

DIVISION 13

SPECIAL CONSTRUCTION

INDEX

<u>Section</u>	<u>Title</u>
13325	Process Instrumentation and Control Products
13425	Pump Control Panel
13465	Sequence of Operations

[This Page Intentionally Left Blank]

SECTION 13325

PROCESS INSTRUMENTATION & CONTROL PRODUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 0 and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY OF WORK

- A. This Section of the Specifications includes process instrumentation and control products, instruments, devices, and accessories associated with Process Instrumentation and Control Systems.
- B. The work covered under this Section of the Specifications includes furnishing all plant, labor, equipment, instruments, devices, appliances, hardware, software, accessories, incidentals and materials, and in performing all operations in connection with the furnishing, installation, calibration, testing, certification, and training of all instruments, equipment, devices associated with the process instrumentation and control systems, complete in place, in accordance with the Specifications and Drawings, by the City's instrumentation and control system integrator/supplier (Northeast System Controls) as specified in Section 13320.
- C. All work provided by the Integrator shall be done in harmony with the Contractor, Contractor's sub-contractors, Engineer, Owner (City), and Owner's existing SCADA system.
- D. All work shall be done in accordance with the National Electric Code, National Electric Safety Code, Occupational Safety and Health Administration, Underwriters Laboratories, Inc., International Society of Measurement and Control, National Electric Manufacturers Association, and all other state and local codes.
- E. Related sections includes the following:
 - 1. Division 11 – Equipment
 - 2. Division 13 – Special Construction
 - 3. Division 16 – Electrical

- F. Work not included:
1. Electrical conduit, relays, etc., required for operation of the equipment shall be furnished and installed under Division 16 of these specifications.
 2. All electrical devices furnished under this Section shall be installed under Division 16.
 3. The power connections to all electrical devices furnished under this Section shall be performed under Division 16.
 4. Installation of process equipment, pumps, piping, valves, fittings, and appurtenances shall be covered under Division 11.

1.3 SUBMITTALS

- A. In accordance with Section 01300 – Submittals.
- B. Component specifications, manufacturer's descriptive literature, shop drawings, and ISA-S20 data sheets for all devices/equipment being furnished. The information shall clearly indicate all pertinent design data for Engineer to evaluate conformance with the Specifications. Devices shall reference the tagging convention used in the Design Documents.
- C. Component drawings showing dimensions, mounting and external connection details, including external piping and/or wiring for all field and pipeline mounted equipment.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Control, delivery, storage, and handling of equipment in accordance with Sections 01600 and 01610.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION GENERAL

- A. All instrumentation and electronic equipment shall be UL approved and of the manufacturer's latest proven design, utilizing printed circuitry and epoxy coating (or equal) to prevent contamination by dust, moisture and fungus. First generation equipment with less than three years general use shall have documentation on construction, operation, field test, and user list.
- B. All equipment and devices furnished hereunder shall be designed for continuous industrial service and shall be of modular construction capable of field expansion.
- C. All equipment shall be suitable for operation in the environment of the project. All equipment shall be suitable for wastewater environments. Equipment installed inside

or within 3 feet of the wet well shall be Class 1, Division 1 rated. Equipment installed an additional 2-foot outside Class 1, Division 1 areas and equipment installed inside the valve vault shall be Class 1, Division 2 rated. Solid state components shall be conservatively rated for their purpose, to provide reliable (>90%) performance over ambient atmospheric temperature between 0-140 degrees Fahrenheit and 0 to 95 percent relative humidity. All indoor control panel-located electronics (inside pump station building only) shall be suitable for operation in ambient temperatures of 40 degrees F to 120 degrees F. All field electronics and outdoor panel equipment shall be suitable for operation in ambient temperatures of -40 degrees F to 140 degrees F.

- D. All electronic instrumentation shall utilize transmission signals (to and from) of isolated 4 to 20 mA DC, unless otherwise approved by the Engineer.
- E. All electronic/digital shall be provided with radio frequency interference protection.
- F. Indicators, controllers, integrators, relays, and other receiving devices when operating in a loop shall be of a design such that a failure of an individual device shall not affect the operation and integrity of the remaining functions. All indicators, either remote or panel mounted, shall have an individual, internal on-off switch.
- G. All equipment necessary to complete the functional requirements shall be supplied by the equipment or systems supplier and shall be of the same manufacturer as the controllers, indicators, and recorders unless otherwise specified (e.g. signal converters, integrator, computing devices, alarm trips, etc.).
- H. All instruments and equipment shall be provided with suitable mounting hardware, floor stands, wall brackets, panel racks, and rails.
- I. All instrument air and fluid fittings and valves necessary for operations shall be suitable and compatible for the process fluids being contacted.
- J. All necessary fuses and 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 internal on/off switch.
- K. All conductors running from the field to control panels shall be of a single, continuous length, without splices, except at approved junction boxes. Special care shall be exercised to carry grounding lines through such junction boxes with the least possible resistance.
- L. Metal nameplates shall be provided on all field-mounted elements, indicators and transmitters. Wording and sizing of nameplates shall be as described in Section 13320.

