

## SECTION 17000

### CONTROL AND INFORMATION SYSTEM SCOPE AND GENERAL REQUIREMENTS

#### PART 1 -- GENERAL

##### 1.01 SCOPE

- A. The Contractor shall provide all hardware and physical installation services for the Instrumentation, Control and Information System. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, and field test the control and information system hardware as shown and/or specified. The Contractor is not required to provide PLC software programming services for the Control and Information System. PLC software programming services shall be provided by the Consultant. The system shall include all measuring elements, signal converters, transmitters, local control panels, digital hardware, remote telemetry units, signal and data transmission systems, interconnecting wiring and such accessories as shown, specified, and/or required to provide the functions indicated.
- B. The scope of the work to be performed under this Division includes but is not limited to the following:
1. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.
  2. Furnish and install local control panels, field panels and associated cabinets and panels as shown on the Drawings and as specified in Division 17.
  3. Furnish and install digital control system hardware as specified in Division 17.
  4. Final termination and testing of all instrumentation and control system signal wiring and power supply wiring at equipment furnished under Division 17.
  5. Furnish, install, and terminate all special cables (instruments, printers, telemetry, etc.). Furnish and terminate control system communication network cables.
  6. Furnish and install surge protection devices for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division, including connections to grounding system(s) provided under Division 16.
  7. Coordinate grounding requirements with the electrical contractor for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under this Division. Terminate grounding system cables at all equipment provided under this Division.
  8. Provide hardware testing, calibration, and startup services as specified herein and as required to make all systems fully operational.

- C. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

## **1.02 RELATED ITEMS**

- A. Field mounted switches, torque switches, limit switches, gauges, valve, and gate operator position transmitters, sump pump controls and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested, and calibrated as specified under other Divisions.
- B. Additional and related work performed under Division 16 includes the following:
  - 1. Instrument A.C. power source and disconnect switch for process instrumentation, A.C. grounding systems, and A.C. power supplies for all equipment, control panels and accessories furnished under Division 17.
  - 2. Conduit and raceways for all instrumentation and control system signal wiring, grounding systems, special cables, and communication network cables.
  - 3. Instrumentation and control system signal wiring.
  - 4. Install control system communication network cables.
  - 5. Furnish and install grounding systems for all digital equipment, local control panels, remote telemetry units, and instrumentation provided under Division 17. Grounding systems shall be complete to the equipment provided under Division 17.
  - 6. Termination of all instrumentation and control system signal wiring at all equipment furnished under other divisions of the Specifications.
  - 7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g. panelboards, motor control centers, and other sources of electrical power).

## **1.03 GENERAL INFORMATION AND DESCRIPTION**

- A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.
- B. In order to centralize responsibility, it is required that all equipment (including field instrumentation and control system hardware) offered under this Division shall be installed under the supervision of the Consultant.
- C. The Contractor shall be responsible for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, and checkout of the instrumentation and control system hardware as well as equipment furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of all detailed drawings, manuals, and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation and related equipment and/or systems.

- D. The mechanical, process, and electrical drawings indicate the approximate locations of field instruments, control panels, systems and equipment as well as field-mounted equipment provided by others. The Contractor shall examine the mechanical, process and electrical drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The Contractor shall inspect all equipment, panels, instrumentation, controls and appurtenances either existing or furnished under other Divisions of the Specifications to determine all requirements to interface same with the control and information system. The Contractor shall coordinate the completion of any required modifications with the associated supplier of the item furnished.
- E. The Consultant shall review and approve the size and routing of all instrumentation and control cable and conduit systems furnished by the electrical contractor for suitability for use with the associated cable system.
- F. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.
- G. The CCMUA shall have the right of access to the contractor's facility and the facilities of the equipment suppliers to inspect materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records and certifications during any stage of design, fabrication and tests.
- H. The terms "Instrumentation", "Instrumentation and Control System", and "Instrumentation, Control and Information System" shall hereinafter be defined as all equipment, labor, services and documents necessary to meet the intent of the Specifications.

## 1.05 DEFINITIONS

- A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices shall not be considered as satisfying the requirements for solid state components of circuitry.
- B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.
- C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.
- D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.

E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.

F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A = 100 \times (\text{MTBF}/(\text{MTBF} + \text{MTTR})) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A_2 + 1 - ((1-A_1) \times (1-A_1))$$

where:

A1 = availability of non-redundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

G. Abbreviations: Specification abbreviations include the following:

A	-	Availability
ADC	-	Analog to Digital Converter
AI	-	Analog Input
AO	-	Analog Output
AVAIL	-	Available
BCD	-	Binary Coded Decimal
CSMA/CD	-	Carrier Sense Multiple Access/Collision Detect
CPU	-	Central Processing Unit
CRC	-	Cyclic Redundancy Check
CRT	-	Cathode Ray Tube
CS	-	Control Strategy
DAC	-	Digital to Analog Converter
DBMS	-	Data Base Management System
DI	-	Discrete Input
DMA	-	Direct Memory Access
DO	-	Discrete Output
DPDT	-	Double Pole, Double Throw
DVE	-	Digital to Video Electronics
EPROM	-	Erasable, Programmable Read Only Memory
FDM	-	Frequency Division Multiplexing

FSK	-	Frequency Shift Keyed
HMI	-	Human Machine Interface (Software)
I/O	-	Input/Output
LAN	-	Local Area Network
LDFW	-	Lead-Follow
MCC	-	Motor Control Center
MTBF	-	Mean Time Between Failures
MTTR	-	Mean Time To Repair
OS	-	Operating System
PAC	-	Programmable Automation Controller
PCB	-	Printed Circuit Board
PID	-	Proportional Integral and Derivative Control
PLC	-	Programmable Logic Controller
PROM	-	Programmable Read Only Memory
RAM	-	Random Access Memory
RDY	-	Ready
RMSS	-	Root Mean Square Summation
RNG	-	Running
ROM	-	Read Only Memory
RTU	-	Remote Telemetry Unit
SPDT	-	Single Pole, Double Throw
ST/SP	-	Start/Stop
TDM	-	Time Division Multiplexing
UPS	-	Uninterruptible Power Supply

- H. To minimize the number of characters in words used in textual descriptions on CRT displays, printouts and nameplates, abbreviations may be used subject to the CMCMUA's approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and/or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

## 1.06 ENVIRONMENTAL CONDITIONS

- A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.
- B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (i.e., for dust).

- C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.
- D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets, interconnecting hardware, and fasteners shall be aluminum, type 316 stainless steel, or metal alloy as otherwise suitable for chemical resistance within chemical feed/storage areas shown on the installation detail drawings.

## **PART 2 -- PRODUCTS**

### **2.01 NAMEPLATES**

- A. All items of equipment listed in the instrument schedule, control panels, and all items of digital hardware shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include the equipment identification number and description. Abbreviations of the description shall be subject to the CMCMUA's approval.
- B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background.
- C. Nameplates shall be attached to metal equipment by stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of stainless steel wire.

## **PART 3 -- EXECUTION**

### **3.01 SCHEDULE OF PAYMENT**

- A. Payment to the Contractor for Control and Information System materials, equipment, and labor shall be in accordance with the General and Supplementary Conditions. The schedule of values submitted as required by the General and Supplementary Conditions shall reflect a breakdown of the work required for completion of the Control and Information System.

### **3.02 CLEANING**

- A. The Contractor shall thoroughly clean all soiled surfaces of installed equipment and materials.
- B. Upon completion of the instrumentation and control work, the Contractor shall remove all surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the CMCMUA.

### **3.03 FINAL ACCEPTANCE**

- A.** Final acceptance of the Instrumentation, Control and Information System shall be determined complete by the CMCMUA, and shall be based upon the following:
  - 1.** Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.
  - 2.** Completion of the Availability Demonstration.
  - 3.** Completion of all specified control system training requirements.
  - 4.** Completion of all punch-list items that are significant in the opinion of the CMCMUA.
- B.** Final acceptance of the System shall mark the beginning of the extended warranty period.

**(END OF SECTION)**

## SECTION 17030

### CONTROL AND INFORMATION SYSTEM SUBMITTALS

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall submit for review complete Shop Drawings for all equipment in accordance with the General Conditions and Division 1 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 17000 – Control and Information System Scope and General Requirements

##### 1.03 DIGITAL HARDWARE SUBMITTALS

- A. Submit system block diagram(s) showing:
  - 1. All equipment to be provided.
  - 2. All interconnecting cable.
  - 3. Equipment names, manufacturer, and model numbers.
  - 4. Equipment locations.
- B. Submit information for all digital equipment including, but not limited to, the following:
  - 1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
  - 2. Catalog cuts, including complete part number breakdown information.
  - 3. Complete technical, material and environmental specifications.
  - 4. Assembly drawings.
  - 5. Mounting requirements.
  - 6. Color samples.
  - 7. Nameplates.
  - 8. Environmental requirements during storage and operation.



#### **1.04 SOFTWARE SUBMITTALS**

- A. No software submittals are required. Software shall be provided by the consultant.

#### **1.05 CONTROL PANEL SUBMITTALS**

- A. Submittals shall be provided for all control panels, and shall include:
  - 1. Exterior panel drawings with front and side views, to scale.
  - 2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale.
  - 3. Panel area reserved for cable access and conduit entry.
  - 4. Location plans showing each panel in its assigned location.
- B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:
  - 1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
  - 2. Catalog cuts, including complete part number breakdown information.
  - 3. Complete technical, material and environmental specifications.
  - 4. Assembly drawings.
  - 5. Mounting requirements.
  - 6. Color samples.
  - 7. Nameplates.
  - 8. Environmental requirements during storage and operation.
- C. Submit panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc.

#### **1.06 INSTRUMENT SUBMITTALS**

- A. Submit information on all field instruments, including but not limited to the following:
  - 1. Product (item) name and tag number used herein and on the Contract Drawings.
  - 2. Catalog cuts, including complete part number breakdown information.
  - 3. Manufacturer's complete model number.
  - 4. Location of the device.
  - 5. Input - output characteristics.

6. Range, size, and graduations.
  7. Physical size with dimensions, NEMA enclosure classification and mounting details.
  8. Materials of construction of all enclosures, wetted parts and major components.
  9. Instrument or control device sizing calculations where applicable.
  10. Certified calibration data on all flow metering devices.
  11. Environmental requirements during storage and operation.
  12. Associated surge protection devices.
- B. Where multiple instruments are included in the same submittal, instrument data sheets shall be included in the same binder section as the backup information (cut sheets, etc.).

#### **1.07 WIRING AND LOOP DIAGRAMS**

- A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.
- B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11 X 17-inch reproducible prints.
- C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4, Figures 1-3, Minimum Required Items.
- D. Loop drawings shall not be required as a separate document provided that the interconnecting wiring diagrams required in Paragraph B., above, contain all information required by ISA 5.4.

#### **1.08 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01300 - Submittals. Operation and Maintenance (O&M) manuals shall consist of two basic parts:
  1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.
  2. Custom O&M information describing the specific configuration of equipment, and the operation and maintenance requirements for this particular project.
- B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer

standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

- C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include troubleshooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches. The manuals shall include 15% spare space for the addition of future material. The instructions shall include drawings reduced or folded and shall provide the following as a minimum.
1. A comprehensive index.
  2. A complete "as-built" set of all approved shop drawings, which shall reflect all work required to achieve final system acceptance.
  3. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.
  4. Full specifications on each item.
  5. Detailed service, maintenance, and operation instructions for each item supplied.
  6. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
  7. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.
  8. References to manufacturers' standard literature where applicable.
  9. Warning notes shall be located throughout the manual where such notes are required to prevent accidents or inadvertent misuse of equipment.
- D. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.
- E. The hardware maintenance documentation shall include, as a minimum, the following information:
1. Operation Information - This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.

2. Preventive-Maintenance Instructions - These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.
3. Corrective-Maintenance Instructions - These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.
4. Parts Information - This information shall include the identification of each replaceable or field-repairable component. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between equipment numbers and manufacturer's part numbers shall be provided.

#### **1.09 FINAL SYSTEM DOCUMENTATION**

- A. All documentation shall be delivered to the CMCMUA prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.
- B. If any documentation or other technical information submitted is considered proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the construction, operation, or maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.
- C. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected so as to describe final "as-built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.

#### **1.10 SUBMITTAL/DOCUMENTATION FORMAT**

- A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.
- B. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Microsoft Word or in Searchable Adobe Portable Document Format (.pdf).

#### **1.11 ELECTRONIC O&M MANUALS**

- A. Subject to acceptance by the CMCMUA and Engineer, the O&M information may be submitted in part or in whole in an electronic format on optical media.
- B. Electronic O&M manuals shall contain information in standard formats (Searchable Adobe PDF, Word, AutoCAD, HTML, etc.) and shall be easily accessible through the use of standard, "off-the-shelf" software such as an Internet browser.

**PART 2 – PRODUCTS (Not Applicable in this Section)**

**PART 3 – EXECUTION (Not Applicable in this Section)**

**(END OF SECTION)**

## **SECTION 17050**

### **TOOLS, SUPPLIES AND SPARE PARTS - GENERAL**

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

##### **1.01 THE REQUIREMENT**

- A. The Contractor shall provide tools, supplies, and spare parts as specified herein for the operation and maintenance of the Control and Information System.

##### **1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 01300 – Submittals
- B. Section 17000 – Control and Information System Scope and General Requirements
- C. Section 17030 - Control and Information System Submittals

#### **PART 2 -- PRODUCTS**

##### **2.01 TOOLS**

- A. None required.

##### **2.02 SUPPLIES**

- A. The Contractor shall provide supplies as specifically required in other Sections of Division 17

##### **2.03 SPARE PARTS**

- A. Provide spare parts for items of control and instrumentation equipment as recommended by the manufacturer and in accordance with the Contract Documents.
- B. Furnish all spares in moisture-proof boxes designed to provide ample protection for their contents. Label all boxes to clearly identify contents and purpose.
- C. The Contractor shall replace all spare parts consumed during installation, testing, start-up, the system availability demonstration, and the guarantee period.
- D. Refer to individual digital hardware and instrument sections for additional requirements specific to those devices.

#### **PART 3 – EXECUTION (Not Applicable in this Section)**

**(END OF SECTION)**

## SECTION 17060

### SIGNAL COORDINATION REQUIREMENTS

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall conform to the signal coordination requirements specified herein.
- B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers, the electrical subcontractor, and the instrumentation subcontractor.
- C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLC's and Control System PLC's.
- D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLC's, the Control System, etc.

##### 1.02 ANALOG SIGNAL TRANSMISSION

- A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 volts D.C.
- B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
- C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.
- D. Analog signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.
- E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs shall be converted to an isolated, linear, 4-20 milliamperes signal.
- F. The Contractor shall provide 24 V DC power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.
- G. Where two-wire instruments transmit directly to the Control and Information System, the Contractor shall provide power supplies at the PLC-equipped control panels for those instruments.
- H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the Contractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power

supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

### **1.03 DISCRETE INPUTS**

- A. All discrete inputs to equipment and Control and Information System PLC's, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLC's, unless specified otherwise.
- B. Sensing power (wetting voltage) supplied by the PLC shall be 24 VDC.

### **1.04 DISCRETE OUTPUTS**

- A. All discrete outputs from local control panels and Control and Information System PLC's to field devices, starters, panels, etc., shall be 24 VDC powered (sourced) from PLC's.
- B. PLC powered discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts, and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and contractor furnishing the field device, starter, or panel.
- C. Where required or specified herein, discrete outputs from equipment and Control and Information System PLC's to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.

### **1.05 OTHER DISCRETE SIGNALS**

- A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.
- B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.
- C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.
- D. The above requirements shall apply to all starters and panels, regardless of supplier.

### **1.06 SUBMITTALS**

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.



## **1.07 SHOP DRAWINGS**

- A.** Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B.** Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C.** Shop drawings shall include but are not limited to:
  - 1.** Product datasheets.
- D.** The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.08 OPERATION AND MAINTENANCE MANUALS**

- A.** The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **1.09 TOOLS, SUPPLIES AND SPARE PARTS**

- A.** The electrical control and relay systems and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the CMCMUA by the Contractor.
- B.** The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C.** Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the CMCMUA.
- D.** Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" shall not be acceptable.
- E.** Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.
- F.** Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.

- G. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.
- H. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.
- I. The above requirements shall apply to all starters and panels, regardless of supplier.

