.
- B. All motors, except where the driven equipment presents unusual requirements, shall have torque and locked rotor characteristics as outlined in the NEMA Standards for Design B.
- C. All gear motors and speed reducers shall be designed for correct mounting position and rated in accordance with the application practice outlined in the Standards of the American Gear Manufacturers Association, for Class II service.

2.05 BEARINGS

- A. All motor bearings shall be of the antifriction type except where otherwise shown or specified. All antifriction bearings shall have a minimum rating life of 100,000 hours, based on a reliability of 90 percent in accordance with ANSI B3.15. All motor bearings shall be oil or grease lubricated with convenient provisions for inspecting and servicing.

2.06 MECHANICAL PROTECTION

- A. Motors shall be of the totally enclosed, corrosion resistant (mill and chemical duty) type, unless a higher classification is required by the intended service. Vertical motors shall have solid shafts with high ring bases having ample space for coupling adjustments.
- B. All motors shall be fan cooled except for smaller sizes (approximately 2 HP and less). All totally enclosed motors shall be tapped at a low point and fitted with an Appleton ECD 1/4-inch drain fitting.

2.07 PERFORMANCE DATA

- A. Motor make, type and rating, speed-torque curves, along with the outline dimensions and the guaranteed full load and locked rotor amperes at full voltage, shall be presented with the equipment details for review and approval.
- B. Motors shall have the following minimum full load efficiency and uncorrected power factor ratings (efficiencies and power factor of motors at other speeds shall be as specified with driver equipment):

Motor Efficiency and Power Factor - Minimum Percent

Horsepower	<u>At 1800 RPM</u>		<u>At 1200 RPM</u>	
	<u>Efficiency</u>	<u>Power Factor</u>	<u>Efficiency</u>	<u>Power Factor</u>
1	81.5	74.3	78.5	69.7
1-1/2	82.5	76.5	84.0	62.0
2	82.5	70.3	85.5	70.1
3	86.5	79.9	86.5	73.7
5	87.0	83.8	86.5	75.8
7-1/2	88.5	82.4	88.5	78.2
10	88.5	85.0	88.5	76.4
15	90.2	85.0	89.5	81.1
20	90.2	84.6	89.5	81.9
25	91.7	84.5	91.0	82.0
30	91.7	84.2	91.0	82.5
40	92.4	84.2	92.4	83.3
50	92.4	85.0	92.4	84.9
60	93.0	86.8	93.0	85.7
75	93.6	86.6	93.0	86.0
100	94.1	88.3	93.6	86.4
125	94.1	89.3	93.6	85.8
150	94.5	88.5	94.5	87.5

The machine noise of the motors shall not exceed the following sound power levels when measured in accordance with IEEE Standard 85:

<u>Overall Sound Power Level, Decibels, A-Weighted</u>		
<u>Horsepower</u>	<u>At 1800 RPM</u>	<u>At 1200 RPM</u>
1 - 2	70	67
3 - 5	74	71
7-1/2 - 10	77	74
15 - 20	81	78
25 - 30	85	80
40 - 50	89	84
60 - 75	90	88
100 - 150	90	93

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: Install motors in accordance with the manufacturer's recommendations and approved shop drawings and as specified in the General Provisions. Make all necessary adjustments to equipment to provide a complete operational system.
- B. Install additional grounding connections where shaft grounding protection is applied.
- C. Motors shall be of the right or left hand assembly, as required, so that the conduit box and nameplate will be readily accessible.

3.02 FIELD QUALITY CONTROL

- A. Inspections and Tests: Perform field preliminary and final inspection and testing for motors as follows:
 - 1. Preliminary Inspection:
 - a. Demonstrate that each motor has been properly connected.
 - b. Check for proper rotation by bumping prior to connecting motor to driven equipment.

2. Final Test:
 - a. Measure motor applied voltage and current with equipment operating at full load.
 - b. Operate equipment as specified.

3.03 TEST REPORTS

- A. Unless the equipment specifications stipulate shop tests reports on the actual motors used the test data shall be on a representative motor of the same horsepower and speed. They shall show the motor full load and locked rotor amperes and full load efficiency and power factor rating, and be recorded on standard test forms as outlined in the NEMA Standards.

3.04 PAINTING

- A. Painting shall meet the requirements of the Workmanship and Materials section headed "Painting." All steel parts shall be chemically treated to insure clean surfaces, then given a rust-resistant undercoat. Screws, nuts, bolts and similar items shall be of nonferrous metal or have an approved rust-resistant finish.