M. Instrument Summary List:

SECTION	INSTRUMENTATION	TYPE
2.2	Level	Level/Float Switches

2.2 LEVEL INSTRUMENTS

A. Level/Float Switches

1. Direct-acting, normally open, mercury-free type float switch with polypropylene housing and PVC-jacketed type SO cable of sufficient length to directly reach the Pump Control Panel. Float switch shall have two (2) Form C dry contacts. Float switch shall be intrinsically safe and suitable for corrosive sewage environments and submerged conditions. Class I, Division 1, Group D rated.
2. Manufacturer: Conery 2900-B8-S1-C1-50 or Engineer approved equal.

2.3 MISCELLANEOUS EQUIPMENT

A. Spare Parts

1. Spare parts shall be provided as a part of the start-up services during the initial start-up and phase-in period. These items shall include accessories such as fuses, electrodes, membranes, fluids, charts, ink, lights, etc. required to start-up and operate the system for a period of 60 days. These items shall be packaged in separate containers and shipped to the job site with the instruments and shall be tagged "INSTRUMENTION START-UP EQUIPMENT."
2. Spare parts and accessories above and beyond those being provided for start-up services shall be provided under this Section. All spare parts shall be packaged and shipped at one time. Separate shipment of spare parts shall not be acceptable. The Engineer shall be notified of the shipment release in writing indicating that all items have been shipped. Each item shall be checked by the Engineer as being received and that all components have been provided as specified.
3. A one year supply of consumables and replacement parts required for all instruments, analyzers, and devices being furnished for the system. A list of spare part to be included in the one year supply of consumables and replacement parts shall be provided to the engineer during the shop drawing approval stage. Consumables and replacement parts shall be those over and above that which have been specifically identified in this section.
4. Refer to Section 13320 for additional spare part requirements.

PART 3 – EXECUTION – NOT USED

END OF SECTION 13325

SECTION 13425

PUMP CONTROL PANEL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplemental Conditions, Division 0 and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY OF WORK

- A. The Work of this Section shall include all labor, materials, and equipment required to provide a complete pump control system and associated instrumentation. A single Instrumentation and Control System Supplier shall provide all labor, materials, equipment and services required to achieve this scope as specified herein and within the Contract Documents.
- B. The work shall include panel for the Clapboardtree Street Sewage Pumping Station Upgrade located in Westwood, Massachusetts.
- C. The work shall include an interface for equipment provided under other Sections of the Contract Documents. In order for the equipment furnished and installed within this Section to function as a complete system there shall be close coordination with other equipment furnished under other Sections of the Contract Documents.
- D. Provide and configure a new pump control panel that shall include, but not be limited to, pump controls, power distribution equipment, motor starters, surge protection devices, relays, indication lights, and operator controls.

1.3 SUBMITTALS

- A. Detailed submittal packages identifying the equipment to be supplied and its operation shall be furnished. The intent of the submittals is to ensure complete project scope coverage and does not relieve the Instrumentation and Control System Supplier from fulfilling any specified requirements. The submittal shall consist of legible printed text and high quality CAD drawings printed in electronic PDF form. The Instrumentation and Control System Supplier shall submit the following items in accordance with SECTION 01330 – SUBMITTALS:

- 1. Hardware and Panel Drawings. This submittal shall include data sheets and manufacturer's literature on the proposed equipment and devise to meet the requirements of this Section. Provide a listing of all significant equipment to be supplied followed by descriptive data sheets. The list shall include each component name, manufacturer, model number, a description of the operation, quantity supplied, and any special set up, operation or maintenance characteristics. Include in this submittal system panel layout and wiring drawings. Drawings of equipment

to be supplied shall include, as a minimum, overall dimension details for each unit including installation arrangements and door mounted operator devices including nameplate designations. Wiring diagrams of all control panels and other system equipment including field device connections shall be included and specific installation wiring responsibilities identified. A list of spares, expendables and test equipment shall be included in this submittal.

