

## INSTRUMENTATION AND CONTROL GENERAL REQUIREMENTS

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### 1. GENERAL

#### 1.1 Requirements of Work

- .1 Supply, install, Verify Performance, provide commissioning assistance, and provide warranty for a complete and fully documented I&C system as shown on the Drawings and specified herein. The I&C system will form a subsystem of the overall WTP control system and contains City supplied equipment and Vendor Packages as specified in this and other Sections of the Specification.
- .2 Component subsystems of the I&C system will include, but are not limited to, the following:
  - .1 Primary elements and transmitters
  - .2 Final control elements
  - .3 I&C field devices
  - .4 I&C junction boxes, local control panels, and marshalling panels
  - .5 Instrumentation cabling
  - .6 Instrumentation power supplies
  - .7 Conduit and cable tray
  - .8 PLC based control system
  - .9 Analyzer and transmitter manufacturer's configuration and programming software
- .3 The Contractor's responsibility also includes receiving, un-crating, examining for shortages or damage, assembling, field fitting, installing, mounting, wiring, and testing of City supplied equipment and Vendor Packages.
- .4 Where packaged, stand-alone control systems are supplied under other Divisions of this Specification, provide cabling to connect to the required remote monitoring and/or controllers. Provide end-to-end Performance Verification of all required remote monitoring and/or controllers. Ensure the correct functionality of any equipment supplied under Divisions 15 and 16.
- .5 Documentation provided by the Contractor shall include as a minimum:
  - .1 Equipment descriptive data.
  - .2 Equipment installation instructions, service manuals, O&M manuals, bills of materials, and recommended spare parts lists.

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- .3 Schematics and interconnection wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.
  - .4 Records of conductor identification, field terminals, cable lists, changes, etc.
  - .5 I&C panel Shop Drawings, face layouts, schematics, and point-to-point wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.
  - .6 Records of as-built information for the complete instrumentation system.
  - .7 For the PLC based control system, the Contractor shall provide detailed documentation of the system hardware.
- .6 Documentation provided by the Contractor shall be formatted as follows:
- .1 P&IDs – Depict the general intent of the control systems and are to be used as the governing document for the scope of Work.
  - .2 Instrument Index – A sorted index of the detailed information for the devices shown on the P&IDs. The index lists the appropriate support documentation for the devices' supply and installation. The instrument index is the controlling document for the supply of materials.
  - .3 I/O Index – A sorted index of the control system I/O points shown on the P&IDs, giving the supporting documentation as per the instrument index.
  - .4 Instrument Specification Sheets – Detail the relevant data for the supply of devices.
  - .5 Instrument Loop Diagrams – Show interconnections and hook-up of devices. The Contractor is to produce an instrument loop diagram for each device and record all relevant information on each sheet for submission at the completion of the Work. Fill in all terminal and wiring numbers etc. from the Shop Drawings as they become available. A set of 'B' size (11" x 17") AutoCAD drawings and associated files will be made available to the Contractor.
  - .6 Location Drawings – Indicate in plan and/or elevation views where the instrument elements are physically located. These Drawings are provided to assist the Contractor in estimating the amount of cable and ducting required.
  - .7 Standard Details – Provide a reference for installation, operation, and other instructions pertinent to a particular device.
  - .8 Detailed Specification – Lists qualifications, quality of materials and workmanship, and supplementary information.

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.7 References

- .1 This Specification contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section prevail.

<b><u>Reference</u></b>	<b><u>Title</u></b>
<b>API 550</b>	Manual on Installation of Refinery Instruments and Control Systems, Part I – Process Instrumentation and Control Section one (1) through thirteen (13)
<b>ASME BPVC-VIII-1-2004</b>	Rules for Construction of Pressure Vessels
<b>ASTM B68-02</b>	Seamless Copper Tube
<b>ASTM D883-00</b>	Terms Relating to Plastics
<b>IEEE 100-00</b>	Dictionary of Electrical and Electronic Terms
<b>ANSI/ISA-7.0.01 1996</b>	Quality Standard For Instrument Air
<b>ISA 5.4-1999</b>	Instrument Loop Diagrams
<b>ISA S18.1-79(1992)</b>	Annunciator Sequences and Specifications
<b>ISA S51.1-79(1993)</b>	Process Instrumentation Terminology
<b>NEMA 250-2003</b>	Enclosures for Electrical Equipment (1000V Max)
<b>NEMA ICS 1-00(R2005)</b>	General Standards for Industrial Controls and Systems
<b>NEMA ICS 2-2000</b>	Industrial Control and Systems, Controllers, Contactors
<b>NFPA 70-2005</b>	National Electrical Code
<b>SAMA PMC 17-10-63</b>	Bushings and Wells for Temperature Sensing Elements
<b>UBC-88</b>	Uniform Building Code
<b>UL 1012-89</b>	Power Supplies
<b>UL 94-06</b>	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
<b>Weik, Martin H.</b>	Communications Standard Dictionary, Van Nostrand Reinhold Co., 1983

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.8 Related Work

.1 Mechanical: Division 15

.2 Electrical: Division 16

.9 Codes, Rules, Permits and Fees

.1 Give all required notices, submit Drawings, obtain all permits, licenses, and certificates, and pay all fees required for this Work.

.2 Furnish a certificate of final inspection and approvals from inspection authorities to the Contract Administrator.

.10 Qualifications

.1 The instrumentation Subcontractor shall be a firm normally engaged and fully competent in the type of Work described in this Section of the Specification. The firm shall have been continuously and successfully engaged in this business for at least five (5) years.

.2 Qualified journeyman instrument mechanics that are familiar with the devices being installed shall perform all instrument hook-ups, calibrations, and checkouts.

.3 Qualified journeyman electricians shall perform all control wiring installation and connections.

.11 Standards of Workmanship

.1 Arrange and install products to fit properly into designated building spaces.

.2 Install products in accordance with the recommendations and ratings of the product Manufacturers.

.3 Supply and execute installation of all instrumentation control tubing in accordance with Section 17140 – Instrument Air Supply and Transmission.

**1.2 Equipment**

.1 Receiving, storing, and protection of components during construction:

.1 Examine each component upon delivery to Site. Report all damage noted to the Contract Administrator prior to accepting or rejecting delivery. All instrumentation primary elements, control components, panels, etc. shall be placed in a secure, dry, heated storage building. Maintain the space temperature above 10°C and the space relative humidity below 50%.

.2 Perform a preliminary examination upon delivery to ensure that:



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- .1 All I&C components supplied for this project under this Section of the Specifications comply with the requirements stated in the instrument specification sheets.
  - .2 All I&C components supplied under other Sections of these Specifications, to be connected to I&C components supplied under this Section of the specifications, comply with the requirements stated in the Contract Documents.
  - .3 Itemize all non-conformities noted above and forward them to the Contract Administrator. Any delays in construction resulting from the delivery to Site of non-conforming I&C components shall be borne by the Contractor.
  - .4 Do not install primary elements or other sensitive equipment until construction is sufficiently completed to provide an "operating condition" environment. Notify the Contract Administrator prior to installing any equipment of this type.
  - .5 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage.
- .2 Take all necessary precautions to ensure that equipment is supplied free of damage. If deemed necessary by the Contract Administrator, damaged equipment shall be replaced with new product at no additional cost to the City. The Contractor shall bear any costs due to construction delays resulting from the delay in delivery of acceptable equipment.

### 1.3 Documentation

- .1 Submittals
  - .1 Submit Shop Drawings for all products supplied by this Division. Submit Shop Drawings for review prior to purchase of any products or equipment and sufficiently in advance to allow ample time for checking.
  - .2 Contractor to review, modify, and approve the Shop Drawings prior to submitting Shop Drawings to the Contract Administrator for review. Contractor approval of a Drawing indicates the following:
    - .1 The Drawing has been checked by the person making the approval.
    - .2 The equipment or material complies in all respects with the requirements of the Specifications and Drawings.
    - .3 The quantities indicated are correct.
    - .4 The physical dimensions of the components are such that they can be installed without interference with the building structure or other equipment, and after installation, there are sufficient clearances on all sides for maintenance, servicing and operation of the equipment.

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- .5 The points of attachment are clearly indicated, i.e. TOP, BOTTOM, SIDE, etc.
- .6 The arrangement and location are properly oriented.
- .7 The product is suitable for its intended use.
- .8 The submission consists of sufficient information to adequately convey the scope of supply and the specific product to be supplied is highlighted.
- .9 The submission contains sufficient information to install the equipment or systems.
- .3 Stamp and sign the Shop Drawing to show approval, indicating the above has been complied with. If Contractor revisions are too extensive, return the submission to the Manufacturer for revision, then repeat the Shop Drawing approval process before submitting to the Contract Administrator.
- .4 Manufacture of products shall conform to Shop Drawings marked as reviewed by the Contract Administrator and returned to the Contractor.
- .5 Keep one (1) complete, maintained set of Shop Drawings at the Job Site during the construction period. Record modifications and changes as they arise during the construction period and incorporate these changes in the Record Drawings.
- .6 Refer to Division 1 for further information on Shop Drawing submittals.
- .2 O&M Manuals
  - .1 Refer to Division 1 for general O&M manual submittal information.
  - .2 In addition to the requirements specified in Division 1, provide the following information:
    - .1 Table of Contents – Arrange contents sequentially by systems under section numbers. Label tabs of dividers between each to match section numbers in the Table of Contents.
    - .2 Systems Descriptions – A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
    - .3 O&M instructions of all equipment and controls – These operating instructions need not be Manufacturer's data but may be typewritten instructions in simple language to guide the City in the proper O&M of this installation.
    - .4 A copy of all wiring diagrams complete with wiring coding.
    - .5 Include type and accuracy of instruments used.
    - .6 Set of final reviewed Shop Drawings.

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- .7 Provide a tabulated list of all consumables utilized (fuses, lamps, etc.) indicating where used, type, rating and reorder details.
- .3 Record Drawings
  - .1 Maintain On-Site a complete set of Record Drawings.
  - .2 In addition to the requirements stated in Part E13, record the following information on the Drawings:
    - .1 all changes alterations or additions
    - .2 all instrumentation cable and control tubing
    - .3 all changes to the numbers and location of outlets, motors, panels and end devices that may occur during the course of the Work.
  - .3 Before requesting the Certificate of Total Performance, make any necessary final corrections to the Record Drawings, sign each print as a certification of accuracy and deliver all sets to the Contract Administrator for approval.

## **2. PRODUCTS**

### **2.1 General**

- .1 Refer to the requirements of Division 1.
- .2 Selected Products:
  - .1 The design have been based on the use of the first named product where multiple products have been listed.
  - .2 The instrument Manufacturer's listed within this Division have been compiled into the list of approved instrument Manufacturer's that is included in the Appendices. Please refer to Division 11 for process specific analyzers not included in this list.
- .3 Quality of Products
  - .1 All products provided should be CSA approved, ULC approved where applicable, and new unless otherwise specified.
  - .2 If products specified are not CSA approved, obtain special approval of the relevant provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
  - .3 Products provided, if not specified, shall be new, of a quality best suited to the purpose required and there use subject to approval by the Contract Administrator .

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### **.4 Uniformity of Manufacture**

- .1 Unless otherwise specifically called for in the Specification, uniformity of manufacture to be maintained for similar products throughout the Work.

### **.5 Product Finishes**

- .1 Contractor to specify proposed finishes to be used for Contract Administrator's review.

### **.6 Use of Products During Construction**

- .1 Any equipment used for temporary or construction purposes is to be approved by the Contract Administrator. Clean and restore to "as new" condition all equipment prior to the time of Substantial Performance.