## **PART 2 -- PRODUCTS**

### **2.01 PILOT RELAYS**

- A. Pilot relays shall be supplied with the following:
  - 1. Coil Voltage: 24 VDC or 120 VAC coils, as required.
  - 2. Contacts: SPDT, DPDT, 4PDT as required.
  - 3. Contact Rating: 6 A @ 277 VAC, 3 A @ 28 VDC
  - 4. Operations: 10,000,000 operations
  - 5. Mounting: Plug in Sockets for 24 VDC and 120 VAC relays shall be of different configurations.
  - 6. Terminations: Screw Type
  - 7. Indicator lights that glow when the relay coil is powered.
- B. Pilot relays shall be Zelio Relay as manufactured by Schneider Electric, or equivalent.

## **PART 3 – EXECUTION (Not Applicable in this Section)**

**(END OF SECTION)**

## SECTION 17071

### FACTORY ACCEPTANCE TESTING

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Control Panel Drawings provided by CMCMUA

##### 1.03 GENERAL REQUIREMENTS

- A. Control system factory acceptance testing (FAT) shall be performed to ensure that all panels and parts meet the design documents before they are delivered to site. The Contractor will prepare a FAT document per the 5 items listed below and perform a pre-FAT of the control panels before control panels before have the client witnessed FAT. The Contractor should notify the CMCMUA at least 2 weeks before they are ready for inspection so that the CMCMUA can scheduled time for a visit to the panel builder's location and witness the FAT. Bellow list of items that should be confirmed during the FAT:
  - 1. Hardware matches the bill of materials on the Arrangement Drawings. Confirm no dents or damage to enclosure or equipment.
  - 2. Wires are harnessed neatly and have legible wire numbers on them per the Electrical Drawings.
  - 3. A point to point wiring check on the wires that are run in the panels:
    - a) The power distribution.
    - b) Between Analog Input modules and terminal block.
    - a) Between Analog Output modules and terminal block.
    - b) Between outputs and relay in panel.
  - 4. Power up the DC Power Supply, PLC, HMI and Ethernet switch to confirm each item powers up and operates.
  - 5. Any deviation from the drawings without prior CMCMUA approval will be considered a Failure of the test and will need to be corrected before enclosures are delivered to the CMCMUA site.

- 6. Any changes requested by the contractor that have CMCMUA Approval will be redlined on the drawings and maintained with the panel. Scan any red-lined drawings and send to CMCMUA for their records.
- B. The CMCMUA Representative shall witness the acceptance test that shall be performed to demonstrate satisfactory performance of control panel assembly.
- C. Each group of panels FAT shall be fully and successfully completed and all associated documentation submitted and approved prior to the next group being started. Specific exceptions are allowed if written approval has been obtained in advance from the CMCMUA.

#### **1.04 CONTRACTOR'S RESPONSIBILITIES**

- A. The Contractor will use the provided drawings for the FAT and prepare a FAT document based on the items in section 1.03 A 1 through 6 and present to the CMCMUA for approval. Once approved by the CMCMUA the Contractor will proceed with a dry run through the FAT to ensure everything is ready.
- B. The Contractor shall ensure that all control panels are assembled per the design drawings and tested for any defects like a loose or missing wire prior to control panels being delivered to site. Each FAT shall be witnessed, dated and signed off by both the Contractor (or designee) and the CMCMUA upon satisfactory completion.
- C. The Contractor shall be responsible for coordination of meetings with the CMCMUA for the Factory Acceptance Testing. A meeting shall be held to review the test schedule with the CMCMUA. Similarly, a meeting shall be held for each group of control panels and the next test schedule as appropriate.
- D. Contractor shall scan and provide any redlined drawings to the CMCMUA for their records.
- E. It is preferred that multiple enclosures are tested over a full day or consecutive days in order to minimize the number of times both the Contractor and the CMCMUA must travel to the testing site.

#### **PART 2 – PRODUCTS (Not Applicable in this Section)**

#### **PART 3 – EXECUTION (Not Applicable in this Section)**

**(END OF SECTION)**

## SECTION 17072

### FIELD TESTING

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17071 – Factory Acceptance Test

##### 1.03 GENERAL REQUIREMENTS

- A. Control system start-up and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:
  - 1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in Sections 17600, 17700, and 17800.
  - 2. Each final control element shall be individually tested as specified hereinafter.
  - 3. Each control loop shall be tested as specified hereinafter.
  - 4. Each control strategy shall be tested under automatic digital control as specified hereinafter.
  - 5. The entire control system shall be tested for overall monitoring, control, communication, and information management functions, and demonstrated for system availability as specified hereinafter.
- B. System start-up and test activities shall include the use of water, if necessary, to establish service conditions that simulate, to the greatest extent possible, normal operating conditions in terms of applied process loads, operating ranges and environmental conditions.
- C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the CMCMUA.

##### 1.04 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a

loop-by-loop basis prior to control system startup to verify that each is ready to function as specified. Each test shall be witnessed, dated and signed off by both the Contractor (or designee) and the CMCMUA upon satisfactory completion.

- B.** The Contractor shall be responsible for coordination of meetings with all affected trades. A meeting shall be held each morning to review the day's test schedule with all affected trades. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.
- C.** The Contractor shall ensure that they conform to the start-up, test and sign-off procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete and/or analog signals between equipment furnished by the electrical contractor and the control system specified herein.

#### **1.05 FINAL CONTROL ELEMENT TESTING**

- A.** The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.
- B.** All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against OEM specified accuracy tolerances. Final control elements, such as VFD's, that require turndown limits shall be initially set during this test.
- C.** All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals, and observing the equipment for proper reaction.

#### **1.06 LOOP CHECKOUT**

- A.** Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.
- B.** Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the CMCMUA. All modes of control shall be exercised and checked for proper operation.
- C.** The accuracy of all DAC's shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.
- D.** The accuracy of all ADC's shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.
- E.** Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the CMCMUA upon satisfactory completion.

## **1.07 CONTROL SYSTEM STARTUP AND TESTING**

- A.** Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.
- B.** All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.
- C.** Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.
- D.** Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the CMCMUA.
- E.** Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.
- F.** The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.
- G.** A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.
- H.** Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the CMCMUA upon satisfactory completion.

## **1.08 FACILITY STARTUP COORDINATION**

- A.** Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.
- B.** The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the CMCMUA that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.

- C. The Contractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.
- D. At least one qualified technician shall be provided for control system startup and test activities (at least two when loop checkout is being performed).

**PART 2 – PRODUCTS (Not Applicable in this Section)**

**PART 3 – EXECUTION (Not Applicable in this Section)**

**(END OF SECTION)**



## SECTION 17080

### QUALITY ASSURANCE

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. It is the intent of these Specifications and Drawings to secure high quality in all materials, equipment and workmanship in order to facilitate operations and maintenance of the facility. The Contractor shall provide equipment and services to meet this intent.

##### 1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. All work shall be installed in accordance with the National Electric Code, National Electric Safety Code, OSHA, State, local and other applicable codes.

##### 1.03 QUALITY ASSURANCE - GENERAL

- A. All equipment and materials shall be new and the products of reputable recognized suppliers having adequate experience in the manufacture of these particular items.
- B. For uniformity, only one manufacturer shall be accepted for each type of product.
- C. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses that may occur during fabrication, transportation, and erection as well as during continuous or intermittent operation. Equipment shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.
- D. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, which shall be of sturdy and durable construction and be suitable for long, trouble-free service.
- E. Electronic components shall be de-rated to assure dependability and long-term stability.
- F. Printed circuit boards in field mounted equipment shall be suitable for the specified environmental conditions.
- G. Alignment and adjustments shall be non-critical, stable with temperature changes or aging and accomplished with premium grade potentiometers.
- H. Components of specially selected values shall not be inserted into standard electronic assemblies in order to meet the performance requirements of this specification.

##### 1.04 OPTIONAL EQUIPMENT

- A. Optional or substituted equipment or both requiring changes in details or dimensions required to maintain all structural, mechanical, electrical, control, operating, maintenance or design features incorporated in these Specifications and Drawings shall be made at no additional cost to the CMCMUA. In the event that the changes are necessary, calculations

and drawings showing the proposed revisions shall be submitted for approval. The Contractor shall coordinate all changes with other affected trades and pay all additional charges incurred.

#### **1.05 GUARANTEE**

- A.** The Contractor shall install, maintain and guarantee the instrumentation as specified under the General Conditions and Division 1 of the Specifications. Maintenance personnel provided by the instrumentation Contractor shall instruct the CMCMUA's personnel in the operation, adjustment, calibration and repair of the equipment being serviced. All preventive and corrective activities shall be documented with service reports, which shall identify the equipment being serviced, state the condition of the equipment, describe all work performed and list materials used. A copy of all service reports shall be delivered to the CMCMUA on the day the work is performed.
- B.** The instrumentation Contractor shall provide the services of factory-trained service technician(s) at least twice during the guarantee period, for the purpose of performing preventive hardware maintenance.
- C.** Corrective hardware maintenance during the guarantee period shall be performed in accordance with the requirements of Division 1 and, in addition, shall meet the following requirements:
  - 1.** Corrective hardware maintenance shall be performed by factory-trained service technician(s) specifically trained to service the digital equipment provided. Technicians possessing suitable training and experience shall be provided to perform corrective maintenance on all other equipment. The hardware service technician(s) shall be available on-site within 24 hours after notification by the CMCMUA.
  - 2.** Corrective hardware maintenance performed during the guarantee period shall be performed at no cost to the CMCMUA.
  - 3.** As used herein, the term "operating hours" shall be defined as those of the treatment facility (seven days per week, 24 hours per day). The term "business hours" shall be defined as the hours between 7:00 a.m. and 3:30 p.m., local time, Monday through Friday; excluding holidays.
  - 4.** The guarantee period shall commence upon final acceptance of the completed work in accordance with the provisions of the Contract Documents.

#### **1.06 SHIPPING HANDLING AND STORAGE**

- A.** In addition to shipping, handling and storage requirements specified elsewhere in the Contract Documents, air conditioning/heating shall be provided for storage of all field instrumentation, panels, digital equipment and ancillary devices to maintain temperatures between 20 and 25 degrees C and relative humidity 40 to 60 percent without condensation. The air shall be filtered and free of corrosive contaminants and moisture.

## **1.07 FABRICATION**

- A.** Fabrication of all equipment shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.
- B.** The CMCMUA may inspect the fabricated equipment at the factory before shipment to the job site. The Contractor shall provide the CMCMUA with sufficient prior notice so that an inspection can be arranged at the factory. Inspection of the equipment at the factory by the CMCMUA will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- C.** Equipment approval at the factory only allows the equipment to be shipped to the project site. The Contractor shall provide for the proper storage, installation and satisfactory start-up and operation of the equipment to the satisfaction of the equipment manufacturer, the Contractor, and the CMCMUA.

## **1.08 INSTALLATION**

- A.** All instrumentation and control system installation work, whether new construction or modifications to existing equipment/panels/structures, shall conform to the codes and standards outlined in this Section, and other portions of the Contract Documents.
- B.** All labor shall be performed by qualified craftsmen in accordance with the standards of workmanship in their profession and shall have had a minimum of three years of documented experience on similar projects.
- C.** All equipment and materials shall fit properly in their installations. Any required work to correct improperly fit installations shall be performed at no additional expense to the CMCMUA.
- D.** All work shall be performed in a neat and workmanlike manner. All hardware and instrumentation shall be installed in accordance with requirements specified herein, in accordance with industry best practices, in accordance with manufacturers' recommendations, and in a manner suitable for ease of operation, inspection, and maintenance. All wiring shall be neatly bundled, run in wireway, and terminated. All spare wiring shall be neatly coiled and clearly labeled at both ends for future use by the CMCMUA. Any work not meeting these requirements shall be corrected at no expense to the CMCMUA.
- E.** Sufficient common-mode and differential-mode noise rejection shall be provided to insure operation of the plant process control system to meet all specification requirements. General practice shall include:
  - 1.** Maintaining crossings between noisy wires and signal wires at right angles.
  - 2.** Maintaining separation between noisy wires and signal wires as wide as practical.
  - 3.** Grounding all signals, shields and power supplies at the process control unit or local control panel.
  - 4.** Providing passive filters on signals with time constant compatible with scan intervals and overvoltage protection.

- 5. Eliminating cable splices. All splices in instrumentation and control system signal and network cables shall be approved in advance by the CMCMUA.
- 6. Providing a floating output for transmitters that have their own power sources.
- F. DC and AC power grounding shall be performed in accordance with the digital hardware manufacturer's recommendations as well as all applicable code requirements.
- G. The case of each field instrument and control panel shall be grounded in compliance with the National Electric Code.
- H. Power wires shall be separated from parallel-running signal wires by the following minimum spacing:

<u>CIRCUIT VOLTAGE (VAC)</u>	<u>MINIMUM SPACING (IN.)</u>
120	12
240	18
480	18
2000 and above	24

- I. The Contractor shall provide all required cutting, drilling, inserts, supports, bolts, and anchors, and, shall securely attach all equipment and materials to their supports. Embedded supports for equipment furnished under this Division shall be provided and installed as shown specified herein and shown on the Drawings.
- J. Following acceptance of the factory tests by the CMCMUA, and in accordance with the construction schedule, the Contractor shall commence installation of the digital control system hardware. Digital system equipment items shall not be installed, however, until all architectural, mechanical, HVAC and electrical work has been completed in the equipment rooms, MCC's, control rooms and all structural and/or mechanical work has been completed within 50 feet of equipment locations.
- K. Upon completion of the above construction work, the Contractor shall request an inspection of the above-named areas. The CMCMUA will issue a written approval to proceed with delivery and installation only after being satisfied that all work described above has been properly performed. Digital equipment shall remain at the factory site or storage prior to approval for delivery to the project site. Partial shipments may be required to meet construction schedule requirements.

**PART 2 – PRODUCTS (Not Applicable in this Section)**

**PART 3 – EXECUTION (Not Applicable in this Section)**

**(END OF SECTION)**

## SECTION 17100

### CONTROL AND INFORMATION SYSTEM HARDWARE - GENERAL

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The process control system is physically and functionally distributed between PLC equipped control panels, motor control panels, field panels, operator workstations, and appurtenances.
- B. Although manual control facilities shall be provided adjacent to each final control element or in local control panels, such facilities are for testing, maintenance, and local monitoring purposes only and shall not be regarded as a backup to the PLC-based control system.
- C. Major plant control system digital equipment items are shown on the Drawings and include but are not limited to the following:
  - 1. Eighteen (18) programmable logic controller/remote rack panels
  - 2. Fiber optic data highway network and appurtenances.
  - 3. Local area network and appurtenances.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17030 - Control and Information System Submittals
- B. Section 17120 – Programmable Logic Controllers
- C. Section 17180 – Local Area Network

##### 1.03 DIGITAL HARDWARE CONFIGURATIONS

- A. The digital hardware configuration shown on the Drawings depicts overall system configuration requirements. System design shall be based upon this concept and shall provide an overall digital system availability of 99.8 percent under the conditions specified in Section 17073. Unless otherwise specified, designs that vary from this concept shall be rejected.
- B. All discrete and analog data acquisition, pre-processing, storage, and process control functions shall be performed at the PLC level. Operator workstations shall be fully independent devices, individually connected to the data highway local area network.
- C. No other exceptions shall be considered.

## **PART 2 -- PRODUCTS**

### **2.01 GENERAL SYSTEM HARDWARE REQUIREMENTS**

- A.** Large scale integrated (LSI) circuit construction shall be employed unless otherwise specified.
- B.** Modular construction shall be employed to simplify maintenance and to provide for future hardware expansion. Plug-in, modular PCB's or modules shall be employed for easy removal to permit exposure of circuit wiring, components, and test points. Extender boards shall be provided if necessary to permit PCB's to be completely exposed for testing purposes.
- C.** Keying schemes shall be used to prevent PCB misplacement.
- D.** Each process control system local area network connected device shall continuously perform on-line diagnostics and failure reporting to the operator workstations.

### **2.02 DIGITAL SYSTEM FAILURE DETECTION AND FAIL-OVER REQUIREMENTS**

- A.** No degradation in control system performance shall occur when the system is operating in a partial failure or an equipment fail-over mode. Likewise, no degradation of system performance shall occur while a backed-up system component is undergoing preventive or corrective maintenance.
- B.** All devices connected to the data highway local area network shall be self-checking and shall report their operational status to the operator workstations as whether "normal" or "failed".

## **PART 3 – EXECUTION**

- A.** The Contractor will install Owner provided Ethernet switches in the PLC panels as required. See arrangement drawings for details.

### **3.01 REQUIREMENTS**

- A.** Refer to Section 17000, Part 3.