B. Submittals shall include at least the following:

1. Data sheets for each piece of equipment following ISA S20 format as applicable.
2. Manufacturer's data, order sheet or equivalent for each individual instrument, control panel, or device being supplied. The information shall include but not be limited to model number, exact chart, scale or calibration range, type of enclosure and mounting, input/output and power data and the instrument tag number (or loop number for auxiliary equipment). Sales literature will not be accepted.
3. Scaled layout drawings for control panels, including interfacing details for equipment to be supplied.
4. The Instrumentation and Control System Supplier shall clearly identify in the Project Plan any exception to the Contract Documents. Failure to do this will be grounds for rejection of the submittal.

C. Manufacturer's literature and brochures shall be submitted for all items to be furnished in accordance with the provisions of Section 01300 – Submittals

1.4 QUALITY ASSURANCE

- A. The supply of the pump control panel shall be by a Instrumentation and Control System Supplier. The supplier shall be responsible to the Contractor for: (1) satisfactory detailed design of a complete and coordinated pump control system (2), start-up and testing services, (3) training, and (4) services to assure satisfactory operation.
- B. The Contractor shall not purchase separate equipment and attempt to assemble a system. This Work is to be performed by a qualified Instrumentation and Control System Supplier as approved by the Engineer.
- C. All internal wiring of the control panel(s) shall be done by the Instrumentation and Control System Supplier in accordance with the drawings and instrument manufacturer's instructions and UL requirements.
- D. All work shall be executed in full accordance with UL requirements and codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Instrumentation and Control System Supplier and ultimately the Contractor shall bear full responsibility for such violations and assume all costs arising there from this situation.

E. Factory Testing

1. Factory Testing shall be performed as specified herein and as directed in the approved Testing Plan Submittal.
 2. The Instrumentation and Control System Supplier shall conduct an unwitnessed factory test. A simulated system layout that includes all equipment and interconnections shall be arranged to perform all system functions to the maximum extent practicable. The specified functions of the instrumentation and control system shall be verified for each loop and for each applicable paragraph in the specifications. The Instrumentation and Control System Supplier shall notify the Engineer in writing upon completion of the unwitnessed factory test. The Instrumentation and Control System Supplier shall submit to the Engineer a certified unwitnessed factory test report. No equipment shall be shipped from the factory without approval of the unwitnessed factory test report
- F. The Instrumentation and Control System Supplier shall be one of the following pre-qualified Instrumentation and Control System Supplier's listed in alphabetical order. Only pre-qualified Instrumentation and Control System Suppliers shall be allowed to provide the Contractor with a price for inclusion in the General Bid.

1. Electrical Installations, Inc.
Moultonboro, New Hampshire
603-253-4525
2. Harbor Controls
North Kingstown, RI
401-667-0930
3. R. E. Erickson Co., Inc.
Walpole, Massachusetts
508-668-9330

G. WARRANTY

1. The manufacturer shall guarantee all system equipment for a period of one year from the date of final acceptance.

1.5 DESIGN CRITERIA

- A. The Contractor shall provide a complete and operational system. This equipment shall be provided as described in this Section. It shall be the Contractor's responsibility to coordinate the installation of this equipment with all other associated equipment and to provide for a complete and operational system.
- B. The Work of this Section shall require field equipment interconnections. This Section shall describe the field equipment for interconnections but does not detail each specific point-to-point connection. It shall be the Contractor's responsibility to verify and coordinate final connections to all equipment.

- C. Control panel enclosures and components shall be Underwriters Laboratories (UL) recognized or listed, where such components are available. The complete control panel assembly shall be constructed by an accredited UL-508 fabrication and wiring assembly shop in accordance with UL-508 and related UL standards.
- D. The Work of this Section shall adhere to the requirements of the standards listed below as applicable. The latest edition in effect at the time of bid opening shall apply.
 - 1. American Petroleum Institute (API)
 - 2. The Instrumentation, Systems and Automation Society (ISA)
 - i. ISA S5.4, Instrument Loop Diagrams.
 - ii. ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - iii. ISA RP60.3, Human Engineering for Control Centers
 - iv. ISA RP60.6, Nameplates, Labels, and Tags for Control Centers
 - 3. National Electrical Manufacturers Association (NEMA)
 - 4. National Fire Protection Agency (NFPA)
 - i. NFPA 70, National Electrical Code (NEC).
 - ii. NFPA 79, Standard for Industrial Machinery.
 - 5. Underwriters Laboratories, Inc. (UL)
 - i. UL 508, Standard for Industrial Control Equipment.
 - ii. UL 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.
 - 6. American Society for Testing and Materials (ASTM)
 - i. ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