END OF SECTION

SECTION 16445

MOTOR CONTROL CENTER MODIFICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for providing new components for an existing motor control center.
- B. Related Work Specified in Other Sections Includes:
 - 1. Section 16050 - Basic Electrical Materials and Methods
 - 2. Section 16075 - Electrical Identification
 - 3. Section 16170 – Disconnects and Protective Devices
 - 4. Section 16484 - Solid State Soft Starter

1.02 REFERENCES

- A. Codes and standards referred to in this Section are:
 - 1. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Not More than 2000 Volts AC or 750 Volts DC.
 - 2. NEMA ICS 3 - Industrial Control and Systems Factory Built Assemblies
 - 3. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 4. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors
 - 5. UL 845 - Motor Control Centers

1.03 SYSTEM DESCRIPTION

- A. This section defines the required modifications required to the existing General Electric (GE) 8000 Line Motor Control Centers (MCC-40 and MCC-4) which currently serve the Mixed Sludge Pumping Station.

1.04 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in the Specific/General Provisions and Section 16050.
- B. Product Data and Information: Provide catalog data for all associated equipment and devices.
- C. Shop Drawings: Furnish shop drawings customized to the project for the motor control center modifications to include the following:
 - 1. Outline drawings showing dimensions, weights, arrangement, elevations, identification of components and a nameplate schedule for all units.
 - 2. Bill of materials including manufacturers' name and catalog number.
 - 3. Interconnecting wiring diagrams, where required.
 - 4. Individual schematic and wiring diagrams for each compartment.
 - 5. Furnish instruction booklets and time-current curves for each circuit breaker supplied.
- D. Operation and Maintenance Manuals: Furnish operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Standards: Provide motor control center components in accordance with NEMA ICS 2, ICS 3, and UL Standard No. 845.
- B. UL Label: Provide a UL Label each component supplied for each motor control center.

1.06 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in the Specific/General Provisions.
- B. Shipping and Packing: Provide all structures, equipment and materials rigidly braced and protected against weather, damage, and undue strain during shipment.
- C. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Motor Control Center Components:
 - a. GE 8000 Line Series

2.02 MOTOR CONTROL CENTER COMPONENTS

- A. Basic Components:
 - 1. Provide hinges, screws, bolts, circuit breaker operating mechanisms, nameplate mounting screws and other metallic appurtenances with a noncorrodible metal covering.
- B. Circuit Breaker Unit: Provide new circuit breaker unit for 12-inch (2U) space in MCC-40-B7.
 - 1. Provide unit of the plug-in or nonremovable type in accordance with the manufacturer's standard for type and size of circuit breaker.
 - 2. Provide plug-in unit within-plated, pressure-type line disconnecting stabs of high strength copper alloy. Hold each plug-in unit in place and arrange the units such that they can be removed or remounted readily without access to the rear of the structure.
 - 3. Construct door to be drip-proof and dust-tight. Provide door with hinges and screw fasteners for holding the door closed. Fabricate door as a part of the structure and not part of the unit.
 - 8. Equip the door with a circuit breaker operating mechanism.
 - 9. Provide mechanical interlocks between the compartment door and circuit breaker operating mechanism to prevent opening of the door unless the breaker is in the OFF position, and to prevent closing the breaker unless the door is fully closed.
 - 10. Provide circuit breaker operating mechanisms or handles that are padlockable in the OFF position with room for a minimum of three padlocks.

11. Provide unit having devices that are serviceable from the front, without provisions for rear access.
- C. Soft Starter Feeder Circuit Breaker: Provide molded-case type, three-pole feeder circuit breaker with a minimum voltage rating of 600-volt ac.
1. Interrupting Ratings: Provide an interrupting capacity of 42,000 rms symmetrical amperes at 480 volts. Base interrupting rating on the IEEE and NEMA Standard duty cycle for this class of equipment.
 2. Provide circuit breaker trip units as follows:
 - a. Provide individual, thermal-magnetic trip unit.
 - b. Provide trip units that actuate a common tripping bar to open all poles when an overload or short circuit occurs on any one.
 - c. Provide trip elements with inverse time tripping and instantaneous tripping at about ten times the normal trip device rating.
 - d. Provide circuit breakers with trip-free handles.
 - e. Refer also to Section 16170.
- D. Remove existing starter, circuit breaker, control transformer and associated equipment for Sludge Pump #1 currently located within MCC-40-A1.
- E. Soft starter : Provide and install new soft starter and associated control power transformer for new Sludge Pump #1 in MCC-40 cubicle A1. Refer also to drawings and Section 16484.
- F. Soft starter unit: Provide new 24-inch (4U) blank door for MCC-40 cubicle A1.
- G. Identification: Provide nameplates having the same type, appearance and shape throughout each motor control center in accordance with the requirements of Section 16075.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in the Specific/General Provisions.
- B. Cable Connections: Terminate and label all field wiring per the approved diagrams.
- C. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening recommendations. Where manufacturers' torquing requirements are not available, tighten connectors and terminals in accordance with UL Standard 486 A.