**(END OF SECTION)**

## SECTION 17120

### PROGRAMMABLE LOGIC CONTROLLER AND ENCLOSURE EQUIPMENT

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, and install all programmable logic controllers, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17060 – Signal Coordination Requirements
- D. Section 17130 – Operator Interface Units
- E. Section 17190 – Uninterruptible Power Systems
- F. Section 17500 – Enclosures, General

##### 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets

## 2. Operation and Maintenance Manuals

- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

### 1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

### 1.06 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies, and spare parts shall be provided as specified in Section 17050 - Tools, Supplies, and Spare Parts. In addition, the following specific spare parts items shall be provided:

1. None

## PART 2 -- PRODUCTS

### 2.01 PROGRAMMABLE LOGIC CONTROLLERS - GENERAL

- A. The Contractor shall furnish programmable logic controllers (PLC's) as specified herein and as shown on the Drawings. PLC's shall be provided complete with the backplane, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein.
- B. All components of the PLC system shall be of the same manufacturer; who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The PLC system shall have been tested to meet the requirements of IEC/EN Standard 61000-6-2, 61000-4011 and IACS- E10: IEC 61000-4-11 (for voltage and Frequency Variations). IEC/EN 61131-2, 61000-6-2, 61000-4-2 and IACS E10 (for HF Interference). The processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.
- C. PLC's shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0°to +60°C and relative humidity of 10-95 percent, non-condensing. The PLC shall operate on supply voltages of 100-240 VAC at 47-63 Hz or 24 to 48 VDC if provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and under-voltage protection shall be provided on the power supply.
- D. Where applicable, the minimum PLC backplane size shall be 8 slots, not including power supply slots. All input/output modules shall be hot-swappable.
- E. System configuration shall be as shown on the Drawings. PLC types shall be designated on the Drawings, and correspond to the specifications herein. Only a single type of



processor shall be supplied for all PLC's of a designated type. Memory and processor shall be adequate for all control functions specified.

F. Processors shall fully function with the Unity Pro software.

G. PLC's shall be the Modicon M340 with following components included or approved equivalent.

- BMXP342020 (Processor)
- BMXNOE0110 (Communication Module)
- BMXCPS3500 (Power Supply)
- BMXXBP1200 (Backplane can be less than 12 slots – as shown on drawings)
- BMXDDI6402K (64 Point Digital Input Module)
- BMXDDO6402K (64 Point Digital Output Module)
- BMXFCC103 (Interconnection Cable 1m)
- BMXFCC203 (Interconnection Cable 2m)
- BMXAMI0410 (4 Point Analog Input Module)
- BMXAMO0410 (4 Point Analog Output Module)
- BMXFTB2000 (Screw Terminal Strip 20PT)
- BMXFTB2800 (Screw Terminal Strip 28PT)
- ABE7H16C11 (Terminal Block 16 Channel)
- ABE7BV20 (Terminal Block Base)
- BMX XBE 1000 (Rack Expansion Module)
- BMX XBC \*\*0k (Bus Extension cord set – length to be determined)
- TXK TLY EX (Line terminator set of 2)

## 2.02 PROCESSORS

A. The processor and its associated memory shall be enclosed in a modular enclosure. LED-type indicating lights shall be provided to indicate processor, memory, and battery status. Errors in memory shall be recognized and shall activate the memory error indicating lights. The PLC processor shall monitor the internal operation of the PLC for failure and provide an alarm output. Nonvolatile memory in the form of a manufacturer supplied industrial CompactFlash card or equivalent technology shall be required to maintain the entire current program and firmware of the controller in the event of power loss. The program shall be updated onto the flash memory each time a program changes

such as an online edit or tag value is changed. When non-volatile memory (flash memory) is not available for certain controller models as offered by the PLC manufacturer, lithium batteries shall be used to maintain process RAM memory for at least one year in the event of power loss. The lithium battery unit shall be an externally mounted battery assembly with the highest available capacity. The PLC shall send an alarm to the plant control system if the battery level is low.

- B. The instruction set for the PLC shall conform to the requirements of IEC 61131-2. Each PLC shall have the capability to run all five of the standard IEC 61131-2 languages simultaneously. These five languages shall be:
  - 1. Function Block Diagram
  - 2. Ladder Diagram
  - 3. Structured Text
  - 4. Instruction List
  - 5. Sequential Function Chart
- C. Additional co-processors or modules may be required to meet the minimum instruction set.
- D. PLC processors shall be provided with substantial user program, data and logic memory to allow for future expansion of the overall system. The total memory used on each processor shall be less than 60% of available memory at project completion.
- E. PLCs shall be capable of:
  - 1. Modbus TCP messaging: The web services shall use Modbus TCP messaging over port 502 of the TCP packet.
  - 2. Capable of Fast Device Replacement (FDR): PLCs shall act as a fast device replacement client/server. This will enable PLCs to automatically download the IP address and configuration file to FDR client devices.
  - 3. Capable of network management using SNMP (Simple Network Management Protocol).
  - 4. Capable of Time synchronization service: PLCs shall be capable of synchronizing from its internal clock from a clock on a NTP server.
  - 5. I/O scanning service: I/O scanning will allow the PLC to exchange data to/from remote devices on the network.
  - 6. Capable of Global Data: PLCs shall use Global Data service to ensure real time communication between stations in the same distribution group while minimizing network loading. Global Data servicing will use Real-Time Publisher Subscriber producer consumer based protocol.

7. PLCs web services shall be compatible with other devices. This includes power equipment, HMIs, Switches, and VFDs

## 2.03 COMMUNICATIONS

- A. PLC communications shall be provided as specified in Section 17180 - Process Control System Networks and as shown on the Control System Architecture Drawing.
- B. In addition to a communications port for the control system network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.
- C. The PLC shall be able to support various types of Fieldbus communication systems for data links to field instruments (where specified) in addition to connected equipment such as power monitors, VFDs, motor protection monitors, etc. As a minimum, Profibus DP, Foundation Fieldbus, Modbus RTU Master and Slave, TCP/IP Ethernet shall be supported. The Contractor shall coordinate the efforts of the necessary parties (Contractor and equipment suppliers) to accomplish the required device and data table addressing between each PLC and the associated connected equipment.
- D. Additional communication modules or protocol gateways may be required to support specific communication protocols required under this Contract and shall be supplied at no extra cost to the CMCMUA.
- E. Communication Capabilities: PLCs shall support the following without the need for third party modules
  1. 10/100 MB Ethernet with Fast Device Replacement (FDR) capability, Ethernet scanner capabilities (64 devices per card), Global Data, Network Time Protocol support, standard web page and custom web page capability. A memory card will be available to store web pages and data.
  2. ASi V2 Master
  3. Serial protocols including Modbus, Unitelway, and ASCII.
  4. DNP3
  5. CANopen
  6. The PLC shall have an Ethernet card with four (4) ports. Each port shall be capable of communicating both Modbus TCP, and Ethernet I/P simultaneously. Cards requiring that the port be configured for one protocol will not be accepted. The card will also support the following functions:
    7. Ring topologies using RSTP (Rapid Spanning Tree Protocol)
      - Priority of Ethernet packets using QoS (Quality of Service) service
      - Automatic module configuration recovery using FDR (Fast Device Replacement)

- Embedded Web Server for application monitoring and module diagnostic
- Sharing data between PACs
- Network management using SNMP (Simple Network Management Protocol)

## 2.04 INPUT/OUTPUT SUBSYSTEMS

- A. Input/output hardware shall be plug-in modules in associated I/O backplane or DIN-rail mounting assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.
- B. Discrete inputs shall be 24 VDC signals (integral to the PLC) from dry field contacts. Discrete outputs shall be 24 VDC outputs sourced from the PLC. Refer to Section 17060 – Signal Coordination Requirements for further details of discrete signal type and voltage requirements. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Interposing relays shall be as specified in Section 17550. Electrical isolation shall be provided where required. The maximum density for discrete I/O modules shall be 64 per input module and 64 per output module.
- C. Analog input circuits shall be isolated, minimum 16-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15°C and be capable of accepting signals from 100-ohm Platinum RTD's. Analog outputs shall be coordinated with the receivers but shall generally be isolated 24 VDC 4-20 mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 17560 - Surge Protection Devices. The maximum density for analog I/O modules shall be 8 per module.
- D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.
- E. External power supplies shall be provided with the PLC as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC.

## **2.05 REMOTE I/O SUBSYSTEMS**

- A.** Remote I/O shall be provided as designated on the Control System Architecture Drawing. Remote I/O shall be either PLC backplane type I/O or field modules as manufactured by the PLC manufacturer. Field modules shall meet the requirements of Subsection 2.04, Input/Output Subsystems. Remote I/O processor or communication modules shall be modular and individually replaceable.
- B.** Remote I/O shall communicate with the PLC using the PLC manufacturer's standard protocol or an open standard network such as DeviceNet, Ethernet IP, ProfiNet, Foundation Fieldbus, Modbus TCP/IP, or equivalent.

## **2.06 INPUT/OUTPUT CIRCUIT ARRANGEMENT**

- A.** Signal and control circuitry to individual input/output boards shall be arranged such that board failure shall not disable more than one-half of the control loops within any group of controlled equipment (e.g., one pump out of a group of three pumps, two pumps out of four, etc.). Where possible, individual control loops and equipment shall be assigned to individual boards such that failure of the board will disable only one loop or piece of equipment.

## **PART 3 - EXECUTION**

### **3.01 REQUIREMENTS**

- A.** Refer to Section 17000, Part 3.

**(END OF SECTION)**

## SECTION 17130

### OPERATOR INTERFACE

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall install, test and place in satisfactory operation the Operator Interface, with all accessories, and appurtenances as herein specified and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17700 – Powered Instruments, General

#### PART 2 -- PRODUCTS

##### 2.01 OPERATOR INTERFACE FOR PUMP STATIONS

- A. CMCMUA will be providing all the Operator Interfaces.  
The contractor will provide Operator Interfaces to the panel builder to cutout and mount into the door of the enclosures. Provide power wiring and Ethernet wiring to the back panel so the panels can go through a factory acceptance testing before delivery to site.
- B. The Operator Interface will be a 21.5" Industrial grade LCD touch screen display/computer running Windows 10 IOT Enterprise 2019 LTSC operating system. See details below:
  - 1. Base System: 21.5 Fan-less Panel Mount PC
  - 2. System:
    - 2.1. CPU: Intel I5-6300U
    - 2.2. Cores: Dual Core
    - 2.3. Frequency: 2.4 GHz; 3.0 GHz with Turbot Boost
    - 2.4. L3 Cache: 3 MB
    - 2.5. TDP: 15W
    - 2.6. Memory: 8GB (1X8G) SO-DRR\$-2400 1GX8 1.2V SAM
    - 2.7. Storage:
      - 2.7.1. Hard Disk Drive: None

2.7.2. Solid State Disk (2.5" SSD): SQF 2.5" SSD 640 512G MLC

2.7.3. Solid State Disk (mSATA): None

## 2.8. Network

2.8.1. LAN: 2 x 10/100/1000 Mbps Ethernet (Intel I211-AT; Intel I219LM)

2.8.2. Wireless LAN: None

## 2.9. I/O

2.9.1. 2 x Serial Ports:

2.9.1.1. 1 x RS-232

2.9.1.2. 1 x RS-232/422/485 (Adjustable through Bios)

2.9.2. 2 x USB 3.0, 2 x USB 2.0

2.9.3. 1 x HDMI

2.9.4. 1 x TPM 2.0 Internal

2.10. Speakers 2 x 1W

2.11. Expansion: 1 x Full-size mini PCIe Slot

2.12. Watchdog Timer: 255 timer levels, setup by software

## 3. Operating Software:

3.1. Windows 10 IOT Enterprise 2019 LTSC Value EPKEA

## 4. LCD

4.1. Display Type: 21.5 TFT LCD (LED Backlight)

4.2. Resolution: 1920 X 1080

4.3. Viewing Angle: 89 (left), 89 (right), 89 (up) 89 (down)

4.4. Luminance: 300

4.5. Contrast Ratio: 5000

4.6. Backlight Lifetime: 50,000 hr.

## 5. Touchscreen

5.1. Touch Type: 10-Point multi-touch projected capacitive

5.2. Light Transmission: 90% +/- 3%

5.3. Controller: USB interface

6. Power Consumption

6.1. Input Voltage: 12 to 24VDC

6.2. Power Consumption: 75 Watts

7. Environment:

7.1. Operating Temperature:

7.1.1. 0°C to 50°C (32°F to 122°F) for SSD

7.1.2. 0°C to 45°C (32°F to 113°F) for HDD

7.2. Relative Humidity: 10 to 95% @ 40°C (non-condensing)

7.3. Shock: Operating 10 G peak acceleration (11ms duration)

7.4. Vibration:

7.4.1. Operating Random Vibration 5 to 500Hz, 1Grms @ with HDD

7.4.2. Operating Random Vibration 5 to 500Hz, 2Grms @ with SSD

7.5. EMC: CE, FCC Class B, BSMI

7.6. Safety: CB, CCC, BSMI, UL

7.7. Front Panel Protection: IP65 Compliant

- C. Operator Interface shall be Model PPC-3211SW-7S50 for Pump Stations as manufactured by Advantech, or approved equivalent.

## 2.02 OPERATOR INTERFACE FOR PLANT CONTROL PANELS

- A. CMCMUA will be providing all the Operator Interfaces.  
The contractor will obtain the Operator Interfaces from CMCMUA and give to the panel builder to cutout and mount into the door of the enclosures. Provide power wiring and Ethernet wiring to the back panel so the panels can go through a factory acceptance testing before delivery to site.
- B. The Operator Interface will be a 21.5" Industrial grade LCD touch screen display, Zero Client and 2 High Availability Servers. See details below for each of these items:
- a) Touch Screen Monitor
1. Monitor General
- 1.1. Housing: Die-Casting magnesium alloy



- 1.2. Mounting: Panel Mount
- 1.3. Power: 24 VDC
- 1.4. Power Consumption: 25 Watts + 20%
- 1.5. Video Port: VGA and DVI-D Port
- 1.6. Size: 21.98" x 13.77" x 1.88"

2. LCD Screen

- 2.1. Display Type: 21.5 Full HD, TFT, LED, LCD
- 2.2. Resolution: 1920 X 1080
- 2.3. Max Color: 16.7 M
- 2.4. Viewing Angle: 178 (left), 178 (right), 178 (up) 178 (down)
- 2.5. Luminance: 300
- 2.6. Contrast Ratio: 5000:1
- 2.7. Backlight Lifetime: 50,000 hr.

3. Touchscreen

- 3.1. Touch Type: 10-Point multi-touch projected capacitive
- 3.2. Controller: USB or RS232 interface
- 3.3. Light Transmission: above 75%
- 3.4. Hardness: 6H

4. Environment:

- 4.1. Operating Temperature: 0°C to 55°C (32°F to 122°F)
- 4.2. Relative Humidity: 10 to 95% (non-condensing)
- 4.3. Front Panel Protection: IP66 Compliant
- 4.4. Vibration: Operating Random Vibration 5 to 500Hz, 1Grms

b) Operator Interface shall be Model FPM-7211W-P3AE for Water Treatment Plant as manufactured by Advantech, or approved equivalent.