1.6 OPERATION CRITERIA

A. WETWELL LEVEL MONITORING

- 1. Five of the following gfloat type level switches shall be located in the wetwell and wired through an intrinsically safe relay.
 - i. High Alarm Float Switch (LSH-101)
 - ii. Lead Pump On Float Switch (LSH-103)
 - iii. Lag Pump On Float Switch (LSH-102)
 - iv. Lead/Lag Pumps Off Float Switch (LSL-104)
 - v. Low Alarm Float Switch (LSL-105)

2. The intrinsically safe relay shall be located within a separate intrinsically safe panel. A contact from each of the intrinsically safe relays shall be wired via interposing relays for the pump control wiring and the following lights and interface signals.
3. Door Mounted Indication Lights and Beacon Alarm.
 - i. Wet Well High Alarm
 - ii. Wet Well Low Level Alarm
4. Dry Contact SCADA Interface Signals
 - i. Wet Well High Alarm
 - ii. Wet Well Low Level Alarm

B. PUMP OPERATION

1. The pump operation shall be automatically controlled by the pump controller via hardwired relay logic controls.
2. Pump #1 and Pump #2, shall be capable of being assigned Lead, Lag and Alternate via a control door mounted hand switch. If pump alteration is enabled the lead pump selection shall cycle through the next assigned status on the stop/start of the assigned lead pump via an alternating relay.
3. Hand-Off-Auto (H-O-A) selector switches will be located on the control panel door. When the switch is in the "Auto" position the associated pump shall be controlled as described below.
4. The lead pump shall come on when level in the wet well exceeds the Lead Pump On float switch (LSH-103) and shall run until the level drops below the Lead/Lag Pump off float switch (LSL-104).
5. The lag pump shall come on when level in the wet well exceeds the Lag Pump On float switch (LSH-102) and shall run until the level drops below the Lead/Lag Pump off float switch (LSL-104).

C. PANEL POWER FAILURE

1. Loss of the incoming AC power to the panel shall be indicated by door mounted LED light via a interposing power relay.

D. ALARM BEACON/SIREN

1. A 120VAC alarm beacon shall be mounted on top of the electrical enclosure. The beacon will be activated on upon any new alarm condition and stay activated until manually acknowledged via a panel mounted alarm reset pushbutton. The following alarms shall be wired into the alarm beacon/siren circuit control:
 - i. Pump #1 failure (Overload and High Motor Temperature).

- ii. Pump #2 overload (Overload and High Motor Temperature).
- iii. Wet well level high.
- iv. Wet well level low.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Upon completion of shop assembly and testing, all control panels shall be enclosed in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving the equipment without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.
- B. Special instructions for proper field handling and installation required by the manufacturer for proper protection shall be securely attached to each piece of equipment prior to shipment.
- C. Each package shall be tagged to identify its location and function in the system. Identification shall be prominently displayed on the outside of the package.
- D. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters and, including in-line equipment, shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired or the damaged equipment replaced by the Contractor at the Contractor's cost and expense. If any apparatus has been subject to possible damage by water, it shall be thoroughly dried out and put through such tests as directed by the Engineer at the Contractor's cost and expense, or the apparatus shall be replaced by the Contractor at the Contractor's cost and expense.
- E. All materials shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance

PART 2 –PRODUCTS

2.1 GENERAL

- A. All equipment shall be of the latest proven design. First generation equipment with less than three years general use shall have documentation on construction operation, field test and user list.
- B. All equipment shall be suitable for operation in the environment of the Project.
- C. All panels shall be completely assembled and wired at the Instrumentation and Control System Supplier's factory. All panels shall be UL listed and labeled.
- D. The operation criteria descriptions herein do not specify all hardware required for complete system operation. It is the responsibility of the Instrumentation and Control System Supplier to provide all necessary equipment for complete systems.

- E. All equipment necessary to complete the functional requirements of this Section shall be supplied by the Instrumentation and Control System Supplier and be of the same manufacturer to the maximum practical extent unless otherwise specified.
- F. All external connection points shall be made at terminal blocks with No. 6-32 or larger screws.