## **2.2 Instrumentation**

### **.1 General**

- .1 Instruments are to be suitable for the environmental conditions in which they are to be installed.
- .2 Determine where injurious conditions may be expected to occur and make proper provision to protect the instruments to ensure their proper and reliable operation.
- .3 Provide power surge protection, heating cables, and devices to protect instruments, equipment, and lines from being functionally impaired or damaged by power surges or environmental conditions such as moisture or freezing.

## **2.3 Identification**

- .1 Refer to Division 16 for general identification requirements. Provide lamacoid nameplates with 6 mm black lettering on white background. Identify the loop tag number (where applicable) and the device name, function, and instrument range or setpoint value on the nameplate.
- .2 Where it is not possible to attach a lamacoid nameplate to a field instrument component, provide the component with a stainless steel metal tag firmly wired to the device and identified with the loop tag number.
- .3 Identify all wires where they terminate at the marshalling panels, junction boxes, control panels, and field devices with a heat shrink sleeve with machine printed labeling.
- .4 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.
- .5 Provide neatly typed circuit directories for panel power distribution systems to indicate loops or devices powered by the circuit and the fuse size.

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- .6 Identify all exposed control conduits at all pull box locations, where the conduits enter or leave a room, and 13 m on centre throughout the room. This shall apply to conduits above removable ceilings. Use Thomas & Betts TY-RAP 5532-M labels for conduit identification.
- .7 For direct current wiring use black for positive and white for negative.
- .8 For thermistor wiring to motors use red and blue coloured insulated wire.

### **3. EXECUTION**

#### **3.1 Coordination With Other Divisions**

- .1 Examine the Drawings and Specifications of all Divisions and become fully familiar with the Work. Before commencing Work, obtain a ruling from the Contract Administrator on any conflicting issues between Divisions. No compensation will be made for any costs arising from conflict not identified before Work has commenced.
- .2 Coordinate the Work to be performed under this Section of the Specification with all Divisions installing equipment to ensure that there are no conflicts.
- .3 Install anchors, bolts, pipe sleeves, hanger inserts, etc. required in ample time to prevent delays to installation Work.
- .4 Lay out the Work and equipment with due regard to architectural, structural, and mechanical features. Architectural and structural Drawings take precedence over electrical Drawings regarding locations of walls, doors, and equipment.
- .5 Structural members shall not be cut without prior approval of the Contract Administrator.
- .6 Examine previously constructed work and notify the Contract Administrator of any conditions which prejudice the proper completion of this Work.

#### **3.2 Product Handling**

- .1 Use all means necessary to protect the products included in this Division before, during and after installation, and to protect products and installed Work of all other trades.
- .2 Any damage to the products and/or installed Work shall be repaired or replaced to the approval of the Contract Administrator by the Contractor.
- .3 Remove advertising labels from all products installed that have such labels attached. Identification or CSA labels are not to be removed.
- .4 Remove dirt, rubbish, grease, etc. resulting from Work performed under this Division of the Contract from all surfaces.

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**3.3 Separation of Services**

- .1 Maintain separation between the electrical wiring system, piping, ductwork, and the instrumentation cables so that each system is isolated (except at approved connections to such systems) to prevent galvanic corrosion. In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is unacceptable.
- .2 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from the Contract Administrator and the ceiling installer, and only if approved clips or hangers are used.
- .3 Classifications of Circuits
  - .1 The circuit categorization shall of first priority follow Canadian Electrical Code with respect to separation for electrical safety and the following shall apply with respect to electro-magnetic compatibility:

Very Noisy	High voltage circuits and their associated grounding
	High current (>200 A) LV circuits.
	Harmonic-rich LV circuits.
	DC circuits: un-suppressed or above 50 V.
Noisy	Low current class two (2) circuits.
	Medium power pulsed or radio frequency circuits.
Indifferent	ELV digital status circuits.
	Intrinsically safe circuits.
	Telecommunications circuits.
	Fire alarm and emergency lighting circuits (note that some fire alarm circuits may fall into the category of signal circuits).
	Any other emergency, shutdown, or high integrity circuit (e.g. toxic gas alarm).
Sensitive	Analogue signal circuits.
	Data communication circuits.
Very Sensitive	Low level voltage and current signals (e.g. from instrument sensors).

- .4 Separation of Circuits
  - .1 This Section relates to the running of cables carrying differing types of circuit in close proximity to one another and to other services. Sensitive circuits shall normally be run in overall shielded cable. Very sensitive circuits shall normally be run in individually twisted pair shielded cable.
  - .2 For cables sharing the same support/containment system, the following shall provide guidance to minimize extraneous interference.

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<b>Segregation between circuits</b>	<b>Very Noisy</b>	<b>Noisy</b>	<b>Indifferent</b>	<b>Sensitive</b>	<b>Very Sensitive</b>
Very Noisy	Thermal grouping as per CE Code.	150 mm	300 mm	300 mm	300 mm
Noisy	150 mm	Thermal grouping as per CE Code.	150 mm	150 mm	150 mm
Indifferent	300 mm	150 mm	Separation of circuit types.	100 mm	100 mm
Sensitive	300 mm	150 mm	100 mm	Touching	50 mm
Very Sensitive	300 mm	150 mm	100 mm	50 mm	Touching

**3.4 Wire and Cable**

- .1 Refer to Section 17124 – Instrumentation Cable.

**3.5 Equipment Connections**

- .1 Prior to the connection of signal wiring to process control and instrumentation devices, check the device voltage rating and polarity for compatibility with the corresponding loop and/or schematic diagram. Where device and circuit characteristics are found to be incompatible, the connections are not to be made. Report the condition immediately to the Contract Administrator.
- .2 All control wiring diagrams illustrate typical control circuits applicable to the type of equipment specified. Control circuits may vary with different manufacturer’s equipment. Verify all control circuits with the Manufacturers of the equipment and make any corrections to the control wiring diagrams that may be required.
- .3 Provide power disconnect terminals in marshalling panels for all devices and PLC I/O sourced from the panel. Provide local power disconnect switches for all 120 VAC power instruments. Mount adjacent the instrument.
- .4 Provide a disconnecting means in the cable connecting each ultrasonic transponder to the transmitter. This disconnect shall consist of a terminal strip in a local water proof junction box.

**3.6 Wiring to Equipment Supplied by Others**

- .1 Equipment supplied by the City or as part of a vendor package, that has external or field mount control devices, are to be installed and wired by this division. The equipments performance will also be verified by this Division.

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### 3.7 Access Panels

- .1 Provide access panels where I&C system junction boxes are concealed. Panels to be of adequate size for servicing of the concealed junction box and complete with necessary frames and hinged doors held closed with captive fasteners.
- .2 In removable ceiling areas provide markers on ceiling tile to locate equipment requiring access. Use a 25 mm diameter blue circle painted on the access panel to indicate that it is for instrumentation and control system access.

### 3.8 Instrument Mounting Stands

- .1 Supply and install instrumentation mounting stands as required. Stands are to be either floor or wall mounted. The mounting stands are to be fabricated from aluminum or galvanized steel.
- .2 Supply and install protective drip shields for any exterior stand-mounted instrumentation equipment. The drip shield is to extend 50 mm at the top and sides from the front face of the equipment. The drip shield is to be fabricated from aluminum.

### 3.9 Sealing of Wall and Floor Openings

- .1 Seal all conduit and cable entries passing through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade.
- .2 Seal openings after all wiring entries have been completed.
- .3 Sealing material shall be fire resistant and not contain any compounds which will chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations, if required, are to be sealed. Acceptable methods are Canstrut "Fire Stop", Electrovert "Multi-Cable Transit" or Dow Corning RTV Silicone Foam.

### 3.10 Sleeves

- .1 Provide sleeves of galvanized steel pipe with machine cut ends of ample size to accommodate conduits passing through walls, partitions, ceilings, floors, etc.
- .2 For wall partitions and ceilings the ends shall be flush with the finish on both sides. For floors, the ends shall extend 100 mm above finished floor level.
- .3 Fill the space between the sleeve and the conduit with fire stop material and caulk around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound. Ensure that the seal is compatible with the floor and ceiling finishes.
- .4 Locate the sleeves and position exactly prior to construction of the walls and floors.
- .5 Failure to comply with the above requirements shall be remedied at the Contractor's expense.



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### **3.11 Connections to Mechanical, Electrical and Existing Systems**

- .1 Refer to Division 16 for the required tie-in procedures.

### **3.12 Tagging Standards for Devices and Wiring**

- .1 Tag all devices, wires, and I/O using the assigned loop, equipment, or device tag name. Where tag naming and numbering is not specified, the Contract Administrator will provide naming and numbering that is consistent with the WTP naming conventions.

### **3.13 Testing of Instrumentation Loops**

- .1 After all devices within a loop have been connected, check the loop for correct functioning and interaction with other loops, where applicable. Provide written notice to the Contract Administrator when the loops are going to be tested so that the tests may be witnessed at the Contract Administrator's discretion.
- .2 Check the operation of final control elements such as solenoid valves, actuators, etc. by manual control before checking with automatic control.
- .3 Check and simulate all alarms and shutdown functions.
- .4 Verify the status of all points connected or accessible to the WTP control and monitoring system.
- .5 Where applicable, test all tubing for leaks in compliance with the ISA RP7.1. Isolate all instruments when tubing is being tested to protect against over pressure.
- .6 Perform tests and record results on the test data forms that are included in this Section. Develop additional and/or more detailed test forms as necessary to suit more complex instrumentation.
- .7 Sign and date all test reports. Submit the test reports to the Contract Administrator within five (5) Business Days of testing.

### **3.14 Calibration**

- .1 Instruments are to be factory pre-calibrated. Verify calibration after installation for all instruments installed under these Specifications. Provide a printed record of the factory calibration parameters for "smart" devices.
- .2 Prior to calibration, completely program all "smart" transmitters including entries of the appropriate range and tag number. Provide a printed record of smart device serial numbers against their assigned tag number.
- .3 Instruments are to be set up and calibrated by an accredited instrument technician working under the approval of the instrument Manufacturer.

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- .4 Calibrate all instruments to an accuracy of 0.5% of full range, or to the manufacturer's stated accuracy of the instrument whenever an accuracy of 0.5% is not achievable.
- .5 Perform the following applicable calibration verification for each instrument and its associated signal conditioning equipment:
  - .1 Calibrate all inline flow meters by a draw-down test.
  - .2 Calibrate all density meters by lab samples.
  - .3 Calibrate all vacuum and pressure instruments by manometer or accurate test instrument and hand test pump.
  - .4 Calibrate gas detectors using standard gas samples.
  - .5 Calibrate temperature instruments against a standard lab thermometer.
  - .6 Online analyzers with known samples.

**3.15 Test Forms**

<b><u>Form No.</u></b>	<b><u>Title</u></b>
.1 ITR	Instrument Test Report.
.2 LCR	Loop Check Report.