1. Zero Client General

- 1.1. Housing: Plastic

- 1.2. Mounting Bracket: VESA Option (Dell Part # 575-BBMK)
  - 1.3. Power: 24 VDC +/- 15%
  - 1.4. Power Consumption: 24 Watts
  - 1.5. Size: 4" x 4" x 1.125"
  - 1.6. Weight: 0.53 lbs.
  2. System:
    - 2.1. BIOS: ACP Bios Enabled
    - 2.2. CPU: Intel Atom X5-78350
    - 2.3. Frequency: 1.44 GHz
    - 2.4. Cores: Quad Core
    - 2.5. Memory: 2GB DRR3L 1600 MHz
  3. I/O Interface
    - 3.1. LAN Ports: 1 x RJ45, 1 GBS
    - 3.2. USB Ports: 3 x USB 2.0  
1 x USB 3.2 Gen 1
    - 3.3. Displays: 1 x DisplayPort 1.1, Supports 1920X1200 (HD6250) @ 30 bpp
    - 3.4. Power Connector: 1 x 2 Pins, Terminal Block
    - 3.5. Grounding: Chassis Grounding
    - 3.6. Audio Port: 1 3.5mm Combo Jack
  4. Operating Software:
    - 4.1. None
  5. Environment:
    - 5.1. Operating Temperature: 0°C to 40°C (32°F to 104°F)
    - 5.2. Relative Humidity: 20 to 80% (non-condensing)
- c) Zero Client shall be Model Wyse 3040 for Water Treatment Plant as manufactured by Dell or approved equivalent.
- d) The control system servers will be two (2) Stratus ZTC Edge 100I High Availability Server for the Plant Control Panels. See details below:

1. Server General \*

1.1. Housing: Steel Chassis with Die-Casting Aluminum Heat Sinks

1.2. Mounting Bracket: Included (Wall or Din Rail mounting)

1.3. Power: 9 to 36 VDC

1.4. Power Supply: 100 – 240 VAC @ 1.8 Amps

1.5. Power Consumption: 62 Watts

1.6. Size: 11.02" x 7.48" x 2.99"

1.7. Weight: 10.1 lbs. x 2

2. System: \*

2.1. BIOS: Stratus Bios Enabled

2.2. CPU: Intel I7-6700TE

2.3. Frequency: 2.4 GHz

2.4. Cache: 8 MB

2.5. Cores: 4 HT Cores

2.6. Memory: 32GB DRR4 2400 MHz

2.7. Hard Drive: 512 GB Solid State Drive

3. I/O Interface

3.1. LAN Ports: 2 x 1 GBE (for Link)  
2 x 1 GBE

3.2. USB Ports: 2 x USB 2.0  
6 x USB 3.2 Gen 1

3.3. Displays: 1 x HDMI Port, 1 x DVI port

3.4. Power Connector: 1 x 3 Pins, Terminal Block

3.5. Grounding: Chassis Grounding

3.6. Audio Port: 1 mic port and 1 speaker port

3.7. Serial Ports: 4 x 9 pin Com ports

4. Operating Software:
  - 4.1. 2019 Server
5. Environment:
  - 5.1. Operating Temperature: -40°C to 60°C (-40°F to 140°F)
  - 5.2. Relative Humidity: 10 to 95% (non-condensing)
  - 5.3. Shock: 50G for 11 ms
  - 5.4. Vibration: 3 Grms @ 5 – 500 HZ

\*Typical specifications from manufacturer

- e) Stratus Servers shall be Model Stratus ZTC Edge 100i High Availability Servers for Water Treatment Plant as manufactured by Stratus or approved equivalent.

### **PART 3 -- EXECUTION**

#### **3.01 REQUIREMENTS**

- A. Refer to Section 01010, of the Specifications.

**(END OF SECTION)**

## SECTION 17150

### AUTO DIALER

#### I. PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the Auto Dialer, with all accessories, and appurtenances as herein specified and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17700 – Powered Instruments, General

##### 1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals shall be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
  - 1. Product datasheets.

#### PART 2 -- PRODUCTS

##### 2.01 AUTO DIALER

- A. Description and Phone Number Dialing:

The dialer shall be a solid-state component capable of dialing up to 16 telephone numbers, each up to 60 digits in length. Phone numbers and Standard pulse dialing or Touch Tone® DTMF dialing are user programmable via the system's keyboard or remotely via Touch Tone telephone. In addition, the dialer shall:

  - 2. Group Alarm Calls - On alarm, system shall selectively call the correct phone number according to the specific alarm(s).

3. Detect Telephone Line Fault and indicate condition with Front Panel LED.
4. Automatically select Tone versus Pulse Dialing.
5. Monitor Call Progress - Detect Busy and Ringing Signals, Abandon Call if Busy, Wait until phone is answered to Annunciate Voice Reports.
6. Provide Numeric Pager Support
7. Provide PBX Support

**B. Solid State Voice Message Recording and Playback:**

The unit shall have two different categories of speech message capability, all implemented with permanent non-volatile solid state circuitry with no mechanical mechanisms. The unit shall allow for message recording from a remote telephone as well as from the front panel.

1. User Field Recorded Messages:

The user may record and re-record his own voice messages for each input channel and for the Station ID.

- a. There shall be no limit on the length of any particular message within the overall available message recording time, which shall vary from 26 to 635 seconds, depending upon the number of input channels selected, and the recording rate used.
- b. The unit shall allow selective recording of both Normal and Alarm advisory messages for each input channel.
- c. The unit shall provide for automatic setting of the optimum speech recording rate for the total set of messages recorder, in order to achieve optimum recording sound quality.
- d. Circuit board switches or jumper straps shall not be an acceptable means of manipulating message length or recording rates.

2. User Field Recorded Messages:

Permanent built-in messages shall be included to support user programming operations, to provide supplemental warning messages such as advising that the alarms have been disabled, and to allow the unit to be fully functional even when the installer has not recorded any messages of his own.

**C. Input Monitoring Function:**

The basic unit shall continuously monitor the presence of AC power and the status of four (4) contact closure inputs. AC power failure, or violation of the alarm criteria at any input shall cause the unit to go into alarm status and begin dial-outs. The unit shall, upon a single program entry, automatically accept all input states as the normal non-alarm state, eliminating possible confusion about Normal Open versus Normally Closed inputs. Further, as a diagnostic aid, unit shall have the capability of directly announcing the state of any given input as currently "Closed Circuit" or "Open Circuit" without disturbing any

message programming. Each input channel shall also be independently programmable, without the need to manipulate circuit board switches or jumpers, to any of the following:

1. Normally Open, Normally Closed, or for No Alarm (Status Only).
2. Run Time Meter - to accumulate and report the number of hours a particular input circuit has been closed. Any channel so configured will never cause an alarm call; rather, on inquiry it will recite its message according to the status of the input and then report the closed circuit time to the tenth of an hour. The input will accumulate and report in tenths of hours up to a total accumulated running time of 99,999.9 hours. The initial value of the Run Time Meter shall be programmable in order to agree with existing electromechanical Run Time Meters. Up to a total of eight Run Time Meters may be programmed.
3. Pulse Totalizer - to count the accumulated number of pulses (momentary contact closures) occurring at the input so programmed. Any input channel may be programmed for a Totalizer Function, up to a maximum of eight. Maximum Input pulse rate is 100 Hz, with a 50% Duty Cycle. The spoken scaled value will not "rollover" to zero until a value of 4,294,967,294 has been exceeded.

**D. Input/Output Expansion Capability:**

The standard unit shall be modular in design, permitting it, therefore, to accept "plug-in" expansion circuit boards to incorporate any of the following:

1. Contact Closure Expansion Capability to a total of 8, 16, 24, or 32 total dry contact inputs.
2. Analog Input Capability to a total of 1, 4, 8, or 16 total analog inputs.
3. Remote Supervisory Control Outputs to manipulate 4 or 8 output relays.

**E. Modbus Communications:**

The unit shall accept an expansion card which enables it to communicate directly with devices utilizing Modbus RTU Protocol. A unit so configured shall be capable of "reading" and "writing" to 32, 64, or 96 data registers via Touch Tone Telephone. No modem or host computer shall be required. Interface shall consist of a single RS-232.

**F. Printer/Computer Communications:**

The unit shall be equipped with a centronics parallel printer port, enabling the user to print alarm reports, download programming data, and generate scheduled status reports as required. Alternatively, the unit shall be able to accept an optional modular, plug-in asynchronous communications card to permit any of the following:

1. Local Data Logging - Permits a single dialer to communicate with a local Serial printer to log routine status reports, alarm reports, and programming data.
2. Central Data Logging - Permits one or more dialers to communicate with a single centrally located Serial printer equipped with a suitable modem to log routine status reports, alarm reports, and programming data.

3. Data Acquisition and Control - Permits one or more dialers to communicate with a centrally located Computer/Printer System equipped with a SCADA software package, thereby functioning as a stand-alone SCADA system.

**G. Alarm and Inquiry Messages:**

Upon initiating an alarm call, the system is to "speak" only those channels which are currently in "alarm status." Inquiry phone calls can be made directly to the unit at any time for a complete status report.

**H. Acknowledgement:**

Alarms are acknowledged either by pressing a Touch Tone "9" as the call is being received, or by calling the unit back after having received an alarm call.

**I. Nonvolatile Program Memory Retention:**

User-entered programming and voice messages shall be kept intact, even during power failures or when all power has been removed, for up to ten (10) years. This shall be accomplished through inclusion in the system of a lithium battery separate from the unit's backup rechargeable gel cell battery.

**J. Local and Remote Programming Capabilities:**

The user may optionally elect to alter the following parameters from their standard normal default values via keyboard entry or remotely from any Touch Tone telephone.

1. Alarm Response Delay: 0.1 to 999.9 seconds, with different delays being assignable to different alarms.
2. Delay Between Alarm Call-outs: 0.1 to 99.9 minutes.
3. Alarm Reset Time: 0.1 to 99 hours, or "No Reset".
4. Incoming Ring Response (Answer) Delay: 1 to 20 Rings.
5. Number of Message Repetitions: 1 to 20 Repetitions.
6. Auto call Test: When enabled, the unit shall place a single round of test calls, both at the time this function is enabled, and also at regular subsequent intervals until this function is disabled.
7. Remote System Microphone Activation.
8. Remote Arming and Disarming of System.

**K. Phone Line:**

The dialer is to use a standard "dial-up" telephone line (direct leased line is not required), and is to be F.C.C. approved. Connection to the telephone is through a 4-pin modular jack (RJ 11).



**L. Speakerphone:**

The unit shall be capable of dialing any phone number on command and functioning as a speakerphone.

**M. Real Time Clock:**

The unit shall be equipped with a real time clock thereby making the following possible:

1. Alarm Ready Schedule - The dialer shall be user programmable to follow a specific schedule of operations. This shall include the flexibility to set a weekday, weekend, and holiday schedule. With this feature the dialer shall arm and disarm itself according to the schedule programmed.
2. In the event any of the printer configurations outlined in Section 6 are utilized, all alarm reports will be time and date stamped. Routine scheduled status reports can also be programmed.

**N. Power/Battery Backup:**

Normal power shall be 105-135 VAC, 15 watts nominal. The product is to contain its own gel cell rechargeable battery which is automatically kept charged when AC power is present. The system shall operate on battery power for a minimum of 20 continuous hours in the event of AC power failure. A shorter backup time shall not be acceptable. The built-in charger shall be precision voltage controlled, not a "trickle charger", in order to minimize recharge time and to maximize battery life available.

**O. Integral Surge Protection:**

All power, phone line, dry contact, and analog signal inputs shall be protected at the circuit board to IEEE Standard 587, category B (6,000 volts open circuit/3,000 amps closed circuit). Gas tubes followed by solid state protectors shall be integral to the circuit board for each line.

**P. Technical/Customer Support:**

All users shall be provided and/or shall have access to the following support resources.

1. Each auto dialer shall be shipped with a CD\_ROM which details all features of the product and provides an in-depth step-by-step video programming guide. A superficial marketing overview will not be acceptable.
2. Free Live Chat support on RACO's website staffed with trained technicians shall be available during the manufacturer's normal working day.
3. Free comprehensive web-based support center with over 550 FAQs shall be available for customers to retrieve copies of all available technical information directly into his own computer. The support center shall have an optimized user interface for smartphones at <http://www.racomobilesupport.com>, allowing users to quickly navigate to the desired support topics. This service shall be available on a 24-hour basis.

4. A toll free 800 number shall be available during manufacturer's normal working day to permit users to talk directly with technical service personnel and resolve problems not solved by the RACO web-based Support Center.

**Q. Warranty:**

The dialer shall be covered by a five (5) year warranty covering parts and labor performed at the factory.

**R. Additional Features: Sealed Switches. LED Indicators. Alarm Disable Warning.**

Talkthrough:

All keyboard and front panel switches shall be sealed to prevent contamination. Front panel LED's shall indicate: Normal Operation, Program Mode, Call-in Progress, Status for each Channel, AC Power present, AC Power failure, and Low, Discharging, or Recharging Battery. On any inquiry telephone call, or On-Site status check, the voice shall provide specific warning if no dial out phone numbers are entered, or if the unit is in "alarm disabled" mode, or if AC power is off or has been off since last reset. A built-in microphone shall allow anyone at a remote site to listen to local sounds and to have a two-way conversation with personnel at the dialer.

**S. Miscellaneous Special Order Items:**

The following options shall be available on specific order:

1. Radio Communications Interface
2. Various NEMA 4X (sealed) Enclosures
3. Thermostatically Controlled Heater
4. UL Approved Power Supply
5. Cellularm Communications Systems

**T. Operating Temp: 20° to 130° F**

**U. Humidity: 0 to 95% Humidity**

**V. Auto Dialer shall be Model 301VSS-8C for Pump Stations and 304VSS-32C for Waste Water Treatment Plant as manufactured by RACO Verbatim, or approved equivalent.**

## **PART 3 -- EXECUTION**

### **3.01 REQUIREMENTS**

**A. Refer to Section 01010, of the Specifications.**

**(END OF SECTION)**

## SECTION 17180

### PROCESS CONTROL SYSTEM NETWORKS

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation IEEE 802.3 Ethernet local area network(s) for communications among plant devices.
- B. Local area network shall be provided with all spare parts, accessories, and appurtenances as herein specified.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17120 – Programmable Logic Controllers

#### PART 2 -- PRODUCTS

##### 2.01 LOCAL AREA NETWORK (LAN)

- A. An IEEE 802.3 Ethernet local area network shall be used for communications between plant devices.
- B. Network wiring shall be unshielded, twisted-pair copper cables for connections within buildings. Fiber optic media shall be used for all inter-device communication links extended outside of a building unless specifically noted. Cables shall be as specified herein.
- C. The Contractor may provide a network configuration different from that shown in the Contract Drawings with the written approval of the CMCMUA, but the Contractor shall coordinate with all affected trades and pay for all additional charges incurred.
- D. The process control system network shall meet the following requirements:
  - 1. The data transmission speed shall be as shown on the Drawings but shall in no case be less than 10 Mbps.
  - 2. The network-connected devices shall equally share access to the network. Devices shall be normally passive (listen) with respect to the network.
  - 3. Networks employing master/slave or similar communication protocols shall be rejected.
  - 4. Data communication protocol shall be firmware resident.
- E. The Contractor shall supply all hardware, cables, connectors, and software to implement a network as specified herein and shown on drawings.

## 2.02 ETHERNET NETWORK SWITCHES

- A. CMCMUA is providing all network switches and the Contractor will install as required. Contractor is responsible to purchase and install all network cabling to the network switch. Network switches will conform to the following:
- B. Except where specifically allowed on the Control System Architecture Drawing, Ethernet network switches shall be provided for each device connected to the process control system network. The switches shall create switched Ethernet networks that conform to the IEEE 802.3 and 802.3u standards using copper wires or optical fibers in a bus, tree or ring network topology as shown on the Drawings. Ethernet network switches shall be modular, rack-mounted within the PLC cabinet or in an adjacent communication cabinet, as shown on the Drawings.
- B. Ethernet network switches shall support ring, bus, tree, or point-to-point network topologies. The Ethernet network switches shall support the non-proprietary Rapid Spanning Tree Protocol (RSTP) in addition to the switch manufacturer's standard redundant ring network protocol, both of which shall provide self-healing communication recovery.
- C. Ethernet network switches shall meet the following minimum performance requirements:

Functions: Modular managed switch with store and forward switching mode, 1Gb Ethernet copper ports, multi-address capability, auto-crossing, auto-negotiation, auto-polarity. Port speed and duplex auto-negotiation shall be configurable. Each network switch shall manage up to eight (8) ports possible via integrated media modules specified below.

Features: PVLAN, PoE, PoE+, MSTP, OSPF, SDN Compatibility.

Management: Simple Network Management Protocol (SNMP) (v1/v2/v3) and Common Industrial Protocol (CIP) support; IGMP filtering and snooping.

Power Requirements: Redundant 24 VDC power supply

Operating Temperature: 0° - 60°C

Relative Humidity: 10 - 95%

Network Size: Up to 50 nodes in ring structure

Port Type & Quantity: (at each PLC location)

- As required; minimum of twelve (12) 1000Base-TX, twisted pair cable, RJ-45 sockets, 0-100 meters LAN segment
- Two (2) 100/1000Base-FX, multimode fiber optic cables (62.5/125 μm), LC or SC sockets, 0-5000 meters LAN segment, single-mode fiber compatibility

Link Budget: 8 dB @ 1300 nm; 10 dB @ 850 nm

Wavelength: 850 or 1300 nm

- D. Acceptable Ethernet network switches shall be JL693A for Pump Stations and JL225A for Waste Water Treatment Plant as manufactured by Aruba Networks, or equivalent.

### 2.03 FIBER OPTIC MEDIA CONVERTERS

- A. Fiber optic media converters shall be provided to transform the specific PLC network communications protocol into an optical signal suitable for transmission over the fiber optic cable specified herein. Fiber optic media converters shall be modular, rack-mounted, or mounted within the PLC rack.