3.02 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
 - 1. Close and open circuit breaker to test operation.

3.03 CLEANING AND PAINTING

- A. Field Painting: Clean and touch up any scratched or marred surface to match original finish.

END OF SECTION

SECTION 16484

SOLID STATE SOFT STARTER

PART 1 - GENERAL

1.01 SCOPE

- A. This specification describes the electrical, mechanical, and reliability requirements for a three phase, solid state soft starter as specified herein and shown on the contract drawings.

1.02 RELATED SECTIONS

- A. Applicable specification sections contained in Division 16 - Electrical

1.03 REFERENCES

- A. The solid state soft starter and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of IEC, UL, and NEMA.

1.04 SUBMITTALS

- A. Manufacturer shall provide the following documents to owner for review and evaluation in accordance with general requirements of Division 1 and Division 16:
 - 1. Dimensional outline drawing on specified product;
 - 2. Schematic diagram on specified product;

1.05 INSTALLATION, OPERATION AND MAINTENANCE DATA

- A. Manufacturer shall provide copies of installation, operation and maintenance procedures to owner in accordance with general requirements of SP-72.
- B. Users manual shall include wiring diagrams, schematics, operating, and maintenance instructions.

1.06 QUALITY ASSURANCE (QUALIFICATIONS)

- A. Manufacturer shall have specialized in solid state soft starter production for more than 10 years.
- B. Solid state soft starter shall be 100% Factory Tested to ensure proper performance upon delivery.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Solid state soft starter shall be stored, protected, and handled in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.
- B. Solid state soft starter shall be inspected and concealed damage reported to carrier within 48 hours.
- C. Solid state soft starter shall be stored in a clean, dry space. Cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic.
- D. Solid state soft starter shall be handled in accordance with manufacturer's recommendations to avoid damaging equipment, installed devices, and finish.

PART 2 - PRODUCTS

2.01 SOLID STATE SOFT STARTER

- A. GENERAL.
 - 1. The Soft Starter shall be designed for use with a standard three-phase, three-wire, squirrel cage, induction motor. The unit shall be microprocessor based and programmed to slowly increase the voltage to the motor over an adjustable acceleration time, providing a shock free, smooth acceleration, while drawing the minimum current necessary to start the motor. The Soft Starter shall be equipped with an internal by-pass contactor that will close at the end of acceleration time, thus reducing heating and saving power.
- B. ACCEPTABLE MANUFACTURERS.
 - 1. The Soft Starter shall be a Solcon Industries Ltd. Model Number RVS-DX 85 -480-115-8-S with conformal coated control boards.

C. TECHNICAL SPECIFICATIONS

1. GENERAL

- a. Supply Voltage (Vn): 480V +10%-15%
- b. Frequency: 45 – 65 Hz
- c. Control Supply: 115V +10% -15%
- d. Load: 60 HP three phase, three wire, induction motor.

2. START-STOP PARAMETERS

- a. Starters shall be rated for a minimum of :
 - i. 4 (four) starts per hour.
- b. Starter FLC: 85 Amps.
- c. Motor FLA: 70Amps (60 HP motor).
- d. Start/Stop Profile: Field Programmable
- e. Kick Start: A pulse of 80% Vn, adjustable range 0.1-1 Sec.
- f. Initial Voltage: 10-50% VN
- g. Initial Current: 100-400% of Motor FLA
- h. Current Limit: 100-400% of Motor FLA
- i. Acceleration Time: 1-30 Sec
- j. Deceleration Time: 1-30 Sec

3. MOTOR PROTECTION

- a. Too Many Starts: Maximum number of starts, range: OFF or 1-10, during a time period of 1-60 min.
- b. Starts inhibit: Period of 1-60 min, during which starting is prevented, after too Many Starts Fault.
- c. Long Start Time: Maximum allowable starting time 1-30 sec.

- d. Over Current (Instant): Two operation functions: during starting trips the starter at 850% and during running at 100-850% In, both within one Cycle (after internal delay).
- e. Electronic O/L (I² t): Adjustable 75-150% of motor FLA, adjustable Trip time at
- f. Under Current: Trips when current drops below 20-90% In, time delay 1-40 sec.
- g. Under Voltage: Trips when main voltage drops below 50-90%, time delay 1-10 Sec. w/ optional automatic reset.
- h. Over Voltage: Trips when main voltage increase above 110-125%, time delay 1-10 sec.
- i. Phase Loss, U/O Freq: Trips when one or two phases are missing and frequency is below 40Hz. or above 65Hz w/ optional automatic reset.
- h. Phase Sequence: Trips when phase sequence is wrong
- j. Shorted SCR: Prevents starting / trips if motor is not connected or incorrectly connected to the starter, or in case one or more SCRs have been shorted
- k. Heat Sink Over temp: Trips when heat-sink temperature rises above 85°C.
- l. External fault: Trips when an External Contact closes for 2 sec.