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**INSTRUMENT TEST REPORT**

**FORM NO. ITR**

SYSTEM: \_\_\_\_\_  
 SERVICE: \_\_\_\_\_ TAG NO.: \_\_\_\_\_  
 LOCATION: \_\_\_\_\_  
 MAKE: \_\_\_\_\_ MODEL: \_\_\_\_\_  
 SERIAL NO.: \_\_\_\_\_ CSA: \_\_\_\_\_  
 ELEMENT: \_\_\_\_\_ RANGE: \_\_\_\_\_  
 DESIGN SETTING/RANGE: \_\_\_\_\_ CONTACT TO: \_\_\_\_\_ ON: \_\_\_\_\_  
 SIGNAL IN: \_\_\_\_\_ OUT: \_\_\_\_\_ ASSOCIATED INSTRUMENT: \_\_\_\_\_  
 INSTRUMENT CONDITION: \_\_\_\_\_ CONFORM TO SPEC: \_\_\_\_\_  
 PROJECT NO: \_\_\_\_\_ DATA SHEET: \_\_\_\_\_

	TEST 1				TEST 2			
TEST METHOD	INPUT		OUTPUT		INPUT		OUTPUT	
	INC.	DEC.	INC.	DEC.	INC.	DEC.	INC.	DEC.
TEST POINT 1								
TEST POINT 2								
TEST POINT 3								
TEST POINT 4								
TEST POINT 5								
COMMENTS								
GRAPHS								

TESTED BY: \_\_\_\_\_ CHECKED BY: \_\_\_\_\_

DATE: \_\_\_\_\_ DATE: \_\_\_\_\_

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**LOOP CHECK REPORT FORM NO. LCR**

- CHECKED OUT OK  
 NOT APPLICABLE  
 FURTHER ACTION REQUIRED

	INSTRUMENT TAG NO.							
LOOP NO. _____								
SHEET NO. _____								
P & I DWG. NO. _____								
<b>INSTALLATION COMPLETE</b>								
Primary Element.								
Impulse Lines.								
Block and Drain Valves.								
Air Supply/Filter/Reg.								
Wiring.								
Tracing/Insulation/Housing.								
Mounting and Location.								
PLC/SCADA I/O & Status.								
<b>CALIBRATED</b>								
Impulse Lines Press. Tested.								
<b>LOOP CHECKED</b>								
Element to Receiver.								
X Mtr. To Receiver.								
X Mtr./Trans. to Receiver.								
X Mtr./Trans. to Switches.								
Switches to Annunciator.								
Interlocking Circuit.								
Controller to Valve.								
Controller Action D or R.								

REMARKS:

**READY FOR START-UP**

Date: \_\_\_\_\_

Installed by: \_\_\_\_\_

Checked by: \_\_\_\_\_

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**3.16 Installation and Performance Testing**

- .1 Refer to the requirements of Division 1 for additional requirements.
- .2 Inspections
  - .1 Provide two (2) weeks' written notice to the Contract Administrator prior to energizing any system to allow for inspection by the Contract Administrator of the following:
    - .1 Proper mounting.
    - .2 Proper connections.
- .3 During Performance Verification, demonstrate to the Contract Administrator proper calibration and correct operation of instruments and gauges.
- .4 Performance Verification of the I&C system is to include but not be limited to the following:
  - .1 Verify installation of components, wiring connections, and piping connections.
  - .2 Supervise wiring continuity and pipe leak tests.
  - .3 Verify instrument calibration and provide written reports.
  - .4 Function check and adjust the I&C equipment under operational conditions.
  - .5 Coordinate manufacturer's service personnel as required for complete system testing.
  - .6 Instruct City personnel in correct method of I&C equipment operation.
  - .7 Direct City personnel at hand-over as to final adjustment of the system for correct operation of WTP.
  - .8 Ensure that the Manufacturer's representatives cooperate to complete the Work of this Section.
  - .9 Verify signal levels and wiring connections to all I&C equipment.
  - .10 Coordinate and cooperate with City staff and the Contract Administrator during the Commissioning Period to commission the interface between the WTP SCADA and the PLC based control system.

**3.17 Training**

- .1 Provide training, in the proper operation and maintenance of all control devices, control valves, and ancillary instrumentation described under this Division of the Specifications.

**END OF SECTION**

**SCOPE OF INSTRUMENTATION AND CONTROL WORK**

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**1. GENERAL**

- .1 Supply and installation all material, equipment, wiring and labour necessary for the installation of the systems detailed on the Drawings in accordance with the Specifications and the latest edition of the Canadian Electrical Code.

**2. WORK INCLUDED**

**2.1 Related Work**

- .1 Supply and installation of instrumentation and control equipment required to operate the WTP including the plant control system PLC equipment and all vendor packages and City supplied equipment as indicated on the P&IDs and in these specifications.

**2.2 General Requirements**

- .1 Shop Drawings
- .2 Record Drawings
- .3 O&M Data

**2.3 Specific Requirements**

- .1 Supply, install, test, and verify the performance of all instrumentation, components, materials and ancillary equipment covered under Division 17 of this Contract.
- .2 Clearwell Inlet Building
  - .1 Provide all analytical, process instrumentation, sample pumps etc including local control panels. as shown on P&ID number WT-P001.
  - .2 Provide all electrical, control and process connections to analytical and process instrumentation including sample lines and stilling tubes to clearwell.
  - .3 Provide part of the WTP wide fibre optic communication network for the PLC based plant control systems as shown on drawings WH-A0103 and WH-A0100.
  - .4 Provide interface wiring and connections between the HVAC BAS controller and LCP-T11.
- .3 Clearwell Outlet Valve Chambers
  - .1 Provide all electrical and control wiring to the new electrical valve actuators shown on P&ID WO-P0002. Cables to be installed to Deacon Booster Pumping Station and terminated into a junction box provided by the contractor.

**SCOPE OF INSTRUMENTATION AND CONTROL WORK**

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- .4 Generator Building
  - .1 Provide all instrumentation and control wiring for all the fuel transfer systems as shown on P&ID WG-P0002.
  - .2 Provide part of the WTP wide fibre optic communication network for the PLC based plant control systems as shown on drawings WH-A0104 and WH-A0100.
  - .3 Provide conductivity type level switch and wiring in the building sump as shown on P&ID WG-P0001.
  - .4 Provide interface wiring to transformers and generators as shown on P&ID WG-P0001
  - .5 Provide interface wiring and connections between the HVAC BAS controllers and CP-H12 as shown on drawings WG-H0501, WG-H0502, WG-H0503 and WG-H0504
  - .6 Provide 2 emergency stop push buttons and the associated wiring to shutdown the fuel transfer system when operated.
  - .7 Provide interlock wiring between fire alarm system and fuel transfer system
- .5 Cell 1 Raw Water Valve Chamber
  - .1 Provide a conductivity type level switch installed in the valve chamber to monitor the air gap between two butterfly valves. The switch will be mounted with the probes into a plastic container (provided by the contractor) measuring any water which enters the container from the air gap. The switch will operate if 25mm of water enters the container.
  - .2 The contractor will provide all pipework and valves required to connect the container to the existing valve drain connection.
  - .6 Provide all control system communications equipment as show on the Drawings listed in above and as described in Specification Section 17275 – Miscellaneous Panel Devices.
  - .7 Terminate all spare fibre optic cores to patch panels at each drop point and label accordingly.
  - .8 Provide local control panels to house all PLC components and ancillary equipment, and to act as a marshalling panel for signals from instrumentation and equipment covered under Division 17.
  - .9 Supply redundant 24 VDC Power supplies installed within the local control panels whenever 24 VDC power is required.
  - .10 Provide power-conditioning equipment within each local control panel.
  - .11 Connect the healthy/fault status dry relay contacts from all power conditioning and UPS equipment to local PLC inputs.

### **SCOPE OF INSTRUMENTATION AND CONTROL WORK**

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- .12 Provide Ethernet connections from the following equipment to the WTP control system: VFDs, transformer power meters, neutral grounding resistors, switchgear protection relays, and large motor protection relays.
- .13 Hardwire I/O signals from the WTP control system PLCs to process instrumentation, HVAC/BMS system, Power Conditioning and UPS equipment and fire alarm panels.
- .14 All WTP control system PLC programming and WTP monitoring system HMI software development shall be performed by others.
- .15 Coordinate with the Supply Contractors of City Supplied Equipment under other contracts but installed under this Contract to install, test and verify performance of the systems shown on the P&ID'S.

#### **2.4 Additional Requirements**

- .1 Provide all necessary testing, detailed wiring continuity checks, installation integrity checks, equipment functional operation checks, and written system verification reports to provide a complete system that is ready for commissioning.
- .2 Provide Performance Verification and Commissioning of all systems included in the Scope of Work.

#### **2.5 Materials**

- .1 Cables and bus support systems, which are intended to enclose or support all forms of electrical conductors used for any purpose covered by this scope. This includes cable trays, raceways and all forms of rigid, flexible, metallic and non-metallic conduit, and including conduit for communication systems.
- .2 Control panels associated with any electrical equipment covered under this Section of Work.
- .3 Circuit breakers of all types and for all applications associated with electrical equipment, which receives its power supply from the main, auxiliary or emergency (including UPS) system.
- .4 Grounding systems, as required by the Canadian Electrical Code, or as otherwise specified.
- .5 Fibre optic patch panels and industrial Ethernet switches as shown on the Drawings and specified herein.
- .6 Electronic data processing and transmission systems, including auxiliary equipment, interfaces and components.

**END OF SECTION**



## ENCLOSURES

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### 1. GENERAL

#### 1.1 References - General

- .1 Equipment, products, and execution must meet all requirements detailed in Section 17010 – Instrumentation and Control General Requirements.

### 2. PRODUCTS

#### 2.1 General

- .1 Unless otherwise specified, provide outside finishes on all enclosures in ANSI 61 Grey as specified in Division 9.
- .2 The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.

#### 2.2 Enclosures

- .1 Provide EEMAC type 12 gasketed enclosures in MCC rooms and control rooms.
- .2 All enclosures for mounting outside of MCC rooms and control rooms to be EEMAC Type 4, watertight except where otherwise specified.
- .3 Provide EEMAC 7/3R enclosures for equipment in and around classified areas such as sumps.
- .4 Enclosures for certain equipment in corrosive atmospheres to be EEMAC 4X approved for the classification (e.g. chemical cleaning).
- .5 Enclosures for mounting field control indicator lamps and switches in unclassified areas to be Allen Bradley model 800T-xTZ die cast enclosures.
- .6 Enclosures for mounting field control indicator lamps and switches in Class 1 areas to be Allen Bradley model 800H-xHHX7 cast aluminum enclosures.

#### 2.3 Panel Enclosures

- .1 Fabricate panel enclosures from 11 gauge steel panels complete with necessary stiffening to form a rigid free-standing lineup. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide removable top and bottom cable entry plates.
- .2 Provide panels with front access only. Doors shall be key lockable and fitted with 3-point heavy duty latching assemblies. Provide a continuous piano hinge and a pneumatic hold open device on each door.

## ENCLOSURES

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- .3 Finish the interior of the enclosure with white paint. Provide a switched fluorescent light fixture and 120 VAC duplex convenience receptacle inside the enclosure.

### **2.4 Marshaling and Control Panels**

- .1 Supply, fabricate, checkout, layout, document and deliver to Site fully equipped and functional panels.
- .2 Supply all components contained on or within the panels fully wired under this Section of the Specification.
- .3 The selection of all accessories, materials, and methods for fabrication not covered by this Specification, but which are necessary to complete the fabrication of the control panels, is the responsibility of the Contractor.
- .4 Fans and filters shall be installed to pressurize all control panels thus discouraging dust accumulation and providing air purging for temperature and corrosion control.
- .5 Control panel layouts and wiring diagrams are to be provided by the Contractor as Shop Drawings.

### **2.5 Network Cabling Termination Cabinets**

- .1 Double hinged wall mounted cabinet for 19 inch rack mounted equipment.
- .2 NEMA 12 cabinet with glass door and locking wing knobs.
- .3 Cabinet to house fibre patch panel, Cat 5E patch panel and Ethernet switches.
- .4 Provide 120 VAC duplex receptacle and power bar with minimum six outlets.
- .5 Provide horizontal wire management under each patch panel and Ethernet switch.
- .6 Provide vertical wire management on one side.
- .7 Provide blank panels for all empty rack units.
- .8 Provide shelf 3U for mounting equipment.
- .9 Cabinet sized for 26 rack units.
- .10 Hoffman ProTek DH Type 12, or approved equal.

### **2.6 Wiring and Accessories**

- .1 Provide wiring inside the panels according to the following Specifications:
  - .1 Control wiring to be a minimum of #16 AWG tinned stranded copper; insulation rated at 600 V.