- B. Fiber optic media converters shall meet the following minimum performance requirements:

1. Input Power: 110/220 VAC or 24 VDC (as required) for stand-alone panel-mounted modules or +5 VDC for PLC rack-mounted modules
2. Operating Temperature: 0° - 60°C
3. Node-to-Node Distance: 6500 feet
4. Wavelength: 850 or 1300 nanometers
5. Connector Type: LC or SC

- C. The PLC manufacturer's standard, PLC rack-mounted fiber optic transceiver may also be used, subject to approval by the CMCMUA.

- D. Port speed and duplex auto-negotiation shall be configurable.

- E. Acceptable fiber optic media converters shall be as manufactured by Black Box, Transition Networks or equivalent.

### 2.05 UNSHIELDED TWISTED PAIR CABLE

- A. Unshielded twisted pair cable for drops within buildings shall consist of 4 pairs of 24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 specifications. Unshielded twisted pair cable shall be Hyper Grade Extended Distance cable as manufactured by Berk-Tek, Belden equivalent, or equivalent. Connectors shall be modular RJ-45 plug.

### 2.06 FIBER OPTIC CABLE

- A. Fiber optic cable shall conform to the following specifications:

1. Fiber Type: Graded Index (GI) Single-Mode
2. Fiber/Cladding Diameter: 62.5/125 microns

3.	No. Fibers:	12, Color-coded
4.	Cable Construction:	Loose Tube, Gel-Free w/ Ripcords
5.	Filling:	Water Swellable Dry Block
6.	Armored:	No
7.	Central Member:	Dielectric (Kevlar)
8.	Rating:	Gigabit Ethernet
9.	Bandwidth:	200/500 MHz-km at 850/1300 nm
10.	Maximum Attenuation:	3.5/1.0 dB/km at 850/1300 nm
11.	Application Type:	Direct-burial/Conduit/Aerial
12.	Sheath:	UV Resistant
13.	Max. Tensile Load:	600 lb (2700 N) installation; 200 lb (890 N) long term
14.	Minimum Bend Radius:	7 in (17.4 cm) under maximum tensile load; 4.6 in (11.6 cm) unloaded (installed)
15.	Operating Temperature:	-40 to 70 degrees C
16.	Operating Relative Humidity:	0-100%

- B.** Fiber optic cable shall be ALTOS Loose Tube, Gel-Free, Double-Jacket Cable 12F, Single-Mode OS2 as manufactured by Corning Cable Systems or approved equivalent.
- C.** Upon entering a cabinet, panel, or console, loose tube fiber optic cable shall be broken out using fan-out kits and terminated in a fiber optic patch panel. All individual fibers shall be terminated and all connections shall be tested. Tight buffered cable shall then be routed to the individual destinations as needed (or loose tube cable for runs to other buildings). Cabinet-mounted patch panels shall be Cabinet-Mounted Interconnect Center (C-MIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equivalent.
- D.** Where cable is required to be routed to numerous, separate destinations within a building, loose tube cable shall be broken out immediately upon entering the building, all individual fibers terminated in a patch panel, and tight-buffered, plenum rated cable shall be routed to the individual destinations. Building patch panels shall be Wall-Mountable Interconnect Center (WIC) or Premises Interconnect Center (PIC) as manufactured by Corning Cable Systems, equivalent by Black Box, Inc., Optical Cable Corporation, or equivalent.
- E.** Fiber optic cable for installation within buildings shall comply with all applicable fire and building safety codes for such applications.

- F. Fiber optic cable shall utilize mechanically spliced, field installable, SC, LC, or ST compatible connectors. Connections shall have a typical loss of 0.35 dB or better and shall provide stable optical performance after numerous ratings. Connections shall utilize physical contact terminations utilizing UV or heat-cured adhesive. Where applicable, field terminations shall use a simple procedure requiring minimal training.

### **PART 3 -- EXECUTION**

#### **3.01 REQUIREMENTS**

- A. The destination of all network data cables (both copper and fiber) leaving an enclosure, patch panel, or building shall be labeled at each end using heat shrink wire markers.
- B. Refer to Section 17000, Part 3 of the Specifications for additional requirements.

**(END OF SECTION)**

## SECTION 17190

### UNINTERRUPTIBLE POWER SUPPLY

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the Uninterruptible Power Supply, with all accessories, and appurtenances as herein specified and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17700 – Powered Instruments, General

##### 1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals
- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

##### 1.04 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

#### PART 2 -- PRODUCTS

##### 2.01 UNINTERRUPTIBLE POWER SUPPLY

- A. Uninterruptible Power Supply shall be a Smart-UPS at a minimum for 1000VA, LCD status display.



- B. Supply voltage: 93-130 VAC.
- C. Supply Connection: 6' Cord with a NEMA 5-15P
- D. Surge Energy Rating: 455 Joules
- E. Output voltage: 120 VAC
- F. Output Connection: 8 NEMA 5-15R outlets
- G. Pure Sine wave output on battery.
- H. Temperature-compensated battery charging to prolong battery life
- I. Audible Alarms
- J. Network Manageable provide remote power management
- K. LCD Status Display
- L. Smart Connect to allow for firmware updates and advanced support
- M. Dimensions: 6.22" high X 6.73" wide X 23.43" deep
- N. Operating Temp: 32° to 104° F (0° to 40° C)
- O. Uninterruptible Power Supply shall be Model SMC 1000 as manufactured by APC, or approved equivalent.

### **PART 3 -- EXECUTION**

#### **3.01 REQUIREMENTS**

- A. Refer to Section 01010, of the Specifications.

**(END OF SECTION)**

## SECTION 17500

### ENCLOSURES - GENERAL

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.
- B. Control enclosures shall be assembled, wired, and tested in the Contractor own facilities unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17120 - Programmable Logic Controller and Enclosure Equipment
- D. Section 17510 – Cabinets and Panels
- E. Section 17550 – Panel Instruments and Accessories
- F. Section 17560 – Surge Protection Devices
- G. Section 17600 – Unpowered Instruments, General
- H. Section 17700 – Powered Instruments, General
- I. Section 17800 – Analytical Instruments, General
- J. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

##### 1.03 GENERAL INFORMATION AND DESCRIPTION

- A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without the removal of other equipment. Face-mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.
- B. Either manufacturer-standard or custom cabinetry may be furnished subject to the requirements of the Contract Documents and favorable review by the CMCMUA.

- C. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and/or field inspect new and existing structures as required to determine installation requirements, and shall coordinate the installation of all enclosures with the CMCMUA and all affected contractors. The Contractor shall be responsible for all costs associated with the installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

#### **1.04 SHOP DRAWINGS**

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals
- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

#### **1.05 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

### **PART 2 -- PRODUCTS**

#### **2.01 See Section 17120 for PLC Enclosure Contents**

### **PART 3 -- EXECUTION**

#### **3.01 FABRICATION**

- A. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel-mounted equipment, and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
- B. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:
  - 1. Louvered openings near the bottom and top (NEMA 12 cabinets only).

2. Thermostatically controlled, low noise internal air blowers (initial setpoint 75°F) to circulate air within the enclosure, maintaining a uniform internal temperature.
  3. Thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet (NEMA 12 cabinets only). Air velocities through the enclosure shall be minimized to assure quiet operation.
  4. All openings in cabinets and panels shall be fitted with dust filters.
- C. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.
  - D. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the CMCMUA, a vendor's pre-CMCMUA and prefabricated wiring termination system shall be acceptable.
  - E. Wiring within cabinets, panels, and consoles shall be installed neatly and shall comply with accepted standard instrumentation and electrical practices. Power, control, and signal wiring shall comply with Division 16 of the Specifications, except that the minimum wire size for discrete signal wiring may be 16 AWG, and analog wiring may be 18 AWG. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.
  - F. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. Where applicable, terminal strips for different voltages of discrete signal wiring shall also be separated. Terminal strips shall be labeled as to voltage and function.
  - G. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. All conductors run open shall be bundled and bound at regular intervals, not exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring.
  - H. Spare field wiring shall be bundled, tied, and labeled as specified above, and shall be neatly coiled in the bottom of the cabinet.
  - I. All installed spare I/O hardware shall be wired along with live I/O wiring to the field wiring terminal blocks within the cabinet. Where space for spare I/O modules has been provided with the PLC backplane or DIN-rail mounting system, corresponding space for wiring, surge protection, and terminations shall be furnished within the cabinet.
  - J. A copper ground bus shall be installed in each cabinet and shall be connected to the building power ground. A single point grounding technique shall be used where all grounding conductors are landed on a single ground bar and grounded to any and all metal parts.
  - K. Interior panel wiring shall be tagged at all terminations with machine-printed self-laminating labels. The labeling system shall be Brady TLS 2200 Printer with TLS 2200®/TLS PC Link™ labels or approved equivalent system by Seton or Panduit. The wire numbering system and identification tags shall be as specified in Section 16123 - Building Wire and Cable. Field wiring terminating in panels shall be labeled in accordance

with the requirements of Section 16123. Where applicable, the wire number shall be the ID number listed in the input/output schedules.

**L. Wires shall be color-coded as follows:**

Equipment Ground - GREEN

120 VAC Power - BLACK

120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED

120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - RED

DC Power (-) - BLACK

DC Control - BLUE

Analog Signal – BLACK/WHITE or BLACK/RED

**M. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a branch circuit will trip only the branch breaker but not the main breaker.**

**N. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and LED service lights. Power to these devices shall be independent of the PLC power supply and its associated uninterruptible power system.**

**O. Where applicable, enclosures shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected to Multiple Sources of Power". Letters in the word "WARNING" shall be 0.75 inches high, white.**

**P. The interconnection between equipment and panel shall be by means of flexible cables provided to permit the withdrawal of the equipment from the cabinet without disconnecting the plugs.**

**3.02 PAINTING/FINISHING**

**A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the CMCMUA from a minimum of six color samples provided. Refer to Division 9 for additional requirements.**

**B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.**

**C. Panels fabricated from stainless steel shall not be painted.**

- D. Panels fabricated from non-metallic materials (e.g., FRP) shall be gel-coated and shall not be painted.

### **3.03 INSTALLATION**

- A. Refer to Section 17000 for additional requirements.

**(END OF SECTION)**

## SECTION 17510

### CABINETS AND PANELS

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the cabinets and panels, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17500 – Enclosures, General

##### 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals
- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.05 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **PART 2 -- PRODUCTS**

### **2.01 CABINETS AND PANELS**

- A. Cabinets and panels shall be formed or welded construction, reinforced with Unistrut, Power-Strut, or equivalent to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.
- B. Cabinets and panels shall be a minimum of 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.
- C. Cabinets and panels located inside buildings, but located in areas other than climate controlled (heated and air conditioned) electrical or control rooms, shall be as a minimum 316 stainless steel NEMA 4X construction, or as specified or shown on the Drawings for hazardous area classification (Class, Division, Group), or submersible (NEMA 6) applications. Epoxy coated cast copper-free aluminum construction shall also be acceptable for NEMA 4, 6 and 7 applications. Cabinets located in storage/feed areas for chlorine or other applicable corrosive chemicals shall be of non-metallic construction, rated NEMA 4X, and fully compatible with the associated chemical.
- D. Cabinets and panels within climate controlled (heated and air-conditioned) electrical or control rooms shall be all steel fully enclosed NEMA 12 units with gasketed doors.
- E. Cabinets and panels shall have doors on the front and shall be designed for front access. NEMA 12 cabinets shall be fitted with three-point door latches. Doors for NEMA 4X cabinets shall be all stainless steel with piano hinges and three-point latches. Door hardware on NEMA 4X cabinets located in chlorine storage/feed areas shall be non-corrosive in that environment.
- F. Panels and cabinets located outside fence-secured areas shall be fitted with pad-lockable latch kits.
- G. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel.
- H. Unless otherwise noted, panel-mounted control devices (OIUs, hand switches, etc.) requiring operator access shall be mounted between 48 and 60 inches above the floor or work platform.
- I. Cabinets and panels shall be prefabricated cabinets and panels by Hoffman, Saginaw Control and Engineering (SCE), or equivalent. The Contractor may optionally provide



cabinets that are custom-fabricated by the Contractor or by a reputable panel fabrication shop acceptable to the CMCMUA.

### **PART 3 -- EXECUTION**

#### **3.01 REQUIREMENTS**

- A. Refer to Section 17500 for additional requirements.

**(END OF SECTION)**

**SECTION 17520**  
**STARTER PANELS**

**PART 1 -- GENERAL**

**1.01 THE REQUIREMENT**

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the Starter Panels, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.
- B. Motor Starter Panels in this section are for three phase 480 VAC 2 HP and less and single phase 120 VAC 1 HP and less motors.
- C. Refer to the motor size chart for motor sizes 3.01 A for technical specifications of motors

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 16000 – Basic Electric Requirements
- B. Section 16902 – Electrical Controls and Relays
- C. Section 17000 – Control and Information System Scope and General Requirements
- D. Section 17500 – Enclosures - General
- E. Section 17510 – Cabinets and Panels

**1.03 RELATED WORK SPECIFIED ELSEWHERE**

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

**1.04 SHOP DRAWINGS**

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals

- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.05 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **PART 2 -- PRODUCTS**

### **2.01 STARTER PANELS**

- A. Type 1/12/3R enclosure and subpanel to hold one (1) or two (2) motor starters and options configured with the following components for each individual motor:
  1. Lockable disconnect(s) with handles on the door.
  2. Molded case circuit breakers for motor over current protection
  3. NEMA or IEC Non Reversing starters sized for each motor with 120 VAC starter coil
  4. Class 10 overloads
  5. Normally open auxiliary contact mechanically operated by starter contact for motor running signal to PLC
  6. Normally open auxiliary contact mechanically operated by overload for motor overload signal to PLC
  7. 3 Position Selector Switches with Hand / Off / Auto name plate with a minimum of two (2) contact blocks for starter interface (120 VAC) and PLC interface 24 VDC (Per Spec 16902 Electrical Controls and Relays)
  8. 24 VDC relay for remote run command interface from PLC (Per Spec 16902 Electrical Controls and Relays)
  9. For three phase motors supply the following additional equipment for each individual motor:
    - a. Single phase 480 VAC to 120 VAC Control Transformers 100 VA with secondary fusing and grounded neutral conductor
    - b. One spare transformer secondary fuse
    - c. 120 VAC starter coil

- B.** Installations that have two (2) motors shall have individual feeders but may have all equipment in the same enclosure provided each motor has a lockable disconnect on the door of the enclosure.