2.2 PUMP CONTROL PANEL (PCP)

- A. Provide a custom PCP pump control panel capable of controlling two separate 3 HP, 1-Phase, 240 Volt submersible sewage pumps. The panel shall contain but be not limited to a main power circuit breaker with through panel disconnect, distribution pump circuit breakers, motor starters, relays, selector switches, indicating lights, pump controls, etc.
- B. A 120/240V volt, 1-phase, 3-wire, 60 amp power feed shall be provided to the control panel. Provide a lug for grounding connection of up to a No. 1/0 AWG conductor.
- C. Panel Enclosures
 1. Control panel shall be NEMA 12 constructed from 10 gauge steel. All seams shall be continuously welded and smooth. Doors shall have three point latching mechanism with vault type operating handle, continuous heavy duty hinges and provisions for pad locking. Door gaskets shall be neoprene attached with oil resistant adhesive. Panel dimensions shall not exceed 36" wide x 48" in height.
 2. The panels shall be free of dents or other defects.
 3. The panels shall have an angle frame. The frame and shell shall be welded construction.
 4. Data storage pockets shall be provided on the inside of each panel and shall be of sufficient size to hold all of the prints required to service the equipment.
 5. Each panel shall be provided with a key lockable front handle. Provide gaskets as required to maintain the panel NEMA rating as specified herein.
 6. Provide a door stop kit for the panel to secure the door in the 90-degree open position.
- D. All wiring within the panel shall be grouped together in harnesses and secured to the structure. Terminal blocks shall be provided for all external connections to the control panel and for all connections between the component mounting plate and enclosure mounted components to allow for easy removal of the component mounting plate if required for service. Terminal blocks shall consist of individual snap together contact sections mounted on a common mounting channel. Terminal block sections shall have tubular screw contacts mounted in a nylon housing to resist breakage; phenolic or other rigid, brittle materials shall not be considered equal. Plan screw contacts requiring lugs to be installed on wires shall not be considered equal.

- E. A complete master wiring diagram and elementary or control schematic shall be furnished and submitted for approval prior to manufacturing. Diagram shall indicate at a minimum the power distribution circuit, pump power/control circuits, terminal and wire numbers, control devices, and pilot lights.
- F. Circuit breakers shall be molded case, three pole with voltage and ampere ratings as required. A through door handle distribution circuit breakers for each pump shall be provided. The interrupting capacity shall be not less than 20KA, RMS symmetrical.
- G. Mount and wire within the pump control panel an existing Veris H8036 power transducer current and voltage transformer on the load side of the control panel main circuit breaker. Wiring shall be per manufacture wiring diagram, coordinate with the Electrical Contractor for delivery of the existing power transducer for installation at the pump control panel factory shop.
- H. Provide a in line motor starter for each pump. Motor starters shall be single phase, 60 Hertz, 240 Volt, open style, UL listed full voltage non-reversing type with electronic overload protection and rated for motor horsepower size for the new submersible pumps. Each motor starter shall have auxiliary run and overload status dry contact.
- I. Mount and wire within the pump control panel the pump manufacture provided 1-phase pump starter kit components consisting of (1) run capacitor with bracket, (1) start capacitor with bracket and end cap, (1) discharge resister, (1) start contactor, and (1) start relay. Wiring shall be per manufacture wiring diagram, coordinate with the pump manufacture for space requirements and delivery of the starter kits for installation at the pump control panel factory shop.
- J. A hand-off-automatic selector switch for each pump and pump lead and alternate selector switch shall be provided. Selector switches shall be three position maintained type of heavy duty oil-tight construction. Toggle switch types shall not be considered equal. Selector switch contacts shall be heavy duty, double-break, silver. Switches shall be mounted through the control panel enclosure
- K. Pump running indicating, pump overload, alarm, and status indicating lights shall be provided and be heavy duty, oil tight, push to test LED type.
- L. Provide Elapsed Time Meters shall be non-reset meter for each pump to indicate elapsed time of operation of the pump from 0 to 99,000.9 hours. The meters shall be mounted through the pump control panel enclosure.
- M. Provide all controls, indication lights, and accessories as shown on the equipment motor wiring diagrams in the contract electrical drawings. A time delay relay for pump motor over temperature and a resistive float relay for pump seal failure shall be provided in the Pump Control Panel.
- N. The Instrumentation and Control System Supplier shall provide all instrument devices necessary for proper pump operation. This shall include all signal conditioning, signal isolation, surge/lightning protection and operational equipment for the system.