## ENCLOSURES

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- .2 Wiring for power distribution shall be a minimum of #14 AWG tinned stranded copper; insulation rated at 600 V.
- .3 Install cables in accordance with the requirements of Division 16.
- .2 Tag each wire at both ends with a heat shrink sleeve that is machine printed. Allow approximately 20 mm of wire insulation between the tag and the bare wire.
- .3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.
- .4 Run all wiring in enclosed plastic wire ways such as Panduit. Size all wire ways so that the total cross sectional area of the insulated wire and cable does not exceed 40% of the cross sectional area of the wire way.
- .5 Provide a minimum clearance of 50 mm between wire ways and any point of wire termination.
- .6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, defined as follows:
  - .1 Wire identification to use the connected field device tag name with the wire's corresponding end device terminal number appended to it.
  - .2 Identify every joint and/or terminal of the above wire run with the same identifier.
  - .3 For example, pressure transmitter PT-O100A located in the field has a 1 PR-TPSH cable connected to it. The cable runs through a junction box to a marshalling panel. The wire identifiers for the pair of wires would be PT-O100A all the way to the marshalling panel.
  - .4 Identify spare wires by using the cable tag, terminal number and an “-SP” suffix.
  - .5 Arrange wiring on terminal blocks such that all internal panel wiring terminates on the inboard side of the terminal blocks and all external wiring terminates on the outboard side.
- .7 Provide two (2) sources of 120 VAC power to each control panel: UPS power for critical loads and non-UPS power for non-critical loads. Provide separate critical and non-critical 120 VAC power distribution systems and a 24 VDC power distribution system in each panel. Provide a thermal magnetic circuit breaker on each main power circuit and a fused terminal block for each branched circuit off the main.
- .8 Provide disconnect type terminal blocks Weidmuller WTR 4 series to isolate field wiring that is powered sourced from the panel. Provide a dedicated fused disconnect type terminal block to isolate each individual PLC input and output.
- .9 Provide sufficient terminals so that not more than two (2) wires are connected under the same terminal. Provide 20% spare terminal capacity at each terminal block assembly.

## ENCLOSURES

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.10 Terminals shall be Weidmuller W Series color coded as follows:

- |    |        |   |                                      |
|----|--------|---|--------------------------------------|
| .1 | Red    | = | positive 24 VDC                      |
| .2 | Black  | = | analog signal plus                   |
| .3 | White  | = | analog signal common and VAC neutral |
| .4 | Grey   | = | 120 VAC                              |
| .5 | Green  | = | ground                               |
| .6 | Yellow | = | shield                               |

.11 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be white lamacoid with black lettering, a minimum of 25 x 75 mm in size with up to three lines of 5 mm lettering. Securely fasten nameplates in and situate them in a visible location.

### 2.7 Panel Grounding

- .1 Provide a ground system for the instrumentation circuits, isolated from the main power system ground to each marshalling panel.
- .2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.
- .3 Provide in each marshalling panel an isolated grounding bus bar 6 x 25 x 600 mm, equipped with necessary lugs for accepting two #2 AWG grounding conductors.
- .4 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

## 3. EXECUTION

### 3.1 References - General

- .1 Refer To Section 17010 – Instrumentation and Control General Requirements, Part 3.

**END OF SECTION**

## **INSTRUMENTATION CABLE**

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### **1. GENERAL**

#### **1.1 Product Data**

- .1 Submit product data in accordance with Division 1 and Division 16.

#### **1.2 Related Work**

- .1 Refer to Division 16.

#### **1.3 Inspection**

- .1 Provide adequate notice to the Contract Administrator so that all cable installations can be inspected prior to energizing equipment.

#### **1.4 Standards**

- .1 All wire and cable shall be CSA approved.

### **2. PRODUCTS**

#### **2.1 TPSH**

- .1 TPSH shall be constructed as follows:
  - .1 Two (2) copper conductors, stranded, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm.
  - .2 Insulated for 600 V, 90°C.
  - .3 100% coverage aluminum foil or tape shield.
  - .4 Separate bare stranded copper drain wire, minimum #18 AWG.
  - .5 Overall flame retardant PVC jacket to CSA-C22.2.
  - .6 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.
  - .7 Shaw Type 1751-CSA or Belden equivalent.
- .2 Where multi-conductor TPSH cables are called for, each pair shall be individually shielded, continuous number coded, and the cable assembly shall have an overall shield and overall flame retardant PVC jacket.

## **INSTRUMENTATION CABLE**

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### **2.2 RTDs and Multi Conductor Shielded Cable**

- .1 RTD cables shall be CSA approved and shall be constructed as follows:
  - .1 Three (3) or more copper conductors, stranded, minimum #18 AWG
  - .2 PVC insulated for 600 V
  - .3 100% coverage aluminum foil or tape shield
  - .4 Separate bare stranded copper drain wire
  - .5 Overall flame retardant PVC jacket to CAS-C22.2

### **2.3 Teck Cables**

- .1 As per Division 16

### **2.4 Wire**

- .1 As per Division 16

### **2.5 100 Base TX Category 5E Communication Cable**

- .1 Category 5E cable shall be CSA approved and constructed as follows:
  - .1 4 bonded pairs, solid stranded, #24 AWG
  - .2 Interlocked aluminum armour
  - .3 Rip cord
  - .4 PVC inner and outer jackets
  - .5 UL verified to Category 5E
  - .6 Insulated for 300 V
  - .7 Belden 121700A or approved equal

### **2.6 Fibre Optic Cables**

- .1 Provide break out style fibre optic cable assemblies where indicated in the Specification and Drawings.
- .2 Fibre optic cables shall be indoor/outdoor direct burial rated loose tube, rodent protected and constructed with specified quantity of 50/125/250  $\mu\text{m}$  multi-mode glass fibres, spiral

## **INSTRUMENTATION CABLE**

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interlocked armour, and outer polyethylene jacket. Maximum attenuation shall be 3.5/1.0 dB/km. Minimum modal bandwidth shall be 220 MHz\*km

- .3 Provide terminations for fibre optic cables including; buffer tube fan out kits, connectors, termination/distribution panels, and wall mount enclosures, as specified in Division 17
- .4 Provide 50/125/250 µm multi-mode duplex fibre patch cords for inter-cabinet connections.
- .5 Number of fibres are indicated on Drawings, in general fibre optic loop shall be 24 fibre, fibre optic cables to power meters and protection relays shall be 2 fibre.

### **2.7 Modbus Plus Cables**

- .1 Modbus Plus cable, aluminum armour suitable for direct burial, Belden YC39000.
- .2 Provide modbus plus terminators, drop cables, connectors as required.

## **3. EXECUTION**

### **3.1 Analog Signals**

- .1 Use TPSH cable for all low level analog signals such as 4 to 20 mA, pulse type circuits 24 VDC and under, and other signals of a similar nature.
- .2 Use RTD cable for connections between RTDs and transmitters or PLC RTD inputs.

### **3.2 Digital Signals**

- .1 Use TPSH cable for all low level (24 V and below) input and output signals.

### **3.3 Instrument Power**

- .1 Use Teck cable or wire and conduit for power to instruments, for 120 V signals other than those mentioned above and as otherwise indicated on the Drawings. Use stranded wire and cable to supply power to instruments.

### **3.4 Installation**

- .1 Install instrumentation cables in conduit systems or in cable trays. Use a minimum of 300 mm and a maximum of 1000 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.
- .2 Where non-armoured instrumentation cables are installed in cable trays, provide barriers in the tray to separate instrumentation cables from power cables.
- .3 At each end of the run leave sufficient cable length for termination.

## INSTRUMENTATION CABLE

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- .4 Do not make splices in any of the instrumentation cable runs.
- .5 Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.
- .6 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the marshalling panel.
- .7 Protect all conductors against moisture during and after installation.

### 3.5 Fibre Installation:

- .1 Always follow the Manufacturer's guidelines for minimum bend radius and tension. Minimum bend radius shall be a minimum of 20 times the cable diameter.
- .2 When installing loose-tube cables, use a silicone injection or sealer to prevent gel migration.
- .3 All fibre installations and terminations shall be performed by personnel experienced in fibre optic cable installation.
- .4 Fibre Terminations:
  - .1 Ensure that the fibres are not damaged when the buffer tubes and fibre coatings are removed.
  - .2 After the coating is removed, clean the fibre with isopropyl alcohol to assure the fibre is clean.
  - .3 Use only high performance connectors as classified and required by TIA-568-A.
- .5 Perform cable testing with optical time domain reflectometer instrument and provide complete detailed test report. Test all runs upon completion of permanent terminations, using instrumentation acceptable to Contract Administrator. Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.
  - .1 Ensure that test instrument is temperature-stabilized or is temperature-independent or temperature-compensated before commencing test.
  - .2 Test for following:
    - .1 Run attenuation at [850] and [1300] wavelengths.
    - .2 Run length.
  - .3 Before recording results, compare readings to predicted values based on cable specification and run length, using connector and patch cord losses as part of predicted value. Retest runs with:



## INSTRUMENTATION CABLE

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- .1 Attenuation values greater than 6.0 dB/km @ 850 nm and 4.0 dB/km @ 1300 nm
- .6 All fibres must pass the cable testing.

### 3.6 Cat 5E Installation:

- .1 Always follow the Manufacturer's guidelines for minimum bend radius and tension.
- .2 All installations and terminations shall be performed by personnel experienced in Cat 5E cable installation.
- .3 Perform cable testing with time domain reflectometer instrument and provide complete detailed test report. Test all runs upon completion of permanent terminations, using instrumentation acceptable to Contract Administrator. Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.
  - .1 Test for the following:
    - .1 Continuity.
    - .2 Pair placement and polarity.
    - .3 DC resistance.
    - .4 Characteristics at highest contemplated frequency:
      - .1 Attenuation - data cable.
      - .2 Mutual Capacitance - data cable.
      - .3 Near-end crosstalk (NEXT) - data cable.
    - .5 Run length.
  - .2 Tests to be conducted to Cat 5E standards
  - .3 Reconnect or re-install and retest as necessary to correct excessive variations.

### 3.7 Conductor Terminations

- .1 All equipment supplied shall be equipped with terminal blocks to accept conductor connections.
- .2 Instrumentation conductors, where terminated at equipment terminals other than clamping type terminal blocks, shall be equipped with Burndy-YAE-2 or STA-KON, self-insulated, locking type terminators, sized as required to fit conductors and screw terminals.

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**INSTRUMENTATION CABLE**

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**3.8 Testing**

- .1 Test all conductors for opens, shorts, or grounds. Resistance values shall not be less than those recommended by the cable Manufacturer.

**3.9 Identification**

- .1 Identify all instrumentation cables.
- .2 Identify each conductor with wire numbers using a machine printed Raychem TMS heat shrink wire marker or approved equal.

**END OF SECTION**

## POWER SUPPLIES

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### 1. GENERAL

#### 1.1 References - General

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements.

### 2. PRODUCTS

#### 2.1 Power Supply and Conditioning Equipment

##### .1 General

- .1 Provide all DC power supplies as required for all instrument circuits. All circuits are to be powered from the marshalling panels. Power supplies to be Hammond, G.F.C. or approved equal, complete with an over-voltage protection module.
- .2 Provide redundant configurations for power supply equipment serving more than one instrument loop, so that failure of a single unit will not disable all or any shared part of the instrumentation and communication system. Provide diode isolation for redundant direct current supply units, and ground the negative terminal of the power supply. In accordance with Section 17110 – Enclosures, a dedicated thermal magnetic circuit breaker shall feed each power supply.
- .3 Power supplies and transmitters feeding circuits that run in non-armored cable in cable tray shall meet the requirements for Class 2 circuits as defined under Section 16 of the Canadian Electrical Code Part I.
- .4 Unless otherwise required, all DC power supplies to be rated 28 VDC, adjustable plus or minus 5%, and set to provide 26.4 V on the panel direct current bus. Size the power supply for 2 times the connected load, minimum size is 2 amps.