For wiring diagrams see sample drawings Attachments D and E

## **PART 3 -- EXECUTION**

### **3.01 REQUIREMENTS**

- A.** The table below identifies the motors requiring a starter

**Sump Pump Motor Information**

<b>Location</b>	<b>Voltage</b>	<b>Phase</b>	<b>HP</b>	<b>FLA</b>	<b>Number of Motors</b>	<b>Notes</b>
Oak Ave PS	120	1	1	16	2	
Neptune PS	120	1	1	16	2	
Lower Township PS	120	1	1	16	4	
Rio Grande PS	120	1	1	16	2	
10th Ave PS	120	1	1	16	2	
Spicer Ave PS	120	1	1	16	2	
Rosemary Rd PS	120	1	1	16	2	
Shawcrest	120	1	1	16	2	
Wildwood Effluent	480	3	5	7.6	2	
Wildwood Eff RBC	480	3	5	7.6	2	
Wildwood Eff Meter	480	3	5	7.6	2	NEMA 3R
Wildwood Prelim	480	3	5	7.6	2	
Wildwood Prelim	480	3	5	7.6	1	
Wildwood Sludge Proc	120	1	1	16	2	NEMA 3R
Wildwood Thickener	480	3	5	7.6	2	
Wildwood Thickener	120	1	1	16	2	NEMA 3R
Wildwood Clarifier	480	3	5	7.6	2	
Wildwood Admin	480	3	25	34	2	NEMA 3R
Wildwood Chem Add	480	3	5	7.6	2	
Wildwood Pri Scum	120	1	3	34	2	
Wildwood Sec Scum	120	1	5	56	2	
Madison PS	120	1	3	34	2	
Claghorn PS	120	1	3	34	2	
CM Prelim - Sludge	120	1	2	24	2	
CM Sludge Proc	120	1	1	16	2	
OC Secondary	240	1	5	28	2	
OC Primary - Sludge	240	1	5	28	2	
OC Primary - RBC	240	1	5	28	2	
OC Eff	240	1	5	28	2	
OC Sludge Proc	240	1	5	28	2	
OC Sludge Proc - TSP	240	1	5	28	2	
20th PS	120	1	1	16	1	
3rd PS	120	1	1	16	2	

32nd PS	120	1	1	16	2
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**Other Single Motor Information**

Location	Voltage	Phase	HP	FLA	Notes
Oak Scrubber	480	3	5	7.6	
Oak Scrubber	120	1	1	16	
Rio Grande HVAC	120	1	1	16	
10th PS Scrubber	480	3	5	7.6	
11th PS Scrubber	120	1	1	16	
Spicer Scrubber	480	3	5	7.6	
Spicer Scrubber	120	1	1	16	
Rosemary PS Scrubber	480	3	5	7.6	
Rosemary PS Scrubber	120	1	1	16	
Shawcrest HVAC	120	1	1	16	
Wildwood Eff Sample	480	3	0.5	1	
Wildwood Sludge Batch	480	3	5	7.6	
Wildwood Sludge Batch	480	3	5	7.6	
Wildwood Sludge Poly	480	3	5	7.6	
Wildwood Sludge Poly	480	3	5	7.6	
Wildwood Sludge Scrubber 1	480	3	25	34	
Wildwood Sludge Scrubber 1	480	3	5	7.6	
Wildwood Sludge Scrubber 1	480	3	5	7.6	
Wildwood Sludge Scrubber 1	120	1	1	16	
Wildwood Sludge Scrubber 1	480	3	N/A	25	For heating element
Wildwood Sludge Scrubber 2	480	3	25	34	
Wildwood Sludge Scrubber 2	480	3	5	7.6	
Wildwood Sludge Scrubber 2	480	3	5	7.6	
Wildwood Sludge Scrubber 2	120	1	1	16	
Wildwood Sludge Scrubber 2	480	3	N/A	25	For heating element
Wildwood Thick Scrubber	480	3	15	21	
Wildwood Thick Scrubber	480	3	5	7.6	
Wildwood Thick Scrubber	120	1	1	16	
Wildwood Thick Scrubber	480	3	N/A	25	For heating element
Wildwood Thick Peroxide	120	1	1	16	NEMA 3R
Wildwood Pri Scum	480	3	7.5	11	
Wildwood Pri Scum	480	3	7.5	11	

Wildwood Pri Scum Mixer	480	3	25	34	
Wildwood Pri Scum Mixer	480	3	25	34	
Wildwood Sec Scum Sample	480	3	1	16	
Wildwood Sec Scum Sample	480	3	1	16	
Wildwood Sec Scum Mixer	480	3	25	34	
Wildwood Sec Scum Mixer	480	3	25	34	
Madison Scrubber	480	3	5	7.6	
Madison HVAC	208	1	5	30.8	
Claghorn Scrubber	480	3	5	7.6	
Claghorn HVAC	208	1	5	30.8	
CM Eff Sample	120	1	1	16	
CM Eff Meter	120	1	1	16	
CM Eff HVAC	480	3	3	4.8	
CM Eff HVAC	480	3	3	4.8	
CM Prelim Bio	480	3	10	14	
CM Prelim Grinder	480	3	3	4.8	NEMA 3R
CM Prelim Grinder	480	3	3	4.8	NEMA 3R
CM Prelim Scum	480	3	2	3.4	
CM Prelim Scum	480	3	2	3.4	
CM Prelim HVAC	120	1	1	16	
CM Sludge Scum	480	3	5	7.6	
CM Sludge Tanker	480	3	25	34	
CM Sludge Sec Scum	480	3	2	3.4	
CM Sludge Sec Scum	480	3	2	3.4	
CM Sludge Recycle	480	3	5	7.6	
CM Sludge Recycle	480	3	5	7.6	
CM Sludge TSP	480	3	7.5	11	
CM Sludge TSP	480	3	7.5	11	
OC Secondary Scum	480	3	5	7.6	
OC Secondary HVAC	480	3	5	7.6	
OC Secondary Lighting	208	3	NA	30	Lighting Contactor
OC Primary Scum	480	3	5	7.6	
OC Primary Scum	480	3	5	7.6	
OC Primary Ferric	120	1	1	16	
OC Primary Ferric	120	1	1	16	
OC Primary HVAC	480	3	5	7.6	
OC Primary Lighting	208	3	NA	30	Lighting Contactor
OC Effluent NonPot	120	1	1	16	
OC Effluent Sample	120	1	1	16	
OC Effluent Sample	120	1	1	16	
OC Sludge Mixer	480	3	2	3.4	
OC Sludge Mixer	480	3	2	3.4	
OC Sludge Batch	480	3	3	4.8	
OC Sludge Scum	480	3	2	3.4	
OC Sludge Scrubber	480	3	7.5	11	

OC Sludge Scrubber	480	3	7.5	11
20th PS HVAC	480	3	3	4.8
20th PS HVAC	480	3	3	4.8
3rd Scrubber	480	3	5	7.6
3rd Scrubber	120	1	1	16
3rd PS HVAC	480	3	3	4.8
3rd PS HVAC	480	3	3	4.8
32nd Scrubber	480	3	5	7.6
32nd Scrubber	120	1	1	16
32nd HVAC	480	3	3	4.8
32nd HVAC	480	3	3	4.8

**B.** Cross reference all starters above to Section 01011

**C.** Refer to Section 01010, of the Specifications for specific information on installation of starters.

**(END OF SECTION)**

## SECTION 17550

### PANEL INSTRUMENTS AND ACCESSORIES

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the panel instruments and accessories, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17500 – Enclosures, General

##### 1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All equipment mounted on the face of a panel shall conform to the same NEMA rating specified for the panel construction.

##### 1.04 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.
2. Operation and Maintenance Manuals.

- B. Each submittal shall be identified by the applicable specification section.

##### 1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.

- C. Shop drawings shall include but are not limited to:

1. Product datasheets
2. Operation and Maintenance Manuals



- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.06 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **PART 2 -- PRODUCTS**

### **2.01 ELECTRONIC INDICATORS**

- A. Electronic indicators shall be 3.5 or 6 digits, as appropriate, with 0.56" high red LED display. Indicators shall be provided with nameplate and scale calibrated to match the calibration of the primary element. The unit shall be designed primarily for use with 4-20 mA current loop signal circuits. Indicator operating voltage shall be 115 VAC 10%, 60 Hz. Indicator controls shall include three (3) front-panel pushbuttons for modifying alarm values and other indicator setup. Two (2) Form-C relays shall be provided for each indicator. Relay contact outputs shall be rated 5A, 120/240 VAC, resistive load. Where required, a regulated and isolated 24 V excitation power supply shall be provided. Indicators shall be suitable for indoor or outdoor service as required and shall have the same NEMA enclosure rating as the associated enclosure. Indicators shall be Red Lion Model PAX or equivalent.

### **2.02 SIGNAL CONVERTERS**

- A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers, and other instrumentation and controls supplied under other Divisions to the controls provided herein.
- B. General Requirements – Converters shall be of the miniature type, utilizing all solid-state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet space is not available, sub-panels or supplemental enclosures shall be provided. The power supply shall be 120V, 60 hertz where required by the converter. Repeatability shall be 0.1% of span, deadband shall be 0.1% span, maximum. Where specific converters are not listed but are required to interface with the process control system, they shall comply with the general requirements stated herein.
- C. Current to Current Isolators – Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations, or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or approved equivalent.
- D. Voltage to Current Transducers – Voltage to current (or current to voltage) transducers shall convert a voltage signal of one magnitude to a 4-20 milliamp DC current signal. The

output current shall be directly proportional to the input signal voltage. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or approved equivalent.

- E. Frequency to Current Transducers – Frequency to current transducers shall convert pulse-rate and pulse-duration signals to 4-20 mA, 24 VDC analog signals. Converters shall include a field-adjustable input frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines. Transducers shall be Series 5100 as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or approved equivalent.
- F. Current to Frequency Transducers – Current to frequency transducers shall convert 4-20 mA, 24 VDC analog signals to pulse-rate, and pulse-duration signals. Converters shall include a field-adjustable output frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines. Transducers shall be Series 5016 as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or approved equivalent.
- G. Integrators – Integrators shall be provided as interchangeable plug-in modules with zero and span adjustment available on the front plate of the units. Output shall range from 0 to 0.1 through 0 to 10 pulses per second. Accuracy shall be  $\pm 0.1\%$  of input span. Integrators shall convert linear analog signals to pulse rate and provide a solid-state output. Integrators shall be as manufactured by AGM Electronics, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or approved equivalent.
- H. Electronic Switches (Alarm Relays) – Electronic switches shall be furnished with a calibrated dial for adjusting set points. The input to the switch shall be 4-20 mADC, and the set-point shall be adjustable over the full range. Unless otherwise noted, the dead band shall be fixed at less than 2 percent of span. The setpoint stability shall be  $\pm 0.1\%$  per degree F. The repeatability shall be  $\pm 0.1\%$  of span. The units shall be furnished with SPDT relays rated at 10 amperes at 115 VAC. Electronic switches shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or approved equivalent.
- I. RTD to Current Signal Converters – RTD to current signal converters shall convert a 3-wire RTD input signal to an isolated 4-20 mADC output signal. Each converter shall operate from a 120 VAC power source. Accuracy shall be 0.10 percent of span or better. The calibrated span of each converter shall be as indicated on the instrument list. The Contractor shall coordinate the calibration of the signal converters with existing RTD elements. The signal converters shall be furnished in the manufacturer's standard enclosure for installation in an existing indoor electrical cabinet. Signal converters shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or approved equivalent.
- J. Interposing Relays – Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring

circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein. Interposing relays shall be small format type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall have a flag indicator to show relay status, a pushbutton to allow manual operation of the relay, and an internal pilot light to indicate power to the coil. Relays shall be as manufactured by Schneider Electric Magnacraft 782 family of relay or approved equivalent.

- K. Timing Relays – Timing Relays (TR) shall be the general-purpose plug-in type, Type JCK as manufactured by Square D Company, Cutler-Hammer/Westinghouse Electric Corporation equivalent, Allen-Bradley equivalent, or approved equivalent. Timing relays shall be an electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.
- L. Intrinsically Safe Relays and Barriers – Intrinsically safe relays and barriers shall be provided where required to interface with equipment such as float level switches that are located in NFPA-classified hazardous areas. Intrinsically safe relays and barriers shall be FM approved and shall be manufactured by Pepperl and Fuchs, Crouse Hinds, Square D, or approved equivalent.

**2.03 ACCESSORIES**

- A. Control operators such as pushbuttons (PB), selector switches (SS), and pilot lights (PL) shall be Square D Company Harmony Type 9001SK, or approved equivalent. Control operators shall be 30.5 mm, round, heavy-duty, oil-tight NEMA 4X corrosion resistant.
- B. Pushbuttons shall be non-illuminated, spring release type. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be the red mushroom type with a manual-pull release. Selector switches shall be non-illuminated, maintained contact type. Pilot lights shall be of the proper control voltage, push-to-test LED type with light lens colors as specified below.

<u>Color</u>	<u>Function</u>
Green	Running (Open)
Red	Stopped or Off (Closed)
Amber	Fault
White	Other

- C. Control operators shall have legend plates as specified herein, indicated on the Drawings, or otherwise directed by the CMCMUA. Legend plates shall be plastic, black field (background) with white lettering. Engraved nameplates shall be securely fastened above each control operator. If adequate space is not available, the nameplate shall be mounted below the operator.
- D. Control operators for all equipment shall be as specified herein and of the same type and manufacturer unless otherwise specified or indicated on the Drawings.
- E. Alarm horns shall be general-purpose type, panel-mounted, and shall be suitable for indoor or weatherproof service, as required. Power supply shall be either 115 VAC or 24

VDC. Horns shall be capable of producing 100 dB at 10 feet, and shall have adjustable volume. Horns shall be Vibratone series as manufactured by Federal Signal Corporation, McMaster-Carr equivalent, Edwards Signaling Company equivalent, or approved equivalent.

### **PART 3 -- EXECUTION**

#### **3.01 REQUIREMENTS**

- A. Refer to Section 17500 for additional requirements.

**(END OF SECTION)**

## SECTION 17560

### TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, install, and place in satisfactory operation the transient voltage surge suppression (TVSS) devices as specified herein and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17100 – Control and Information System Hardware, General
- D. Section 17500 – Enclosures, General

##### 1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All surge protectors of each type provided under this Contract shall be furnished by a single manufacturer.

##### 1.04 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

##### 1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:

1. Product datasheets
  2. Operation and Maintenance Manuals
- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

#### **1.06 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

### **PART 2 -- PRODUCTS**

#### **2.01 ELECTRICAL TRANSIENT PROTECTION, GENERAL**

- A. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.
- B. Manufacturer's Requirements: All transient voltage surge suppressor devices shall be multi-stage serial devices manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, Edco, Transtector, or equivalent.
- C. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.
- D. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.
- E. Suppressor Locations: As a minimum, provide surge suppressors at the following locations as shown on drawings:
1. At all connections between AC power, DC power, and associated electrical and electronic equipment, including panels, cabinets, rack assemblies, and field mounted powered instruments.
  2. At both ends of all two-wire analog signal circuits and all four-wire analog power/ signal circuits.
  3. At the panel end of all 24 VDC or 120 VAC discrete input (dry contact) and discrete output circuits.
  4. At each device termination point of copper-based communication cables (e.g., serial, parallel, Ethernet, DeviceNet, etc.).
  5. On all telephone communications lines.

6. RF antenna cable radio terminus.
- F. All indoor and outdoor panels, racks and enclosures shall contain multi-stage surge suppression devices which shall be integral with the terminal block assembly as a complete surge protection system. Systems shall be DIN rail mounted of modular design for field replacement without the need to remove terminated wiring. System shall be Phoenix Contact PLUGTRAB series, or equivalent.
- G. Surge protectors shall be as follows:
1. 120-Volt field mounted analog transmitter. The protector shall combine AC power protection and 4-20 mA signal line protection. The suppressor shall be EDCO series SLAC or equivalent.
  2. Field mounted 120-Volt power surge suppressor shall be EDCO series HSP121BT or equivalent.
  3. Panel mounted 120-volt power surge suppression shall be Phoenix PLUGTRAB or equivalent.
  4. Two and four-wire 4-20 mA analog signal line and power protection at the panel side shall be Phoenix PLUGTRAB, or equivalent.
  5. Field mounted two and four-wire field mounted 4-20 mA analog signal line and power protection shall be JOSLYN model 1669-06, Edco, or equivalent.
  6. Two-wire discrete input/output signal line protection at the panel side shall be Phoenix PLUGTRAB, or equivalent.
  7. Non-fiber optic data networks (serial, parallel, Ethernet, Profibus, Device Net telephone, etc.) shall include signal line protection at each device termination point. Phoenix PLUGTRAB, or equivalent.

## 2.02 AC POWER PROTECTION CHARACTERISTICS

- A. Surge suppressor assemblies for connections to AC power supply circuits shall be assemblies that:
1. Are constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Suppressor assemblies shall automatically recover from surge events.
  2. Comply with all requirements of UL 1449, second edition and meet or exceed the following performance criteria based on a test surge wave shape with an 8-microsecond rise time and a 20-microsecond exponential decay time:
    - a. Minimum Operating Voltage: 130V ac
    - b. Maximum Breakdown Voltage: 150V ac

- c. Maximum Operating Current: 15 amps
- d. Peak First Stage Surge Current: 20,000 amps
- e. Maximum First Stage Clamping Voltage: 350 volts
- f. Maximum Second Stage Clamping Voltage: 210 volts
- g. Ambient Temperature Range: -20 degrees C to +85 degrees C

### **2.03 ANALOG SIGNAL CIRCUIT PROTECTION CHARACTERISTICS**

#### **A. Surge suppressors for analog signal circuits shall:**

- 1. Limit line-to-ground and line-to-line voltage to 33 volts on 24V dc circuits.
- 2. Meet or exceed the following performance criteria based on a test surge wave with 8-microsecond rise time and 20-microsecond exponential decay time:
  - a. Recovery: Automatic
  - b. Peak Source Current: 10,000 amps
  - c. Pulse Lift Before Failure: 100 occurrences
  - d. Minimum Voltage Clamp Rating: 33 volts
  - e. Series Impedance: 24 ohms total
  - f. Temperature Range: -20 degrees C to +85 degrees C
  - g. Operating Voltage: Less than 30V dc
  - h. Operating Current: 4 to 20 mA dc
  - i. Resistance Line-to-Ground: Greater than 1 megohm

### **2.04 DISCRETE SIGNAL CIRCUIT PROTECTION CHARACTERISTICS**

#### **A. Surge suppressors for analog signal circuits shall:**

- 1. Limit line-to-ground and line-to-line voltage to 60 volts on 24V dc circuits.
- 2. Meet or exceed the following performance criteria based on a test surge wave with 8-microsecond rise time and 20-microsecond exponential decay time:
  - a. Recovery: Automatic
  - b. Peak Source Current: 10,000 amps
  - c. Pulse Lift Before Failure: 100 occurrences



- d. Minimum Voltage Clamp Rating: 60 volts
- e. Series Impedance: 15 ohms total
- f. Temperature Range: -40 degrees C to +85 degrees C
- g. Resistance Line-to-Ground: Greater than 1 megohm

## **2.05 COMMUNICATION CIRCUIT PROTECTION CHARACTERISTICS**

### **A. Surge suppressors for copper-based data communication circuits shall:**

- 1. Be designed for the specific data communication media and protocol to be protected (e.g., telephone, serial, parallel, Ethernet, DeviceNet, coax, twin axial, twisted pair, RF, etc.).
- 2. Provide protection of equipment to within the equipment's surge withstand levels for applicable standard test waveforms of the following standards:
  - a. IEC 60-1 / DIN VDE 0432 part 2
  - b. CCITT K17 / DIN VDE 0845 part 2
  - c. IEEE C62.31
- 3. Provide automatic recovery.