4. CONTROL

- a. Control Interface Module (CIM) – EMA71
- b. 2 line x 20 character LED back-lit LCD display, option K5
- c. Fault Contact: 3A, 240VAC
- d. Run Contact: 3A, 240VAC

5. TEMPERATURE/HUMIDITY

- a. Operating Temp.: -30° to 50°C

- b. Storage Temp.: -50° to 70°C
- c. Humidity: <95% non-condensing

6. STANDARDS

- a. Dielectric Test: 2500VAC
- b. EMC Emissions: EN 55011 CISPR 11 Class A
- c. EMC Immunity: EN 55082-2 ESD 8KV air, IEC 801-2 Electric RF field 10 V/m, 20-1000MHz, IEC 801-3 Fast transients 2KV, IEC 801-4
- d. Safety EN 600947-1 Related to safety requirements. Designed and assembled to conform with UL508C.

PART 3 - EXECUTION

3.01 GENERAL

- A. Installation shall be performed by the Contractor:
 - 1. Install per manufacturer's user manual.
 - 2. Install required safety labels.
 - 3. Refer to other specifications as depicted in Section 16445.

3.02 WARRANTY

- A. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for a period of twelve (12) months from date of commissioning or eighteen (18) months after shipment, whichever occurs first.

3.02 START UP

- A. Services for manufacturer's representative shall be as per Specific Provisions SP-81.

END OF SECTION

SECTION 16850

CONTROL AND WIRING FOR PACKAGED UNITS

PART 1 - GENERAL

1.01 GENERAL

- A. The electrical requirements for packaged equipment shall be supplied as complete factory assembled units that require only external connections for installation. They shall include all electrical features necessary for the proper functioning of the units.

1.02 STANDARDS

- A. All control components shall comply with the latest ANSI, IEEE, and NEMA standards wherever applicable. The assemblies shall be listed as complying with the requirements of U.L., Inc., or other recognized testing organizations, for the particular service to be encountered, where possible.
- B. The conduit and wiring on each unit shall be in accordance with the Workmanship and Materials section headed "Conduit, Wire and Grounding," unless otherwise shown or directed.
- C. The Contractor shall be responsible for providing conduits and wires for field wiring of all the control devices to the packaged units whether such control devices are specifically shown or not. The Contractor shall include in his bid cost for installation and connections of all electrical equipment like control panels, switches, auxiliary control devices, conduit and wires, and all other appurtenances as required.

PART 2 - PRODUCTS

2.01 ELECTRICAL CHARACTERISTICS

- A. Controls for each unit having motors of 1/2 horsepower or larger, except as noted, shall consist of combination circuit breaker and magnetic starter, along with all required control transformers, relays, timers, heaters, and other necessary incidentals to provide a complete functioning unit. Motors shall be designed for 480-volt, 3-phase, 60-Hertz operation with all controls at 115 volts or less.
- B. Controls for each unit having motors of less than 1/2 horsepower shall be provided with 120-volt, single phase, toggle type thermal manual motor starter with neon pilot light.

- C. All controls and equipment shall meet the requirements of the appropriate Workmanship and Materials sections contained herein.

2.02 ENCLOSURES

- A. Principal control components shall be installed in NEMA rated enclosures as follows:

<u>AREA</u>	<u>ENCLOSURE</u>
All areas listed Class I, Group C, D	NEMA 7 - Explosion-proof
Outdoor and below grade elevation indoor	NEMA 4X - Watertight
Above grade indoor	NEMA 12 – Industrial

2.03 AUXILIARY CONTROL DEVICES

- A. Float switches, pressure switches, limit switches, thermo-stats, and other auxiliary control devices shall be of the heavy-duty type and rugged enough to satisfy the intended service. All contacts shall be rated at 10 amperes, 120 volts, 60 Hertz a-c, unless otherwise specified. Where adjustable, the devices shall be conveniently set and the setting secured firmly. Limit switches shall function in accordance with contact development charts.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Packaged units shall be installed in strict accordance with the manufacturer’s recommendations.
- B. Packaged units shall be installed plumb on wall.
- C. Packaged units shall be installed in a location which insures minimum NEC clearances for operation and maintenance are provided.

3.02 PAINTING

- A. Enclosures for electrical controls and connecting conduit shall be finished in accordance with Workmanship and Materials section headed “Painting.”

END OF SECTION

E-Mail to Register as a Plan Holder and E-Mail All Questions to: ContractAdministration@tampagov.net

Sign-In Sheet Please Print

City of Tampa, Contract Administration Department

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