#### 2.2 Noise Suppression

- .1 Provide power conditioners in each panel to power AC instrumentation and control loads. Power conditioners are Oneac Series CX.

#### 2.3 UPS Power Supply

- .1 Provide two sources of 120 VAC power each control panel: UPS power for critical loads and non-UPS power for non-critical loads.
- .2 Control and operator interface system hardware including but not limited to PLCs, PLC I/O racks, PLC communication modules, HMI computers and industrial network switches shall be powered from the UPS.
- .3 Instrument power and associated DC power supplies shall be powered from the UPS.

## **POWER SUPPLIES**

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- .4 Non-critical loads include control panel interior lights and receptacles.
- .5 Online double conversion UPS' shall be provided in each electrical and server room as specified in Division 16. Coordinate with Division 16 to ensure that the plant's UPS' are of sufficient size to power the critical loads that are fed from each control panel.
- .6 Mount a lamacoid on the control panel stating that the panel has more than one power source.

### **3. EXECUTION**

#### **3.1 References - General**

- .1 Refer To Section 17010 – Instrumentation and Control General Requirements, Part 3.

**END OF SECTION**

**INSTRUMENT AIR SUPPLY AND TRANSMISSION**

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**1. GENERAL**

**1.1 References - General**

- .1 Equipment, products, and execution must meet all requirements detailed in Section 17010 – Instrumentation and Controls General Requirements.

**2. PRODUCTS**

**2.1 Pneumatic and Process Connections**

- .1 Pipe, fittings, valves, tubing, tube fittings, etc. required under this Section of the Contract to be Swagelok or approved equal and rated for the service in which they are to be employed. Tubing and fittings are to be made of stainless steel.
- .2 Dimensions:
  - .1 Process connections 12 mm (nominal) O.D. tubing
  - .2 Output/signal - 10 mm (nominal) O.D. tubing
  - .3 Air supply 12 mm pipe (nominal) to isolation valves and 10 mm O.D. tubing (nominal) from isolation valves to end devices (e.g. valves).
- .3 Provide a continuous support channel or raceway for all tubing.

**2.2 Air Sets**

- .1 Provide all pneumatic actuator assemblies with an air set.
- .2 Provide Fischer 67FR air sets unless specified otherwise in the Instrument Specification Sheets of Section 17701 – Instrumentation Specification Sheets.
- .3 Air set to be complete with filter regulator and output gauge.

**2.3 Solenoid Valves**

- .1 Provide ASCO Redhat type solenoid valves unless specified otherwise in Division 11 or on the Instrument Specification Sheets of Section 17701 – Instrumentation Specification Sheets.
- .2 Solenoid enclosures to be minimum EEMAC 4; corrosive areas require EEMAC 4X and hazardous areas require EEMAC Type 9. Refer to Division 16 for area classifications.
- .3 Provide manual overrides on coils when solenoid is used to actuate a valve.
- .4 Standard coil voltage: 120 VAC.

**INSTRUMENT AIR SUPPLY AND TRANSMISSION**

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- .5 Pipe size: 3-way valve – 6 mm; 4-way valve – 10 mm.
- .6 Maximum operating pressure: 850 kPa instrument air.
- .7 Minimum operating pressure: 20 kPa instrument air.

**3. EXECUTION**

**3.1 References - General**

- .1 Refer to Section 17010 – Instrumentation and Controls General Requirements.

**3.2 Tubing and Fitting Installation**

- .1 Group instruments logically together. Orient instrument air and process connection isolation valves to provide consistent handle indication of normal open/closed status.
- .2 Final location of skid mounted instruments to provide sufficient clearance for access to all maintenance settings, to provide unobstructed viewing of instrument indicators and to permit instrument calibration and maintenance during normal operation of the Site.
- .3 Tubing installations shall slope down 20 mm per 2 m of run to process connections.
- .4 Support tubing in channel or raceway if exposed or in close proximity to rotating equipment or high traffic areas. Otherwise, do not exceed 1 m between tubing supports.
- .5 All turns shall have a minimum bending radius of 50 mm.
- .6 Avoid non-terminal connections in tubing runs.
- .7 Use Teflon tape on all threaded fittings. Do not apply tape on the first two threads.
- .8 Tubing shall terminate at devices with fittings or 90° bends so as to allow removal of tubing without disturbing the device mounting.
- .9 Complete the final 300 mm (nominal) of air tubing to instruments or control valves installed in process equipment with flexible reinforced neoprene hose. Support the tubing at the hose connection. Locate the hose connection to facilitate unrestricted removal of the instrument or control valve and to minimize transmission of process equipment vibration into the tubing.

**END OF SECTION**

**PROCESS TAPS AND PRIMARY ELEMENTS**

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**1. GENERAL**

**1.1 References - General**

- .1 Equipment, products, and execution must meet all requirements detailed in Section 17010 – Instrumentation and Control General Requirements.

**2. PRODUCTS**

**2.1 Process Taps**

- .1 Supply pressure gauge and thermowell taps. Products shall be as specified in Division 15.

**2.2 Primary Elements**

- .1 Supply and install primary elements and transmitters as specified on the Instrumentation Specification Sheets of Section 17701 – Instrumentation Specification Sheets.
- .2 Supply written assurance that the instrument Manufacturer approves the selection for the primary element materials that are in contact with the specified process fluid and certifies that the materials are inert to the effects of the process fluid.
- .3 Supply and install drip pots for sensing elements measuring gas. Supply seamless, stainless steel drip pots consisting of a 50 x 300 mm pipe with an isolating valve and a drain valve. Install a separate drip pot on each sensing line. Locate the drain valve within 500 mm of the floor.
- .4 Supply diaphragm seals for any fluid other than water or glycol.
- .5 When diaphragm seals are specified with a pressure gauge or a pressure switch provide the assembly filled with ethylene glycol and calibrated by the Manufacturer.
- .6 Supply and install an ethylene glycol filled assembly calibrated by the manufacturer when in-line pressure sensors are specified with a pressure gauge or a pressure switch or in combination.

**3. EXECUTION (NOT USED)**

**END OF SECTION**

## **TRANSMITTERS AND INDICATORS**

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### **1. GENERAL**

#### **1.1 References - General**

- .1 Equipment, products and execution must meet all requirements detailed in Section 17010 – Instrumentation and Control General Requirements.

### **2. PRODUCTS**

#### **2.1 Transmitters and Indicators**

- .1 Supply and install transmitters and indicators as specified on the Instrument Specification Sheets of Section 17701 – Instrument Specification Sheets.
- .2 Transmitters shall have adequate power output to drive all devices associated with the signal loop. Provide signal boosters as required to achieve adequate signal strength or to isolate the signal. Provide current-to-current signal isolators for all secondary devices in the control loop.
- .3 All transmitters to have local indication scaled in engineering units as specified in the Specifications. Provide a lamicoid label indicating the calibrated range and engineering units and mount adjacent to the transmitter. Mount the transmitter so the indicator is visible by operations personnel.
- .4 Remote indicators provided by Crompton Instruments, Simpson, or Newport are acceptable for use.
- .5 Where the loop specification calls for a transmitter and an indicator to be mounted in the same panel, an indicating transmitter may be considered acceptable, provided the indicator is normally visible from outside the enclosure.
- .6 Where available as an option, the transmitter shall be supplied with an isolated fault contact.
- .7 Standard of acceptance for instrumentation shall be as follows:
  - .1 Pressure Transmitters: Rosemount Model 3051, ABB or Foxboro complete with stainless steel two (2) and three (3) valve manifolds as manufactured by Anderson Greenwood.
  - .2 Pressure Gauges: Ashcroft, H.O. Terrice, Budenberg.
  - .3 Ultrasonic Level Transmitters: Siemens Multiranger 100/200, Magnetrol, Endress & Hauser.
  - .4 Temperature Transmitters (RTD): Rosemount, ABB, Foxboro.



**TRANSMITTERS AND INDICATORS**

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- .5 pH Sensors: Rosemount, Endress and Hauser, ABB, Foxboro 870 Series.
- .6 Turbidity Sensors: Hach, Rosemount, Endress and Hauser, GLI.
- .7 Chlorine Residual Analyzers: Wallace & Tiernan Micro/2000
- .8 Chloramination/Monochloramine Analyzers: Chemscan,
- .9 Power Meters: Power Measurement Limited (PML).
- .10 Gas Detection Systems: Draeger, MSA, Crowcon.

**3. EXECUTION**

**3.1 References - General**

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements.

**END OF SECTION**

## SWITCHES AND RELAYS

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### 1. GENERAL

#### 1.1 References - General

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements.

### 2. PRODUCTS

#### 2.1 General

- .1 Use normally closed contacts for alarm actuation. The contacts open to initiate the alarm.
- .2 Use normally open contacts to control equipment. The contacts close to start the equipment.
- .3 Contacts monitored by solid state equipment to be hermetically sealed and adequately rated for the connected load.
- .4 Contacts monitored by electro-magnetic devices such as mechanical relays to be rated NEMA ICS 2, designation B300.
- .5 Provide double barriers between switch elements and process fluids such that failure of one (1) barrier will not permit process fluids into electrical enclosures.
- .6 Switch electrical enclosures to be rated EEMAC 4X, minimum.
- .7 120 VAC switches to have a 4A rating.

#### 2.2 Indicators, Pushbuttons, and Selector Switches

- .1 All control indicator lamps, pushbutton switches and selector switches in unclassified or non-corrosive areas to be Allen Bradley 800T or 800E series items or Cutler Hammer 10250T series.
- .2 All control indicator lamps, pushbutton switches, and selector switches in classified or corrosive (includes outdoors) areas to be Allen Bradley 800H series items or Cutler Hammer E34 series.
- .3 Enclosures to be specified under Section 17110 – Enclosures.
- .4 All control indicator lamps shall be push-to-test type.

#### 2.3 Relays

- .1 The quality and type of relays shall be based on Omron relays. Other acceptable manufacturers are Idec and Potter & Brumfield.

## SWITCHES AND RELAYS

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- .2 120 VAC relays to be Model LY 4PDT, plug-in, complete with test button and operation indicator, and surge suppressor.
- .3 24 VDC relays to be Model MY 2PDT plug-in, complete with test button and operation indicator, and surge suppressor diode.
- .4 Time delay relays for behind panel mounting to be Omron Model H3BA, 2PDT, plug-in, and programmable for sixteen (16) time ranges and four (4) operation modes.
- .5 Time delay relays for flush panel mounting and operator accessible timing range modifications to be Omron Model H5BR, SPDT, screw terminals, programmable for five (5) timing ranges and eight (8) operation modes, complete with digital display, module for time settings and flexible protective cover.
- .6 Where the contact ratings of the relays listed are insufficient for the application, select an appropriate type from an approved Manufacturer with the same quantity of contacts as was originally specified.
- .7 Provide relay plug-in sockets for DIN mounting complete with stacked screw clamp terminals.

### 2.4 Process Switches

- .1 Standard of acceptance for instrumentation shall be as follows:
  - .1 Thermal Flow Switches: Ifm, Weber.
  - .2 Pressure Switches (Electronic): Ifm, United Electric.
  - .3 Pressure Switches (Conventional): Ashcroft, United Electric, Barksdale.
  - .4 Conductivity Level Switches: Endress & Hauser.
  - .5 Float Switches: Flygt, Consolidated Electric, Warwick, Magnetrol.
  - .6 Temperature Switches: Ifm.

## 3. EXECUTION

### 3.1 References – General

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements.