## **PART 3 -- EXECUTION**

### **3.01 REQUIREMENTS**

- A. Install in accordance with manufacturer recommended practices and applicable codes.
- B. Refer to Section 17500 for additional requirements.

**(END OF SECTION)**

## SECTION 17600

### UNPOWERED INSTRUMENTS - GENERAL

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in operation process instrumentation (flow elements, pressure switches, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process controls as shown on the Drawings and as specified. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the Contractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets, and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The Contractor shall supervise the installation of equipment provided under this Division where the installation is provided by others.
- C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17500 – Enclosures, General
- D. Section 17698 – Instrumentation and Control System Accessories
- E. Section 17700 – Powered Instruments, General
- F. Section 17800 – Analytical Instruments, General
- G. Unpowered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

## **PART 2 -- PRODUCTS**

### **2.01 GENERAL**

- A. Unless otherwise specified, instruments shall be provided with enclosures to suit specified environmental conditions. Field-mounted devices shall be rugged and mounted on walls or pipe stanchions.

## **PART 3 -- EXECUTION**

### **3.01 INSTALLATION**

- A. Equipment shall be located so that it is accessible for operation and maintenance. The Contractor shall examine the Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
- B. Field equipment shall be wall-mounted or mounted on a two-inch diameter pipe stands welded to a 10-inch square 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
- C. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
- D. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
- E. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.

### **3.02 ADJUSTMENT AND CALIBRATION**

- A. The Contractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The CMCMUA, or CMCMUA's designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the CMCMUA of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of the responsibility for meeting all specified requirements.
- B. The Contractor shall provide the services of factory-trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the CMCMUA, at no cost to

the CMCMUA. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

- C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the CMCMUA a detailed description of the installation tests to be conducted to demonstrate the correct operation of the instrumentation and control system.
- D. Field instrument calibration requirements shall conform to the following:
  - 1. The Contractor shall provide the services of factory-trained instrumentation technicians, tools, and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
  - 2. Each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy as set forth by the National Institute for Standards and Technology (NIST).
  - 3. The Contractor shall provide a written calibration sheet to the CMCMUA for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for CMCMUA approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
  - 4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the CMCMUA.
  - 5. Upon completion of calibration, devices shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to over-voltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the CMCMUA.

**END OF SECTION**

## SECTION 17698

### INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the instrumentation and control system accessories with all spare parts, and appurtenances as herein specified and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17600 – Unpowered Instruments, General
- D. Section 17700 – Powered Instruments, General
- E. Section 16902 – Electric Controls and Relays

##### 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals

- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.05 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **PART 2 -- PRODUCTS**

### **2.01 INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES**

- A. General: Accessories include various items of equipment that may be required in the system but are not scheduled. Accessories are shown on details, flow sheets or plans. Accessories are also called out in specifications for scheduled instruments and in the installation specifications. It is not intended, however, that each piece of hardware required will be specifically described herein. This sub-article shall be used as a guide to qualifying requirements for miscellaneous hardware whether the specific item is described or not.
- B. Process Tubing: Process tubing shall be 1/2 x 0.065-inch seamless, annealed, ASTM A-269 Type 316L stainless steel with Type 316 - 37 degrees stainless steel flared fittings or Swagelok or Parker-CPI flareless fittings.
- C. Power, Control and Signal Cables: Power, control and signal wiring shall be provided under Division 16 of the Specifications.
- D. Chemical Diaphragm Seals: Diaphragm seals shall be provided for isolation of pressure gauges, switches and transmitters attached to systems containing chemical solutions or corrosive fluids. As a minimum, seals shall be of all 316 stainless steel construction. In general, diaphragms shall be 316L stainless steel for operating pressures at or above 15 psi and elastomers for operating pressures below 15 psi. However, all components shall be non-reactive with the process fluid in all cases. Refer to the Instrument Schedules for specific materials requirements. Seal shall have fill connection, 1/4-inch NPT valved flush port and capable of disassembly without loss of filler fluid. Where specified, diaphragm seals shall comply with the above requirements and shall be provided with 316 SS factory filled capillaries. The seals shall be Helicoid Type 100 HA, Mansfield & Green, Ashcroft, or equivalent.
- E. Isolating Ring Seals: For solids bearing fluids, line pressure shall be sensed by a flexible cylinder lining and transmitted via a captive sensing liquid to the associated pressure sensing instrument(s).
  - 1. Full Line Size Isolating Ring Seals - For all grit/sludge/slurry/scum applications or wherever the associated pressure instrument is used for control purposes, the sensor body shall be full line size wafer design. Except where noted on the Drawings and/or Instrument Schedule, full line size ring seals shall not be required for return activated sludge (RAS) lines, but shall have tapped ring seals as specified in Item 2, below. Full line size isolating ring seals shall have 316 stainless

steel housing and assembly flanges and Buna N flexible cylinder lining for in-line mounting. The wafer shall have through bolt holes or centerline gauge for positive alignment with the associated flanged piping. The captive liquid chamber and associated instrument(s) shall be furnished with threaded drain tap and plug. Isolating ring seals shall be RED Valve Series 40, Ronningen-Petter Iso-Ring, Moyno RKL Series W, Onyx Isolator Ring, or approved equivalent.

2. Tapped Isolating Ring Seals - For all other solids bearing fluids, pressure shall be sensed via a minimum 1/2" diameter spool-type isolating ring seal mounted on a 1/2" pipe nipple at 90° from the process piping. An isolation ball valve shall be provided between the process piping and the ring seal, and a cleanout ball valve shall be provided between the ring seal and the atmosphere. The pressure instrument shall be back or side-mounted to the ring seal such that the gauge or readout may be viewed normally. Tapped isolating ring seals for solids service shall be Red Valve Series 42/742, Ronningen-Petter Iso-Spool, Onyx Isolator Ring, or approved equivalent.
- F. Filling Medium: The filling medium between instruments, isolating ring seals and diaphragm seals shall be a liquid suitable for operation in an ambient temperature ranging from -10°F to +150°F. Filling medium shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.
  - G. Isolation Valves: Isolation valves shall be 1/2 - inch diameter ball valves with 316 stainless steel body, 316 stainless steel ball, except those materials of construction shall be suitable for the associated process fluid where applicable (i.e., chemical service).
  - H. Sirens: Sirens shall be UL Listed, heavy-duty, AC motor-driven, weatherproof type capable of producing a minimum of 111 dBA at 10 feet. The power supply shall be 120 VAC, 60 hertz. Siren shall be McMaster-Carr Model 6392T11, Federal Signal Corporation equivalent, Edwards Signaling Company equivalent, or approved equivalent.
  - I. Strobe Lights: Strobe lights shall be high profile with Type 304 stainless steel base. Light is rated NEMA 4. Light shall have an outer dome to provide extra lens protection. Lens color shall be as indicated on the Drawings. Surface mount hardware shall be included. Power supply shall be 120 VAC, 60 hertz. Strobe light shall be McMaster-Carr Model 5848T71, Federal Signal Corporation equivalent, Edwards Signaling Company equivalent, or approved equivalent.

## **PART 3 -- EXECUTION**

### **3.01 REQUIREMENTS**

- A. Refer to Section 17600, Part 3 of the specifications.

**(END OF SECTION)**

## SECTION 17700

### POWERED INSTRUMENTS - GENERAL

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in operation powered process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls, and process equipment control panels with the process control system as shown on the Drawings and as specified. Powered instruments are those instruments that require power (120 VAC or 24 VDC loop power) to operate. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the Contractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets, and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The Contractor shall supervise the installation of equipment provided under this Division where the installation is provided by others.
- C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation, and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17500 – Enclosures, General
- C. Section 17600 – Unpowered Instruments, General
- D. Section 17698 – Instrumentation and Control System Accessories
- E. Section 17800 – Analytical Instruments, General
- F. Powered instruments furnished with mechanical equipment shall be furnished, installed, tested, and calibrated as specified elsewhere in the Contract Documents.

#### PART 2 -- PRODUCTS

##### 2.01 GENERAL

- A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid-state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless



otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.

- B. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.
- C. All field instrumentation for outdoor service shall be provided with enclosures which are suitable for outdoor service, as follows:
  - 1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or approved equivalent. Where possible, these instruments shall be mounted in a north-facing direction.
  - 2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in VIPAK instrument field enclosures as manufactured by O'Brien Corporation, by Intertec, or approved equivalent. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.
- D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
- E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Subsection 3.01 (B) herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.
- F. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass or PVC coated copper-free cast aluminum NEMA 4X construction.
- G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.
- H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture, and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
- I. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.
- J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

- K. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
- L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

## **PART 3 -- EXECUTION**

### **3.01 INSTALLATION**

#### **A. General**

1. Equipment shall be located so that it is accessible for operation and maintenance. The Contractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
2. Electrical work shall be performed in compliance with all applicable local codes and practices. Where the Contract Documents do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

#### **B. Equipment Mounting and Support**

1. Field equipment shall be wall-mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square by 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
2. Embedded pipe supports and sleeves shall be schedule 40, 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
3. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
4. Pipe stands, miscellaneous mounting brackets, and supports shall comply with the requirements of Division 5 of the specifications.
5. Transmitters shall be oriented such that output indicators are readily visible.

#### **C. Control and Signal Wiring**

1. Electrical, control, and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

authority to provide such support or protection as may be necessary to ensure the safety of such utility, and the costs of such measures shall be paid by the Contractor.

**PART 2 – PRODUCTS (NOT APPLICABLE IN THIS SECTION)**

**PART 3 – EXECUTION (NOT APPLICABLE IN THIS SECTION)**

**(END OF SECTION)**

## 3.02 ADJUSTMENT AND CALIBRATION

### A. General

1. The Contractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The CMCMUA, or CMCMUA's designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the CMCMUA of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of the responsibility for meeting all specified requirements.
2. The Contractor shall provide the services of factory-trained technicians, tools, and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the CMCMUA, at no cost to the CMCMUA. The Contractor shall bear all costs and provide all personnel, equipment, and materials necessary to implement all installation tests and inspection activities for equipment specified herein.
3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the CMCMUA a detailed description of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

### B. Field Instrument Calibration Requirements

1. The Contractor shall provide the services of factory-trained instrumentation technicians, tools, and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
2. If the manufacturer's recommendations require calibration, each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy as set forth by the National Institute for Standards and Technology (NIST).
3. The Contractor shall provide a written calibration sheet to the CMCMUA for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for CMCMUA approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the CMCMUA.

5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltage, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the CMCMUA.
6. After completion of the instrumentation installation, the Contractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

**(END OF SECTION)**

## SECTION 17750

### LEVEL INDICATING TRANSMITTERS AND SWITCHES

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the level transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17700 – Powered Instruments, General

##### 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals
- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.05 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **PART 2 -- PRODUCTS**

### **2.01 LEVEL INDICATING TRANSMITTERS**

- A. Level indicating transmitters shall be an explosion proof ultrasonic level transmitter that provides continuous level measurement in a hazardous area.
- B. Type 4 X aluminum XP Windowed enclosure with a 2" NPT process mounting plug for corrosive liquids.
- C. Rugged PVD transducer process mounting plug.
- D. Automatic Temperature compensation for accurate measurement.
- E. Range: 8" to 26.2' (20cm to 8M)
- F. Accuracy: +/-0.2% of range
- G. Resolution: 0.079" (2mm)
- H. Dead band: 8" (20cm)
- I. Beam width: 3" (7.6cm)
- J. Configuration: Push Button
- K. Memory: Non-volatile
- L. Display Type: LCD 6-digit display
- M. Display Units: Inches, Centimeters, Present, Feet or Meters.
- N. Supply Voltage: 18-28 VDC Loop powered
- O. Loop Resistance: 250 Ohms Max at 24 VDC
- P. Signal Output: 4-20 mA, two-wire
- Q. Signal Fail Safe: 4 mA, 20 mA, 21 mA, 22 mA or Hold Last Value
- R. Process Temp: -4° to 140° F or -40° to 60° C
- S. Level indicating transmitters shall be Model XP88 as manufactured by Flowline, or approved equivalent.

**2.02 Multi-Point Level Switch**

- A. Multi-Point level switch shall be durable all-PVC level switch for reliable sensing of corrosive liquids.
- B. NSF-approved wetted parts.
- C. 5 Action Levels Settings based on chart below:
- D. Group 1 Wiring: SPST high quality reed switches (first 4 levels will be normally open and the 5 level normally closed)
- E. Mounting Type 1: ½" NPT PVC
- F. Process Pressure: 15 PSI @ 70° F
- G. Process Temp: 0° to 125° F or -17.8° to 51.7° C
- H. Max Length: 60 Inches (152.4cm)
- I. Float Type: PVC
- J. Min Liquid Specific Gravity: 0.85
- K. Float tree shall be mounted within a contractor fabricated and supplied 2" PVC stilling well secured to the side of the sump pit to prevent ragging of the floats.
- L. The 2" PVC stilling well shall have a scalloped bottom and/or multiple ¼" holes along sides to allow liquid to pass freely between sump pit and stilling well for float activation.
- M. Float tree shall be mounted to stilling well in order to allow easy removal of float tree for testing, cleaning, and servicing of floats (2" NPT threads can be used).
- N. Level indicating transmitters shall be Model LSG-800PVC & Part Number W1039108 as manufactured by Gems Sensors, or approved equivalent.
- O. Web Site Address  
<https://ecatalog.gemssensors.com/html/configurators/LS800pvc/LS800pvc.asp?familyID=5050&vid=0,1,0,0>
- P. Standard Ordering Information for All Floats

Specific Gravity:	0.85 and greater
Max. Pressure:	Atmospheric (15 PSI)
Operating Temp.:	0 to 125
Mounting Type:	(3) 2" NPT
Switch Type:	SPST, 20VA
Wiring Group:	Group 1 - Common Return
Number of Levels:	5
Electrical Connection:	Cable
Float Material:	Buna N
Float Type:	Buna N (142251)



**Q. Site Specific Information**

Dimensional Specs	WW-Sludge Sump	Shaw-crest
L5 Normally Close	15	10
L4 Normally Open	18	13
L3 Normally Open	21	16
L2 Normally Open	24	24
L1 Normally Open	27	27
L0 (Overall)	32	32
LEAD LENGTH (IN)	1200	600
Pit Depth	14	22

**2.03 Single Float Level Switch**

- A. Float level switch shall be a Mercury Level Control Pipe mounted or Suspended polypropylene level switch for reliable sensing of liquids.
- B. Single Action: Levels Settings based on site requirements
- C. Switch Type: Low levels will be normally open and the housing is blue in color.  
High levels will be normally closed and the housing is red in color
- D. Mounting: 1" to 3" Stainless Steel with Polypropylene Saddle.
- E. Process Temp: 32° to 140° F or 32° to 60° C
- F. Cable Length: 25 to 200 feet. Order per site requirements
- G. Float Type: Polypropylene
- H. Switch: Mercury, Narrow Angle, Horizontal
- I. Switch Rating: 1.5 amps at 120 VAC  
2.25 amps at 230 VAC
- J. Float level switch shall be Model 073613, 073615 or 073617 as manufactured by Barnes or approved equivalent.