- O. All control and alarm circuitry for shall be complete, including all necessary auxiliary relays, contactors, and isolation so as to require only wiring and connections to the equipment control circuit. All contacts for control of motor-operated or electrically operated equipment shall be rated not less than 1200 VA (10 ampere at 120 volts) unless otherwise specified herein.
- P. Nameplates and Nametags
 - 1. Nameplates shall be provided for all front mounted equipment. The nameplates shall be approximately 1 inch by 3 inch and shall be constructed of black and white laminated, phenolic material having engraved letters approximately 1/4 inch high extending through the black face into the white layer. Nameplates shall be attached to panels by self-tapping stainless steel screws or rivets. Nameplates shall be provided for each panel identifying the panel and shall be located at the top center of the panel. Size of the nameplate shall be as required for proper visual identification.
 - 2. Nametags shall be provided for all equipment located within the control panel. Each and every device shall be tagged with permanently attached nametags with identification reference that shall correspond to all drawings and wiring diagrams for the system. The nametags shall be neatly installed and shall be clearly visible for service and maintenance of the equipment.
- Q. All panel equipment shall be pre-piped and/or pre-wired on or within the cabinet. All wiring shall comply with local and National Electrical Code requirements and shall be in open bundles wired to numbered terminals. Each cabinet shall have at least 25 percent spare additional terminals. A plug-in header with convenience outlets and flexible plug-in leads shall be supplied for each instrument power supply. An overhead, internal, gasketed fluorescent light shall be provided. Cabinet layouts shall be submitted to the Engineer for approval. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.
- R. All equipment shall be designed and constructed so that, in the event of a power interruption, the equipment provided under this Section shall resume normal operation without manual resetting of alarms or power source when power is restored. Therefore, no alarm points shall be activated upon restoration of power after a normal power outage unless it is a true alarm condition. Provide all devices or programming required to maintain this requirement.
- S. Terminal strips shall be provided for the purpose of connecting all control, power, and signal wiring. Provide separate terminal strips for each in order to isolate the different wiring types (power, control, and signal). All terminal strips shall be completely labeled and numbered throughout for each and every unit. Direct inter-wiring between equipment will not be allowed.
- T. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 3 inches of the side panel or 6 inches of adjacent terminal. Wiring troughs shall not be filled to more than 60 percent visible fill. Wiring trough covers shall be match marked to identify placement. If component

identification is shown on covers for visibility, the identification mark shall also appear on the mounting sub-panel. All wiring shall be kept to the upper 3/4 quarters of the control panel.

- U. All miscellaneous components shall be heavy-duty industrial type, or equal. Mounting hardware shall be stainless steel or cadmium plated. All cutouts shall be made true and square with no ragged cuts. The finished cutout shall be deburred, with no sharp edges. All welds shall be ground smooth and be deburred with no sharp edges. Welding on the panel face should be minimized. Adequate stiffness and supports shall be provided to insure a rigid stable structure.
- V. The finished enclosure shall be properly degreased, prime painted (2 coats) and finish painted (2 coats) in accordance with the paint manufacturer's instructions, prior to the installation of equipment. The final finish shall be smooth, free of runs, and uniform in tone and thickness. Two, one-pint containers of each color used shall be supplied with the panel for field touch up.
- W. Provide a LED lighting fixture inside at top of panel with light switch.
- X. All wire ends shall be identified at both ends with wire markers.
- Y. Provide ground lug.

2.3 GENERAL EQUIPMENT

A. Electrical Relays

1. Electrical relays for handling power circuits shall be general purpose equal to IDEC, Omron, Allen-Bradley, Potter & Brumfield, or Engineer approved equal. Relays handling control, telemetering or alarm functions shall be heavy-duty, plug-in type, complete with dust and moisture proof enclosure equal to IDEC, Omron, Allen-Bradley, Phoenix Contact, Potter & Brumfield, or Engineer approved equal. Units shall be provided with integral indicating light to indicate if relay is energized. Units shall have DPDT relay contacts and be rated for 10 A at 120 VAC, 10 A at 24 VDC.
2. Time delay relays shall have DPDT relay contacts and be suitable for on-delay or off-delay operation. Rated load shall be 10 A at 120 VAC, 10 A at 24 VDC. Units shall be provided with integral time-delay adjustment knob. Relays shall be provided with dust and moisture resistant covers. Relays shall be suitable for operating in a temperature range from -30° to 55° C. Units shall be adjustable and available in a single range or multiple ranges from 0.1 second to 1 hour. Time delay time relays shall be true-off and true-on type delay relays and UL listed. Mounting sockets matched to relay and mounting rails/holders shall be provided as required. Time delay relays shall be manufactured by IDEC, Allen Bradley, or Engineer-approved equal
3. Resistive float switch relays shall be a single channel seal failure module that senses the position of a resistive float switch that when the resistance drops below

the sensitivity rating the relay output energizes. The relay shall have 4.7 KOhm to 100 KOhm sensing resistance adjustment knob, a DPDT relay contact, and a LED for when energized. Rated load shall be 10 A at 120 VA. Relays shall be suitable for operating in a temperature range from -20° to 55° C. Mounting sockets matched to relay and mounting rails/holders shall be provided as required. Resistive float switch relays shall be SPM series as manufactured Diversified Electronics or Engineer-approved equal