**END OF SECTION**

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**MISCELLANEOUS PANEL DEVICES**

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**1. GENERAL**

**1.1 References - General**

- .1 Equipment, products, and execution must meet all requirements detailed in Section 17010 – Instrumentation and Control General Requirements.

**2. PRODUCTS**

**2.1 Miscellaneous Panel Devices**

.1 Pilot Lights

- .1 Supply and install LED or transformer type pilot lights for extended lamp life, oil tight, push to test, complete with appropriate colour lenses. Normal colours used are run = red, stop = green. Refer to Division 16 for additional information.

.2 Terminals

- .1 Supply and install strap screw type terminal blocks rated for 600 V.
- .2 Identify each terminal block within an enclosure with a unique machine printed terminal block number. Cabinet chassis grounding terminal blocks are to be identified by the electrical ground symbol.
- .3 Connections to screw terminals to be locking fork tongue insulated crimp type wire connectors.
- .4 Terminals to be Weidmuller or approved equal.
- .5 Supply and install a group of terminals for each of 120 VAC non-UPS hot and neutral, 120 VAC UPS hot and neutral and 24 VDC positive and negative power. Distribution wiring to have a thermal magnetic circuit breaker upstream of all major blocks of loads, adequately sized to protect the connected load while not causing nuisance tripping.
- .6 Supply and install Weidmuller disconnect type terminal blocks for each load or loop powered from the marshalling panels.

.3 Nameplates

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements for nameplate Specification.

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**MISCELLANEOUS PANEL DEVICES**

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**2.2 Signal Current Isolator**

- .1 Isolators shall be installed to provide galvanic isolation of milli-ampere transmission signals from transmitters with inadequately isolated output circuits.
- .2 Isolator shall be housed in a NEMA 250, Type 4/7 conduit body and derive its operating power from the signal input circuit.
- .3 Input and output signals shall be 4 to 20 mA, with an error not exceeding 0.1% of span. Input resistance will not exceed 550 ohms with an output load of 250 ohms.
- .4 Approved manufacturers are Moore Industries, Weidmuller or Phoenix.

**2.3 Intrinsic Safety Barriers and Relays**

- .1 Provide intrinsic safety barriers where required for two-wire transmitters of the active, isolating, loop powered type; MTL Type MT3042, Stahl 9005/01-252/100/00, Pepperl & Fuchs ZG series, or approved equal.
- .2 Provide dual type intrinsic safety barriers for process switches; MTL 787, Panalarm 201-BR2.
- .3 Intrinsic safety relays to be Gems or Warrick.

**2.4 Industrial Ethernet Switches**

- .1 Install rack mounted Ethernet Switches in separate network cabling termination cabinet mounted next to all control panels housing PLCs that interface to the WTP control and operator interface network as shown on the drawings. Connect to the PLCs, local HMIs, VFDs, power meters and motor protection relays as shown on the drawings using cable rated for 100 Base-TX, 10 BaseFL, or 100 BaseFX communication, as required by the device.
- .2 Switches shall comply with IEEE 802.3, 802.3u, 802.3x, 802.1D, IEC 61950-3.
- .3 Switched shall be connected in a ring topology utilizing a 1000SX Multimode backbone.
- .4 Provide switches as required to connect to the equipment indicated in the Drawings and the following minimum spare ports:
  - .1 4 - 10/100 Base T(x) RJ45 ports
  - .2 2 - 10 BaseFL multimode ports
  - .3 2 - 100 BaseFX multimode ports
- .5 Provide as a minimum two (2) switches in each cabinet for the PLC and HMI fibre networks.
- .6 Switches shall include one (1) relay output alarm contact rated for 1A@24 VDC.

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**MISCELLANEOUS PANEL DEVICES**

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- .7 Input power shall be 120 VAC.
- .8 Switches shall be fast spanning for a sub-second recovery in a ring configuration.
- .9 Switches shall be Ruggedcom RSG2100 or approved equal.

**2.5 Fibre Termination Panel**

- .1 Fibre termination panel suitable for the termination of two (2) 24-strand multimode fibre optic cables. Multiple 2-strand multimode fibre cables for connection to power meters and protection relays shall be terminated to same panel.
- .2 Termination panel shall be rack mounted, hinged front and rear doors, complete with grounding kit and cable strain relief.
- .3 Install in network cabling termination cabinet
- .4 Leviton DP-525 or approved equal.

**2.6 Cat 5E Termination Panel**

- .1 Rack mounted termination panel suitable for the termination of 24 Cat 5E cables.
- .2 Install in network cabling termination cabinet.

**3. EXECUTION**

**3.1 References - General**

- .1 Refer To Section 17010 – Instrumentation and Control General Requirements, Part 3.

**END OF SECTION**

## **PROGRAMMABLE LOGIC CONTROLLERS**

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### **1. GENERAL**

#### **1.1 References - General**

- .1 Equipment, products, and execution must meet all requirements detailed in Section 17010 – Instrumentation and Control General Requirements.

#### **1.2 Work Included**

- .1 Supply and installation of a PLC-based control system that will control and monitor the system in accordance with the requirements specified on the drawings and the I/O lists.
- .2 PLC's and I/O shall be housed in central control panels.
- .3 PLC programming is not in the scope of this Contract.
- .4 Start-up and commissioning assistance as required for the control system.

### **2. PRODUCTS**

#### **2.1 PLCs**

- .1 General
  - .1 All new PLC equipment shall be based on the Modicon Unity Processor family.
  - .2 All PLC's shall be Modicon Unity hot standby processors complete with standby processors.
  - .3 Communication protocol for the new PLC network shall be Modbus/TCP. Ethernet communication modules shall be provided in each PLC rack to interface to the WTP control network.
  - .4 Supply and install all necessary racks, power supplies, cables, I/O cards, communication cards, and accessories.
  - .5 Supply spares of all PLC system components (minimum of ten (10) of each exact type with the exception of racks – supply two (2) of these) supplied including: power supplies, processors, communication modules, and input/output modules.
  - .6 Supply 10% spare slot capacity for each PLC panel assembly.
  - .7 Supply 25% spare power supply capacity for each PLC panel assembly.
  - .8 PLC racks shall be powered from the external UPS system. Each new PLC panel assembly shall include Sola Hevi-Duty STV100K series incoming power transient

## **PROGRAMMABLE LOGIC CONTROLLERS**

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surge suppression or approved equal. Connect the surge suppressor dry contact to a PLC input and configure as an alarm on the control system at each panel.

- .2 PLC
  - .1 Modicon Unity main processor and hot standby central processing unit (CPU): Model Number 140 CPU 671 60.
  - .2 Modicon NOE (Modbus/TCP) modules for each processor rack.
  - .3 Redundant cable remote I/O modules in each I/O rack: Model Numbers 140 CRP 932 00 and 140 CRA 932 00.
  - .4 I/O modules to meet the specifications specified in Subsection 2.1.1 and the I/O requirements of the P&IDs, instrument loop diagrams and I/O Lists.
- .3 I/O
  - .1 120 VAC Digital Inputs: Model Number 140 DAI 540 00.
  - .2 24 VDC Digital Inputs: Model Number 140 DDI 353 00.
  - .3 Digital Outputs: Model Number 140 DRA 840 00.
  - .4 Analog Inputs: Model Number 140 ACI 030 00.
  - .5 Analog Outputs: Model Number 140 ACO 020 00.
  - .6 Provide at least 20% spare I/O of each type in each panel assembly.
- .4 Remote I/O Fiber Optic Repeaters
  - .1 Modicon 490 NRP 954.
  - .2 Repeaters shall be installed in network cabling termination cabinet as indicated on Drawings.

### **2.2 System Integration Requirements**

- .1 Cooperate with other Contractors, the City and the Contract Administrator to facilitate installation, testing, validation, and Commissioning of the control system.
- .2 Supply, install, test, and verify performance of the PLC Control Panel as specified in this Section and as shown on the Drawings.
- .3 Assist the Systems Integrator to establish communication with the PLCs. Test data exchange with the PLC as specified in this Section and the process descriptions.



**PROGRAMMABLE LOGIC CONTROLLERS**

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- .4 Supply the spare PLC equipment to the Systems Integrator within six (6) months of award of Contract.

**3. EXECUTION**

**3.1 References – General**

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements, Part 3.

**END OF SECTION**

## **OPERATOR INTERFACE REQUIREMENTS**

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### **1. GENERAL**

#### **1.1 References – General**

- .1 Equipment, products, and Execution must meet all requirements detailed in Section 17010 – Instrumentation and Control General Requirements.

#### **1.2 General Requirements**

- .1 For the purpose of this project, the tag name convention used on the I/O lists included with the Specifications and shown on the P&IDs will be used. Coordinate the implementation of tags for any instrumentation not listed with the Contract Administrator.

### **2. PRODUCTS**

#### **.1 Local Control and Operator Interfaces**

- .1 Provide all necessary local controls to allow local operation that compliments the operation of the WTP control system and facilitates satisfactory system control consistent with the intent of this Specification.

#### **.2 Interface to the WTP Control System**

- .1 This Contractor is to support the design, installation, programming, and start-up of the WTP control system as follows:
  - .1 Supply all field instrumentation necessary to facilitate both local and remote monitoring and control of the system.
  - .2 Provide all hardware interfaces required to facilitate the interconnection of the contractor supplied PLC's to the WTP control system.
  - .3 Supply and install all cables, jumper wires and termination panels as shown on the Drawings and as necessary to facilitate connection of local HMIs to the WTP monitoring system and to create a complete and comprehensive WTP control and monitoring system.
  - .4 Update all system documentation prior to Total Performance to reflect the final installation.

### **3. EXECUTION**

#### **3.1 Performance – General**

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements, Part 3.

## **OPERATOR INTERFACE REQUIREMENTS**

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### **3.2 Installation**

- .1 Provide hardware in accordance with the foregoing requirements in sufficient quantity to satisfy the performance requirements specified in this and other Divisions of this Specification.
- .2 Provide all necessary documentation to complete the configuration of the control system including I/O lists, alarm lists, critical process variables, instrumentation lists, loop wiring requirements for I/O and local control equipment details.
- .3 Assist with Performance Verification and Commissioning.
- .4 Provide all documentation and training as defined in the Specifications.

**END OF SECTION**

**PLC I/O INDEX**

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**1. GENERAL**

**1.1 References - General**

.1 Refer to Section 17010 – Instrumentation and Control General Requirements.

**1.2 Programmable Logic Controller Input/Output Index**

.1 The following spreadsheet gives an itemized list of the I/O between the PLC and the field devices. It is intended to serve as an aid for determining the cabling requirements for the Work specified in this Division.