**PART 3 -- EXECUTION**

**3.01 REQUIREMENTS**

- A. Refer to Section 01010, of the Specifications.

**(END OF SECTION)**

## SECTION 17760

### PRESSURE TRANSMITTERS & SWITCHES

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the pressure indicating transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17700 – Powered Instruments, General

##### 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals
- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.05 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **PART 2 -- PRODUCTS**

### **2.01 GAUGE PRESSURE TRANSMITTERS**

- A. CMCMUA will be providing all the Pressure Transmitters.
- B. Gauge pressure transmitters shall have a stainless-steel pressure sensor that are designed for media that will not adversely attack 316L stainless steel. The back-side metal tube is made from 304 stainless steel which provides effective protection against most harsh environments.
- C. Housing: Stainless steel devices are rugged and reliable transducers for use in a wide variety of pressure sensing applications where corrosive liquids and gases are monitored.
- D. Process Connection: ¼" NPT male thread
- E. Electrical Connection: Two (2) foot pig-tail cable.
- F. Signal Output: 4-20 mA, two-wire
- G. Supply Voltage: +12.5 to +24 VDC Loop Powered
- H. Zero Pressure Offset: 3.84ma to 4.16 ma.
- I. Full Scale Span: 15.84 to 16.16ma.
- J. Pressure non-linearity: +/-0.1 to +/- .25% of full-scale span.
- K. Pressure Hysteresis: +/-0.015% normally and up to +/-0.030% Full Scale Span.
- L. Repeatability: +/-0.01% normally and up to +/-0.030% Full Scale Span.
- M. Thermal Hysteresis: +/-0.1% normally and up to +/-0.3% Full Scale Span.
- N. Vibration resistance of: 10 G at 20 to 2000Hz.
- O. Shock Resistance of: 100G for 11 milliseconds.
- P. Range: 0 to 3 psi, 0 psi to 5000 psi
- Q. Process Temp: -40° to 185° F or -40° to 85° C
- R. Gauge pressure transmitters shall be Model SPTMA0015PG5W02 for the 15 PSI transmitter and Model STPMA0100PG5W02 for the 100 PSI transmitter as manufactured by Honeywell, or approved equivalent.

## **2.02 DIFFERENTIAL PRESSURE SWITCH**

- A.** Differential pressure switch shall be diaphragm operated snap switches actuate electrical circuits with an auto reset.
- B.** Enclosure: Aluminized Steel
- C.** Mounting: Mounting holes on each side
- D.** Connection: one-hole ½" conduit
- E.** Process Connection: two ¼" OD Copper or Poly Tubing
- F.** Temperature: -40°F (-40°C) to 180°F (82°C)
- G.** Environmental: for non-classified area
- H.** Terminations: Screw
- I.** Voltage Rating: 120- 277 VAC
- J.** Switching Rating: 15 Amps
- K.** Contacts: SPDT
- L.** Sensing Range: 1" to 12" WC
- M.** Provide ¼" OD Poly Tubing.
- N.** Provide Pitot Tube Part # 269-062
- O.** Differential pressure indicating transmitters shall be Model 141-0518 as manufactured by Siemens, or approved equivalent.

## **PART 3 -- EXECUTION**

### **3.01 REQUIREMENTS**

- A.** Refer to Section 17700, Part 3 of the Specifications.

**(END OF SECTION)**

**SECTION 17770**  
**SIGNALING DEVICES**

**PART 1 -- GENERAL**

**1.01 THE REQUIREMENT**

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the signaling devices, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17700 – Powered Instruments, General

**1.03 RELATED WORK SPECIFIED ELSEWHERE**

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

**1.04 SHOP DRAWINGS**

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals
- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.05 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **PART 2 -- PRODUCTS**

### **2.01 OUTDOOR ALARM HORN**

- A. Alarm horn shall have a NEMA type 4X enclosure with an adjustable output from 78 to 101 dB and a minimum of 200-hour rating.
- B. PLC Compatible Model
- C. Housing: Die-cast weatherproof box
- D. Finish: Powder Epoxy, Corrosion Resistant, Gray Finish
- E. Mounting: Flat Surface Mounting or on 3/4" NPT
- F. Connections: 2 3/4"-14 NPT connection one in back and one in bottom
- G. Assembly: Convenient Plug-In
- H. Volume: Adjustable from 88 to 111 dB @ 1 meter
- I. Supply Power: 19.2 to 26.4 VDC
- J. Coil Resistance: 24Ω
- K. Current draw: 160mA continuous when on
- L. Alarm Horn shall be Model 877-G1 as manufactured by Edwards Signaling, or approved equivalent.

### **2.02 PLC ALARM HORN**

- A. PLC Enclosure alarm horn shall Mallroy Sonalert SC628JR or approved equivalent.
- B. 6-28VDC, 78-89db, Panel Mount, Slow Pulse, 2.9 kHz, SC Series
- C. Housing: Black plastic
- D. Current Rating 20 mA
- E. 42.85 MM diameter
- F. Connections: Screw Terminal

### **2.03 TEMPERATURE HEAT DETECTOR**

- A. Heat Detector shall be a rate of rise temperature heat detector that senses a rise of 15°F (9°C) or more per minute activates the contacts on the alarm.

- B. Housing: Plastic with Pure White Finish
- C. Mounting: Flexible Mounting with Low Profile with mounting plate  
Easy twist installation
- D. Environment: Indoor – Dry location
- E. Contacts: Single Pole Normally Open
- F. Rating: 1amp at 6 to 24 VDC
- G. Termination: Screws
- H. Max Temperature at Ceiling is 100°F (38°C)
- I. Heat Detector shall be Model 281B-PL as manufactured by Edwards Signaling, or approved equivalent.

#### **2.04 FIRE ALARM STATION**

- A. Fire Alarm Station shall be red solid die-cast metal construction for long life and use standard glass break activation.
- B. Enclosure: Die-Cast Metal
- C. Mounting: 4" Standard Square Box
- D. Activation: Pull lever with less than 5 lbs. pull force
- E. Contacts: DPST
- F. Terminations: Screw Terminals
- G. Presignal Activation: Key Operation
- H. Fire Alarm Station shall be Model K-270P-DPO as manufactured by Edwards Signaling, or approved equivalent.

#### **2.05 WIDE GAP DETECTOR**

- A. Wide Gap detector shall be rugged construction for long life and be made with Aluminum housing.
- B. Enclosure: Brushed Anodized Aluminum with ABS Plastic end caps
- C. Temperature: -40°F to 105°F (-40°C to 65°C)
- D. Environmental: Hermetically sealed reed switch encapsulated in polyurethane
- E. Response Time: 1 MSec Max
- F. Life Cycles: 100,000 under full load



- G. Lead Type: Stainless Steel Armored Cable with #22 AWG wire 3' Long
- H. Voltage Rating: 30 VAC / VDC
- I. Load Rating: 3W/VA
- J. Switching Rating: 0.25 Amps
- K. Contact Resistance: 0.25 Ohms
- L. Contacts: SPDT
- M. Sensing Range: 3.0"
- N. Wide Gap Detector shall be Model 2505A-L as manufactured by Edwards Signaling, or approved equivalent.

## **2.06 PHOTOCONTROL DETECTOR**

- A. Photocontrol detector shall be rugged construction for long life and be made with Polycarbonate housing.
- B. Housing: Waterproof Lexan
- C. Color: Gray
- D. Mounting: ½" - 14 NPSM Swivel Mount
- E. Terminations: 6" long, #18awg leads
- F. Environment: Outdoor
- G. Power: 24 VDC
- H. Load Rating: 240VA
- I. Temperature: -40°F (-40°C) to 158°F (70°C)
- J. Life Cycles: 5-year warranty
- K. Photocontrol Detector shall be Model PPS-5 as manufactured by Cooper Controls, or approved equivalent.

## **PART 3 -- EXECUTION**

### **3.01 REQUIREMENTS**

- A. Refer to Section 17700, Part 3 of the Specifications.

**(END OF SECTION)**

## SECTION 17790

### VIBRATION SWITCH

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation the Vibration switch, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17700 – Powered Instruments, General

##### 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Operation and Maintenance Manuals.
- B. Each submittal shall be identified by the applicable specification section.

##### 1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but are not limited to:
  - 1. Product datasheets
  - 2. Operation and Maintenance Manuals
- D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

## **1.05 OPERATION AND MAINTENANCE MANUALS**

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

## **PART 2 -- PRODUCTS**

### **2.01 VIBRATION SWITCH**

- A. Vibration switch shall handle direct shock and vibration. Will be enclosed in a NEMA 3R housing.
- B. Enclosure: NEMA 3R
- C. Mounting: Base Mount
- D. Connection: 1/2" NPT
- E. Contacts: 2 SPDT
- F. Termination: Screw
- G. Reset: Manual Reset Push Button
- H. Operating Temperature: -40°F to 140°F (-40°C to 60°C)
- I. Sensitivity Adjustment
- J. Vibration Switch shall be Model VS2 for the as manufactured by Murphy, or approved equivalent.

## **PART 3 -- EXECUTION**

### **3.01 REQUIREMENTS**

- A. Refer to Section 17700, Part 3 of the Specifications.

**(END OF SECTION)**

## SECTION 17800

### ANALYTICAL INSTRUMENTS - GENERAL

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in operation the analytical instruments as scheduled in the following sections together with all signal converters, transmitters, isolators, amplifiers, etc. to interface with the process control system as shown on the Drawings and as specified. The Contractor may elect to install sensors on process lines provided that the Contractor provides full on-site supervision during installation. Mounting of associated indicators, sensors, sampling pumps, power supplies, brackets, and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The Contractor shall supervise installation of equipment provided under this Section where installation is provided by others.
- C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the analytical instrument served. The Contractor shall ensure that the location, supports, orientation, and dimensions of the connections and tapping for instruments furnished under this Section are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17030 - Control and Information System Submittals
- C. Section 17500 – Enclosures, General
- D. Section 17600 – Unpowered Instruments General
- E. Section 17698 – Instrumentation and Control System Accessories
- F. Section 17700 – Powered Instruments General
- G. Analytical instruments furnished with mechanical equipment shall be furnished, installed, tested, and calibrated as specified elsewhere in the Contract Documents.

##### 1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.

2. Operation and Maintenance Manuals.

B. Each submittal shall be identified by the applicable specification section.

#### **1.04 SHOP DRAWINGS**

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals shall be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.

C. Shop drawings shall include but are not limited to:

1. Product datasheets

2. Operation and Maintenance Manuals

D. The shop drawing information shall be complete and organized in such a way that the CMCMUA can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

#### **1.05 OPERATION AND MAINTENANCE MANUALS**

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

### **PART 2 -- PRODUCTS**

#### **2.01 GENERAL**

A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid-state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.

B. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.

C. All field instrumentation for outdoor service shall be provided with enclosures that are suitable for outdoor service, as follows:

1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or approved equivalent. Where possible, these instruments shall be mounted in a north-facing direction.

2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in VIPAK instrument field enclosures as manufactured by O'Brien Corporation, by Intertec, or approved equivalent. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.
- D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
  - E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Subsection 3.01 B herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.
  - F. Unless otherwise specified, field instrument, and power supply enclosures shall be 316 stainless steel, fiberglass (or equivalent) or PVC coated copper-free cast aluminum NEMA 4X construction.
  - G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.
  - H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture, and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
  - I. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.
  - J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
  - K. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
  - L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

## 2.02 ANALYSIS INSTRUMENTS

- A. Liquid samples shall not pass through housings containing analyzer electronics. Process

fluid temperature will be within a range of 40 to 90 degrees F.

- B. Where ambient temperatures will affect accuracy by more than 1 percent of span, a suitable isothermal enclosure with thermostatically controlled space heater shall be provided.
- C. Sample assemblies shall be suitable for submersion or flow-through service as noted and shall be chemically inert to constituents of raw wastewater solids or other chemical environments, as scheduled. Where the sample is drawn prior to filtration, the sample assemblies shall be capable of handling solids and grease.
- D. Each analyzer requiring reagents and/or other replaceable parts shall be furnished with sufficient chemicals and replaceable parts for startup and acceptance tests and the specified warranty period.
- E. Contractor's submittals on these analyzers shall include information on monthly reagent consumption and a list of replaceable parts required for periodic maintenance and the recommended operating periods between replacements. Installation of analyzers and sample preparation shall be in accordance with the analyzer manufacturer's instructions.
- F. Analysis instrumentation performance, accuracy and reproducibility shall be as prescribed in APHA/AWWA/WEF "Standard Methods for the Examination of Water and Wastewater", latest edition. For those measurements specified herein, for which performance characteristics are not listed in the above, the supplier shall state instrument performance characteristics. The "referee" method shall be as prescribed in EPA Methods for Chemical Analysis of Water and Wastes (1971).

## **PART 3 -- EXECUTION**

### **3.01 INSTALLATION**

#### **A. General**

- 1. Equipment shall be located so that it is accessible for operation and maintenance. The Contractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
- 2. Electrical work shall be performed in compliance with all applicable local codes and practices. Where these specifications and the Drawings do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

#### **B. Equipment Mounting and Support**

- 1. Field equipment shall be wall-mounted or mounted on a two-inch diameter pipe stands welded to a 10-inch square by 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted

between 48 and 60 inches above the floor or work platform.

2. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
3. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.
5. Transmitters shall be oriented such that output indicators are readily visible.

**C. Control and Signal Wiring**

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

**3.02 ADJUSTMENT AND CALIBRATION**

- A. The Contractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The CMCMUA, or CMCMUA's designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the CMCMUA of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of the responsibility for meeting all specified requirements.
- B. The Contractor shall provide the services of factory-trained technicians, tools, and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the CMCMUA, at no cost to the CMCMUA. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.
- C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the CMCMUA a detailed description, in duplicate, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.
- D. Field instrument calibration shall conform to the following requirements:
  1. The Contractor shall provide the services of factory-trained instrumentation technicians, tools, and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
  2. Each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments and specified chemicals of known values to simulate inputs and



read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy as set forth by the National Institute for Standards and Technology (NIST).

3. The Contractor shall provide a written calibration sheet to the CMCMUA for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for CMCMUA approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the CMCMUA.
5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the CMCMUA.
6. After completion of the instrumentation installation, the Contractor shall perform a loop check. The Contractor shall submit the final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

**(END OF SECTION)**

## SECTION 17900

### TAGGING CONVENTION & DESCRIPTIONS

#### PART 1 -- GENERAL

##### 1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place in satisfactory operation all hardware and software required to provide the Control And Information System as specified herein and as shown on the Drawings.

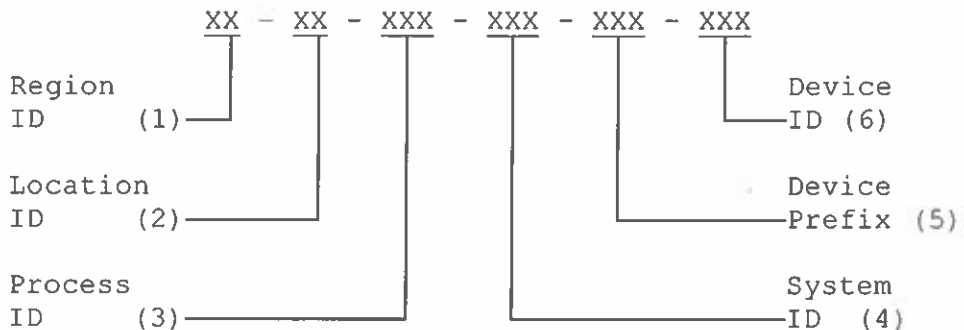
##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. None

#### PART 2 -- CONVENTIONS

##### 2.01 PLANT NUMBERING SYSTEM

- A. The plant equipment numbering system is based on a six-piece hierarchical identifier. The numbering system is broken down as follows:



1. Region ID (2 character identifier)

Example:  
Seven Mile - "SM"

2. Location ID (2 digit identifier)

Example:  
Plant - "01"  
Collection System - "02"

3. Process ID (3 digit identifier)

Example:  
Preliminary Treatment - "001"

Primary Treatment - "002"  
Secondary Treatment - "003"

4. System ID (3 digit identifier)

Example:

Metering - "001"  
Septage - "002"  
Screening - "003"

5. Device Prefix (2-3 character identifier)

Example:

Pump - "PMP"  
Motor - "MTR"  
Flow Transmitter - "FT"

6. Device ID (3 digit identifier)

B. Devices are generally represented on drawings using the last three identifiers.

Example:

XXX - XXX - XXX  
001 - PMP - 001

**PART 3 – EXECUTION (Not Applicable in this Section)**

**(END OF SECTION)**