B. Intrinsically Safe Panel

1. Provide a 12" x 12" panel to house intrinsically safe current intrinsically safe relays. The panel shall have din-rail mounting terminal strips for all wiring and shall receive power from the pump control panel.
2. Intrinsically Safe Relays (IS Relays)
 - i. Din rail mounted intrinsically safe relays shall be furnished for interconnection of each float switch located in the wet well.
 - ii. Operating voltage shall be 115 or 230 VAC, 50/60 Hz.
 - iii. Load contacts shall be double pole, double throw and shall be rated for 10 amperes resistive load or 3 amperes inductive load at 120 VAC.
 - iv. The intrinsically safe control circuit shall be approved by Factory Mutual and the Canadian Standards Association for Class 1, 119 111; Division 1; Groups A, B, C, D, E, F, G hazardous locations.

2.4 SPARE PARTS

- A. Spare parts shall be provided as a part of the start-up services during the initial start-up and phase-in period. These items shall include accessories such as fuses, circuit breakers, power supplies, lights, etc. required to start-up and operate the system for a period of 60 days. These items shall be packaged in separate containers and shipped to the job site with the instruments and shall be tagged "PUMP CONTROLPANEL START-UP EQUIPMENT".
- B. Spare parts above and beyond those being provided for start-up services shall be provided under this Section. All spare parts shall be packaged and shipped at one time. Separate shipment of spare parts shall not be acceptable.
- C. Furnish one box of spare fuses of each type supplied. A box shall consist of a minimum of 12 fuses.
- D. Furnish six spare pilot light lenses and six spare LEDs of each color and type supplied.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The panels shall be installed in accordance with the best field and shop practices.

- B. The workmanship shall be in accordance with the best field and shop practices for instrumentation and control systems.
- C. All workmen shall be skilled in the work to which they are assigned and all work shall be performed under the direct supervision of an experienced and competent Instrumentation and Control System Supplier foreman
- D. Lifting rings from cabinets/assemblies shall be removed. Hole plugs shall be provided for the holes of the same color as the cabinet

3.2 TESTING AND COMMISSIONING

- A. The Contractor shall arrange for and obtain the services of a factory trained and qualified service engineer(s) from the Instrumentation and Control System Supplier to perform the testing, calibration and commissioning of the control panels.
- B. The control panels with field instrumentation, as a unit, shall be tested for proper installation, interconnection, and function as specified in the Contract Documents. The devices shall be checked for correct installation, interconnection and functional operation. After all devices are checked as noted, then the control system shall be checked to verify correct operation as a unit. Equipment and control checkouts shall be the responsibility of the Instrumentation and Control System Supplier and the supplier of the equipment.
- C. Prior to electrical check out all breakers, switches and similar disconnect devices shall be placed in the off position.
- D. Control panel and other equipment grounding shall be verified. The systems shall be checked for improper or accidental grounding.
- E. Visual inspection and continuity testing shall be made to verify that no damaging wiring errors occur between power and signal wiring.
- F. Prior to actuating a final control element (e.g., pump) the Contractor shall obtain permission from the Engineer and any other involved contractors to prevent damage to associated equipment. The factory service personnel shall verify the calibration and direction of the final control element in accordance with the requirements for each portion of the system.
- G. Before witnessed functional acceptance testing commences, the Instrumentation and Control System Supplier shall conduct an unwitnessed functional acceptance test. The control panel shall be checked for correct functional operation. Upon satisfactory completion of the unwitnessed functional acceptance test, the Instrumentation and Control System Supplier shall certify in writing to the Engineer that the instrumentation and control system is ready for witnessed functional acceptance testing. The Instrumentation and Control System Supplier shall base the certification upon successful testing of the control panel for each applicable paragraph in the

specifications. The Instrumentation and Control System Supplier shall submit to the Engineer a certified unwitnessed functional acceptance test report.

- H. A witnessed functional acceptance test shall be performed to confirm that the control panel is performing according to the specifications. The devices shall be checked for correct functional operation, and then the entire system to verify correct functional operation. The specified functions of the control panel shall be verified for each piece of equipment. The testing shall be performed in the presence of the Engineer. A two-week written notification shall be provided to the Engineer to allow for scheduling the testing.