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**

**PLC I/O INDEX**

RECORD NO.	REV. NO.	TAG NAME	DESCRIPTION			I/O SPECIFICATION							
			FUNCTION	SERVICE	P&ID DRAWING	ENG. UNITS	SCALE		ALARMS		PLC CABINET	I/O TYPE	I/O ADDRESS
							LOW	HIGH	LOW	HIGH			
1	0	MN-E901A	Start Command	Generator GN-E901A Start	WG-P0001						CP-H11A	DO TCP	
2	0	YS-E901A	C/O/H Switch in Computer Position	Generator GN-E901A in Computer Mode	WG-P0001						CP-H11A	DI TCP	
3	0	MM-E901A	Running Status	Generator GN-E901A Running	WG-P0001						CP-H11A	DI TCP	
4	0	UF-E901A	General Fault	Generator GN-E901A General Fault	WG-P0001						CP-H11A	DI TCP	
5	0	EI-E901A	Voltage Indication	Generator GN-E901A Output Voltage	WG-P0001						CP-H11A	AI TCP	
6	0	II-E901A	Current Indication	Generator GN-E901A Load Current	WG-P0001						CP-H11A	AI TCP	
7	0	JI-E901A	Kilowatts Indication	Generator GN-E901A Output Kilowatts	WG-P0001						CP-H11A	AI TCP	
8	0	MN-E902A	Start Command	Generator GN-E902A Start	WG-P0001						CP-H11A	DO TCP	
9	0	YS-E902A	C/O/H Switch in Computer Position	Generator GN-E902A in Computer Mode	WG-P0001						CP-H11A	DI TCP	
10	0	MM-E902A	Running Status	Generator GN-E902A Running	WG-P0001						CP-H11A	DI TCP	
11	0	UF-E902A	General Fault	Generator GN-E902A General Fault	WG-P0001						CP-H11A	DI TCP	
12	0	EI-E902A	Voltage Indication	Generator GN-E902A Output Voltage	WG-P0001						CP-H11A	AI TCP	
13	0	II-E902A	Current Indication	Generator GN-E902A Load Current	WG-P0001						CP-H11A	AI TCP	
14	0	JI-E902A	Kilowatts Indication	Generator GN-E902A Output Kilowatts	WG-P0001						CP-H11A	AI TCP	
15	0	MN-E903A	Start Command	Generator GN-E903A Start	WG-P0001						CP-H11A	DO TCP	
16	0	YS-E903A	C/O/H Switch in Computer Position	Generator GN-E903A in Computer Mode	WG-P0001						CP-H11A	DI TCP	
17	0	MM-E903A	Running Status	Generator GN-E903A Running	WG-P0001						CP-H11A	DI TCP	
18	0	UF-E903A	General Fault	Generator GN-E903A General Fault	WG-P0001						CP-H11A	DI TCP	
19	0	EI-E903A	Voltage Indication	Generator GN-E903A Output Voltage	WG-P0001						CP-H11A	AI TCP	
20	0	II-E903A	Current Indication	Generator GN-E903A Load Current	WG-P0001						CP-H11A	AI TCP	
21	0	JI-E903A	Kilowatts Indication	Generator GN-E903A Output Kilowatts	WG-P0001						CP-H11A	AI TCP	
22	0	LI-H901A	Level Indication	Bulk Fuel Storage Tank TNK-H901A Level	WG-P0002						CP-H11A	AI TCP	
23	0	LI-H902A	Level Indication	Bulk Fuel Storage Tank TNK-H901A Level	WG-P0002						CP-H11A	AI TCP	
24	0	LA-E901C	Level Alarm	GN-E901A Day Tank Low Low	WG-P0002						CP-H11A	DI TCP	
25	0	LA-E901D	Level Alarm	GN-E901A Day Tank High High	WG-P0002						CP-H11A	DI TCP	
26	0	LA-E902C	Level Alarm	GN-E902A Day Tank Low Low	WG-P0002						CP-H11A	DI TCP	
27	0	LA-E902D	Level Alarm	GN-E902A Day Tank High High	WG-P0002						CP-H11A	DI TCP	
28	0	LA-E903C	Level Alarm	GN-E903A Day Tank Low Low	WG-P0002						CP-H11A	DI TCP	
29	0	LA-E903D	Level Alarm	GN-E903A Day Tank High High	WG-P0002						CP-H11A	DI TCP	
30	0	MM-H906A	Running Status	Fuel Transfer Pump P-H906A Running	WG-P0002						CP-H11A	DI TCP	
31	0	UF-H906A	No Fault	Fuel Transfer Pump P-H906A Fault	WG-P0002						CP-H11A	DI TCP	
32	0	YS-H906A	C/O/H Switch in Computer Position	Fuel Transfer Pump P-H906A in Computer Mode	WG-P0002						CP-H11A	DI TCP	
33	0	MM-H907A	Running Status	Fuel Transfer Pump P-H907A Running	WG-P0002						CP-H11A	DI TCP	
34	0	UF-H907A	No Fault	Fuel Transfer Pump P-H907A Fault	WG-P0002						CP-H11A	DI TCP	
35	0	YS-H907A	C/O/H Switch in Computer Position	Fuel Transfer Pump P-H907A in Computer Mode	WG-P0002						CP-H11A	DI TCP	
36	0	LA-H908A	Level Alarm	Fuel Leak Detection Alarm	WG-P0002						CP-H11A	DI TCP	
37	0	TI-H222A	Temperature Indication	Generator Building Electrical Room Ambient Temperature	WG-H0501						CP-H12	AI	
38	0	UF-H222A	No Fault	Generator Building Electrical Room HVAC General Fault	WG-H0501						CP-H12	DI	

I/O POINT TYPES: TCP = Modbus/TCP Ethernet, AI = Analog Input, AO = Analog Output, DI = Discrete Input, DO = Discrete Output

RECORD NO.	REV. NO.	TAG NAME	DESCRIPTION			I/O SPECIFICATION							
			FUNCTION	SERVICE	P&ID DRAWING	ENG. UNITS	SCALE		ALARMS		PLC CABINET	I/O TYPE	I/O ADDRESS
							LOW	HIGH	LOW	HIGH			
39	0	TI-H204A	Temperature Indication	Generator GN-E901A Area Ambient Temperature	WG-H0502						CP-H12	AI	
40	0	UF-E901A	No Fault	Generator GN-E901A HVAC General Fault	WG-H0502						CP-H12	DI	
41	0	MM-E901A	Running Status	Generator GN-E901A HVAC Generator Running	WG-H0502						CP-H11	DO	
42	0	ZD-H203A	Open Status	Generator GN-E901A Exhaust Damper Open	WG-H0502						CP-H11	D1	
43	0	TI-H209A	Temperature Indication	Generator GN-E902A Area Ambient Temperature	WG-H0503						CP-H12	AI	
44	0	UF-E902A	No Fault	Generator GN-E902A HVAC General Fault	WG-H0503						CP-H12	DI	
45	0	MM-E902A	Running Status	Generator GN-E902A HVAC Generator Running	WG-H0503						CP-H11	DO	
46	0	ZD-H208A	Open Status	Generator GN-E902A Exhaust Damper Open	WG-H0503						CP-H11	D1	
47	0	TI-H214A	Temperature Indication	Generator GN-E903A Area Ambient Temperature	WG-H0504						CP-H12	AI	
48	0	UF-E903A	No Fault	Generator GN-E903A HVAC General Fault	WG-H0504						CP-H12	DI	
49	0	MM-E903A	Running Status	Generator GN-E903A HVAC Generator Running	WG-H0504						CP-H11	DO	
50	0	ZD-H213A	Open Status	Generator GN-E903A Exhaust Damper Open	WG-H0504						CP-H11	DI	
51	0	TA-E100AA	Temperature Alarm	Transformer XFMR-E100A Winding Temperature High	WG-P0001						CP-H12	DI	
52	0	TA-E100AB	Temperature Alarm	Transformer XFMR-E100A Winding Temperature High High	WG-P0001						CP-H12	DI	
53	0	TA-E100AC	Temperature Alarm	Transformer XFMR-E100A Top Oil Temperature High	WG-P0001						CP-H12	DI	
54	0	LA-E100AA	Level Alarm	Transformer XFMR-E100A Oil Level Low	WG-P0001						CP-H12	DI	
55	0	LA-E100AB	Level Alarm	Transformer XFMR-E100A Oil Level Low Low	WG-P0001						CP-H12	DI	
56	0	PA-E100AA	Pressure Alarm	Transformer XFMR-E100A Oil Pressure High	WG-P0001						CP-H12	DI	
57	0	XA-E100AA	Ground Fault Alarm	Transformer XFMR-E100A Ground Fault	WG-P0001						CP-H11	DI	
58	0	XA-E100AB	Neutral Resistor Fault Alarm	Transformer XFMR-E100A Neutral Resistor Fault	WG-P0001						CP-H12	DI	
59	0	TA-E100BA	Temperature Alarm	Transformer XFMR-E100B Winding Temperature High	WG-P0001						CP-H12	DI	
60	0	TA-E100BB	Temperature Alarm	Transformer XFMR-E100B Winding Temperature High High	WG-P0001						CP-H12	DI	
61	0	TA-E100BC	Temperature Alarm	Transformer XFMR-E100B Top Oil Temperature High	WG-P0001						CP-H12	DI	
62	0	LA-E100BA	Level Alarm	Transformer XFMR-E100B Oil Level Low	WG-P0001						CP-H12	DI	
63	0	LA-E100BB	Level Alarm	Transformer XFMR-E100B Oil Level Low Low	WG-P0001						CP-H12	DI	
64	0	PA-E100BA	Pressure Alarm	Transformer XFMR-E100B Oil Pressure High	WG-P0001						CP-H12	DI	
65	0	XA-E100BA	Ground Fault Alarm	Transformer XFMR-E100B Ground Fault	WG-P0001						CP-H11	DI	
66	0	XA-E100BB	Neutral Resistor Fault Alarm	Transformer XFMR-E100B Neutral Resistor Fault	WG-P0001						CP-H12	DI	
67													
68													
69													
70	0	AI-T102A	Total Chlorine Indication	Clearwell Total Chlorine	WT-P0001						LCP-T11	AI	
71	0	AI-T102B	Total Ammonia Indication	Clearwell Total Ammonia	WT-P0001						LCP-T11	AI	
72	0	AI-T102C	Free Ammonia Indication	Clearwell Free Ammonia	WT-P0001						LCP-T11	AI	
73	0	AI-T102D	Monochloramine Indication	Clearwell Monochloramine	WT-P0001						LCP-T11	AI	
74	0	AF-T102A	Analyzer Fault Indication	Clearwell Chloramination Analyzer Fault	WT-P0001						LCP-T11	DI	
75	0	FA-T102A	Flow Alarm	Clearwell Chloramination Analyzer Sample Low Flow	WT-P0001						LCP-T11	DI	
76	0	AI-T103A	Free Chlorine Indication	Clearwell Free Chlorine Analyzer	WT-P0001						LCP-T11	AI	
77	0	AF-T103A	Analyzer Fault Indication	Clearwell Free Chlorine Analyzer Fault	WT-P0001						LCP-T11	DI	

I/O POINT TYPES: TCP = Modbus/TCP Ethernet, AI = Analog Input, AO = Analog Output, DI = Discrete Input, DO = Discrete Output