3.3 CONTRACT CLOSEOUT

- A. Provide in accordance with Section 01700 – Contract Closeout
- B. Operation and Maintenance Manuals

- 1. Operations and Maintenance Manuals shall include product manuals for each piece of hardware provided, a set of final drawings (in print and on disk), copies of all manufacturer supplied software registered in the Owner's name, customized software configurations, and a written description of normal and emergency operations and control for the complete system. The material shall be submitted in three-ring binders that are a maximum of three inches thick. The Operations and Maintenance Manual shall be a custom product for this project. A generic Operations and Maintenance Manual shall not be acceptable.
- 2. Operation and Maintenance Manuals shall include the following:
 - i. Index.
 - ii. Complete directions on equipment supplied, including: physical description, installation, adjustments, configuration as installed, operation, technical information and servicing including parts list with stock numbers.
 - iii. All material that is to be furnished as part of the Operation and Maintenance Manuals shall be submitted electronically in PDF format. Each bound volume shall be no more than three inches thick. This material shall be furnished complete in one submittal for review and final acceptance.
 - iv. The manuals shall include a functional description of the entire system, including panel drawings that shall reflect "as built" modifications.

END OF SECTION 13425

SECTION 13465

SEQUENCE OF OPERATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS and other DIVISION 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This specification has been developed to describe a basic functional description of each process by means of a loop description. These functional descriptions shall act as a reference for the Contractor and I&C Integrator.
- B. The loop descriptions are intended to provide for system operation. The loops specified under this section describe the general system operating requirements and may not include all required control interlocks or safety shutdowns required based on actual process equipment supplied. The control system supplier shall be responsible for coordinating the actual requirements with the individual equipment manufacturers and providing all control and safety equipment required. Coordinate final loop descriptions with Engineer and equipment manufacturers.
- C. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 1 - General Requirements
 - 2. Division 11 - Equipment
 - 3. Division 13 - Special Construction
 - 4. Division 16 - Electrical

1.3 SUBMITTALS

- A. Submit the following in accordance with the Conditions of Contract and Division 1 Specification Sections and as specified herein.
- B. Submit flow diagrams for the programming of the PLCs.
- C. Submit PLC ladder logic including cross-reference tables, I/O listings, tag names and database configurations.
- D. Submit PLC to SCADA system translation tables including cross-reference tables, I/O listings, tag names and database configurations.

1.4 OPERATIONS AND MAINTENANCE INSTRUCTION MANUALS

- A. Operation and Maintenance Manuals: Submit materials for inclusion in Operating and Maintenance Manuals specified in Division 1.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATIONS

- A. The below Sequence of Operations describes the operation conditions for the Clapboardtree Street Pump Stations.

A summary of alarm conditions and interlocks is provided on I-2 on the Contract Drawings.

- B. Submersible Sewage Pumps:

Two submersible pumps (P-101 and P-102) will pump the contents of the wetwell to the sewage forcemain. The pumps can be operated manually via the SCADA Control Panel.

When in the “AUTO” mode the pumps will start/stop based on the manual floats located in the wet well (LSH-102, LSH-103, LSL-104). The pumps will automatically start/stop based on the float elevations, and the pumps will also automatically rotate lead/lag position every cycle (lead/lag pump position operator adjustable). Daily and total pump runtimes shall be logged in the SCADA system for each pump. Daily pump runtimes shall reset at the start of each day.

The sewer pumps will be installed with a thermal/moisture sensor relays located in the Control Panel. The thermal relay will automatically de-energize the pump in fault and send an alarm signal to the SCADA system. The moisture relay shall send an alarm signal to the SCADA system. The relays will need to be manually reset prior to pump operation.

All PLC alarms will be transmitted to the City’s SCADA system by radio via the SCADA Control Panel.

- C. Wetwell:

The wet well is equipped with a High Level Switch (LSH-101) and a Low Level Switch (LSL-105) to monitor liquid level in the wetwell. The High Level Switch (LSH-101) and Low Level Switch (LSL-105) alarm will be reported in the SCADA system. Alarm conditions will be reported to the SCADA system for high and low level in the wet well.

- D. Interlocks:

Refer to the I-2 of the Contract Drawings and other Sections of Division 13 – Special Construction for equipment interlocks.

- E. Alarms

Refer to the I-2 of the Contract Drawings for a summary of alarms.

END OF SECTION 13465

[This Page Intentionally Left Blank]