RECORD NO.	REV. NO.	TAG NAME	DESCRIPTION			I/O SPECIFICATION							
			FUNCTION	SERVICE	P&ID DRAWING	ENG. UNITS	SCALE		ALARMS		PLC CABINET	I/O TYPE	I/O ADDRESS
							LOW	HIGH	LOW	HIGH			
78	0	FA-T103A	Flow Alarm	Clearwell Free Chlorine Analyzer Sample Low Flow	WT-P0001						LCP-T11	DI	
79	0	AI-T104A	pH Indication	Clearwell pH	WT-P0001						LCP-T11	AI	
80	0	AF-T104A	Analyzer Fault Indication	Clearwell pH Analyzer Fault	WT-P0001						LCP-T11	DI	
81	0	FA-T104A	Flow Alarm	Clearwell pH Analyzer Sample Low Flow	WT-P0001						LCP-T11	DI	
82	0	AI-T105A	Turbidity Indication	Clearwell Turbidity	WT-P0001						LCP-T11	AI	
83	0	AF-T105A	Analyzer Fault Indication	Clearwell Turbidity Analyzer Fault	WT-P0001						LCP-T11	DI	
84	0	FA-T105A	Flow Alarm	Clearwell Turbidity Analyzer Sample Low Flow	WT-P0001						LCP-T11	DI	
85	0	AI-T202A	Total Chlorine Indication	Clearwell Total Chlorine	WT-P0001						LCP-T11	AI	
86	0	AI-T202B	Total Ammonia Indication	Clearwell Total Ammonia	WT-P0001						LCP-T11	AI	
87	0	AI-T202C	Free Ammonia Indication	Clearwell Free Ammonia	WT-P0001						LCP-T11	AI	
88	0	AI-T202D	Monochloramine Indication	Clearwell Monochloramine	WT-P0001						LCP-T11	AI	
89	0	AF-202A	Analyzer Fault Indication	Clearwell Chloramination Analyzer Fault	WT-P0001						LCP-T11	DI	
90	0	FA-T202A	Flow Alarm	Clearwell Chloramination Analyzer Sample Low Flow	WT-P0001						LCP-T11	DI	
91	0	AI-T203A	Free Chlorine Indication	Clearwell Free Chlorine	WT-P0001						LCP-T11	AI	
92	0	AF-T203A	Analyzer Fault Indication	Clearwell Free Chlorine Analyzer Fault	WT-P0001						LCP-T11	DI	
93	0	FA-T203A	Flow Alarm	Clearwell Free Chlorine Analyzer Sample Low Flow	WT-P0001						LCP-T11	DI	
94	0	AI-T204A	pH Indication	Clearwell pH	WT-P0001						LCP-T11	AI	
95	0	AF-T204A	Analyzer Fault Indication	Clearwell pH Analyzer Fault	WT-P0001						LCP-T11	DI	
96	0	FA-T204A	Flow Alarm	Clearwell pH Analyzer Sample Low Flow	WT-P0001						LCP-T11	DI	
97	0	AI-T205A	Turbidity Indication	Clearwell Turbidity	WT-P0001						LCP-T11	AI	
98	0	AF-T205A	Analyzer Fault Indication	Clearwell Turbidity Analyzer Fault	WT-P0001						LCP-T11	DI	
99	0	FA-T205A	Flow Alarm	Clearwell Turbidity Analyzer Sample Low Flow	WT-P0001						LCP-T11	DI	
100	0	LF-T101A	Level Fault	Clearwell Cell No.1 Level	WT-P0001						LCP-T11	DI	
101	0	LF-T101B	Level Fault	Clearwell Cell No.1 Level	WT-P0001						LCP-T11	DI	
102	0	LF-T201A	Level Fault	Clearwell Cell No.2 Level	WT-P0001						LCP-T11	DI	
103	0	LF-T201B	Level Fault	Clearwell Cell No.2 Level	WT-P0001						LCP-T11	DI	
104	0	LI-T101A	Level Indication	Clearwell Cell No.1 Level	WT-P0001						LCP-T11	AI	
105	0	LI-T101B	Level Indication	Clearwell Cell No.1 Level	WT-P0001						LCP-T11	AI	
106	0	LI-T201A	Level Indication	Clearwell Cell No.2 Level	WT-P0001						LCP-T11	AI	
107	0	LI-T201B	Level Indication	Clearwell Cell No.2 Level	WT-P0001						LCP-T11	AI	
108	0	MM-T101A	Running Status	Clearwell Analyser Sample Pump Running	WT-P0001						LCP-T11	DI	
109	0	MM-T201A	Running Status	Clearwell Analyser Sample Pump Running	WT-P0001						LCP-T11	DI	
110	0	MN-T101A	Start Command	Clearwell Analyser Sample Pump Start	WT-P0001						LCP-T11	DO	
111	0	MN-T201A	Start Command	Clearwell Analyser Sample Pump Start	WT-P0001						LCP-T11	DO	
112	0	YS-T101A	C/O/H Switch in Computer Position	Clearwell Analyser Sample Pump in Computer Mode	WT-P0001						LCP-T11	DI	
113	0	YS-T201A	C/O/H Switch in Computer Position	Clearwell Analyser Sample Pump in Computer Mode	WT-P0001						LCP-T11	DI	
114	0	ZB-T002A	Closed Status	Clearwell Cell 1 & 2 Dividing Wall Sluice Gate Closed	WT-P0001						LCP-T11	DI	
115	0	ZB-T003A	Closed Status	Clearwell Outlet Chamber Dividing Wall Sluice Gate Closed	WT-P0001						LCP-T11	DI	
116	0	ZB-T101A	Closed Status	Clearwell Cell 1 Inlet Sluice Gate Closed	WT-P0001						LCP-T11	DI	

I/O POINT TYPES: TCP = Modbus/TCP Ethernet, AI = Analog Input, AO = Analog Output, DI = Discrete Input, DO = Discrete Output

RECORD NO.	REV. NO.	TAG NAME	DESCRIPTION			I/O SPECIFICATION							
			FUNCTION	SERVICE	P&ID DRAWING	ENG. UNITS	SCALE		ALARMS		PLC CABINET	I/O TYPE	I/O ADDRESS
							LOW	HIGH	LOW	HIGH			
117	0	ZB-T102A	Closed Status	Clearwell Cell 1 Outlet Sluice Gate Closed	WT-P0001						LCP-T11	DI	
118	0	ZB-T201A	Closed Status	Clearwell Cell 2 Inlet Sluice Gate Closed	WT-P0001						LCP-T11	DI	
119	0	ZB-T202A	Closed Status	Clearwell Cell 2 Outlet Sluice Gate Closed	WT-P0001						LCP-T11	DI	
120	0	ZD-T002A	Open Status	Clearwell Cell 1 & 2 Dividing Wall Sluice Gate Open	WT-P0001						LCP-T11	DI	
121	0	ZD-T003A	Open Status	Clearwell Outlet Chamber Dividing Wall Sluice Gate Open	WT-P0001						LCP-T11	DI	
122	0	ZD-T101A	Open Status	Clearwell Cell 1 Inlet Sluice Gate Open	WT-P0001						LCP-T11	DI	
123	0	ZD-T102A	Open Status	Clearwell Cell 1 Outlet Sluice Gate Open	WT-P0001						LCP-T11	DI	
124	0	ZD-T201A	Open Status	Clearwell Cell 2 Inlet Sluice Gate Open	WT-P0001						LCP-T11	DI	
125	0	ZD-T202A	Open Status	Clearwell Cell 2 Outlet Sluice Gate Open	WT-P0001						LCP-T11	DI	
126	0	UF-H240A	General Alarm	Clearwell Inlet Bulidng HVAC General Fault	WT-M0007						LCP-T11	DI	
127	0	TI-H240A	Zone Temperature	Clearwell Inlet Bulidng Ambient Temperature	WT-M0007						LCP-T11	AI	
128													
129													
130	0	YB-T301A	Close Command	Clearwell Outlet Valve FV-T301A Close	WD-P0002						CP-D21	DO	
131	0	YD-T301A	Open Command	Clearwell Outlet Valve FV-T301A Open	WD-P0002						CP-D21	DO	
132	0	YS-T301A	C/O/H Switch in Computer Position	Clearwell Outlet Valve FV-T301A in Computer Mode	WD-P0002						CP-D21	DI	
133	0	ZB-T301A	Closed Status	Clearwell Outlet Valve FV-T301A Closed	WD-P0002						CP-D21	DI	
134	0	ZD-T301A	Open Status	Clearwell Outlet Valve FV-T301A Open	WD-P0002						CP-D21	DI	
135	0	YB-T302A	Close Command	Clearwell Outlet Valve FV-T302A Close	WD-P0002						CP-D21	DO	
136	0	YD-T302A	Open Command	Clearwell Outlet Valve FV-T302A Open	WD-P0002						CP-D21	DO	
137	0	YS-T302A	C/O/H Switch in Computer Position	Clearwell Outlet Valve FV-T302A in Computer Mode	WD-P0002						CP-D21	DI	
138	0	ZB-T302A	Closed Status	Clearwell Outlet Valve FV-T302A Closed	WD-P0002						CP-D21	DI	
139	0	ZD-T302A	Open Status	Clearwell Outlet Valve FV-T302A Open	WD-P0002						CP-D21	DI	
140	0	LA-XXXX	Level Alarm	Cell 1 Raw Water Valve Air Gap Flooded							CP-D21	DI	



**INSTRUMENT INDEX**

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**1. GENERAL**

**1.1 References - General**

.1 Refer to Section 17010 – Instrumentation and Control General Requirements.

**1.2 Instrument Index**

.1 The following spreadsheet gives an itemized list of the instrumentation included as part of this Work.

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**

**INSTRUMENT INDEX**

RECORD NO.	REV. No.	TAG NAME	DESCRIPTION		MANUFACTURER	MODEL	POWER SUPPLY	CALIBRATED RANGE	MOUNTING	SUPPLIED BY	INSTALLED BY	COMMENTS	SPEC. DATA SHEET	P&ID DRAWING	INSTRUMENT LOOP DIA.	INSTALLATION DETAIL	LOCATION DWG.
			INSTRUMENT TYPE	SERVICE													
1	0	LE-T101A	Level Element	Clearwell Cell No.1 Level						Contractor	Contractor		I120	WT-P001	WB-A0455	WB-A0401	
2	0	LT-T101A	Level Indicator Transmitter	Clearwell Cell No.1 Level			120v			Contractor	Contractor		I120	WT-P001	WB-A0455	WB-A0402	
3	0	LE-T101B	Level Element	Clearwell Cell No.1 Level						Contractor	Contractor		I120	WT-P001	WB-A0455	WB-A0401	
4	0	LT-T101B	Level Indicator Transmitter	Clearwell Cell No.1 Level			120V			Contractor	Contractor		I120	WT-P001	WB-A0455	WB-A0402	
5	0	FI-T102A	Sample Flow Indicator	Clearwell Chloramination Analyzer Sample Flow				To suit required instrument sample flow rate		Contractor	Contractor	Rotameter Complete With Low Flow Switch		WP-P0001		WT-I0301	WT-I0001
6	0	AE-T102A	Analyzer Element	Clearwell Total Chlorine, Total Ammonia, Free Ammonia and Monochloramine						Contractor	Contractor		I180	WT-P001		WT-I0301	WT-I0001
7	0	AT-T102A	Analyzer/Transmitter	Clearwell Total Chlorine, Total Ammonia, Free Ammonia and Monochloramine			120V	Total Chlorine 0-5mg/L, Free Ammonia 0-2mg/L, Monochloramine 0-5mg/L		Contractor	Contractor		I180	WT-P001	WB-A0465	WT-I0301	WT-I0001
8	0	FI-T103A	Sample Flow Indicator	Clearwell Free Chlorine Analyzer Sample Flow				To suit required instrument sample flow rate		Contractor	Contractor	Rotameter Complete With Low Flow Switch		WP-P0001		WT-I0301	WT-I0001
9	0	AE-T103A	Analyzer Element	Clearwell Free Chlorine						Contractor	Contractor		I170	WT-P001		WT-I0301	WT-I0001
10	0	AT-T103A	Free Chlorine Analyzer/Transmitter	Clearwell Free Chlorine			120V	0-5mg/L		Contractor	Contractor		I170	WT-P001	WB-A0465	WT-I0301	WT-I0001
11	0	FI-T104A	Sample Flow Indicator	Clearwell pH Analyzer Sample Flow				To suit required instrument sample flow rate		Contractor	Contractor	Rotameter Complete With Low Flow Switch		WP-P0001		WT-I0301	WT-I0001
12	0	AE-T104A	Analyzer Element	Clearwell pH						Contractor	Contractor		I165	WT-P001		WT-I0301	WT-I0001
13	0	AT-T104A	pH Analyzer/Transmitter	Clearwell pH			120V	5.5-9pH		Contractor	Contractor		I165	WT-P001	WB-A0465	WT-I0301	WT-I0001
14	0	FI-T105A	Sample Flow Indicator	Clearwell Turbidity Analyzer Sample Flow				To suit required instrument sample flow rate		Contractor	Contractor	Rotameter Complete With Low Flow Switch		WP-P0001		WT-I0301	WT-I0001
15	0	AE-T105A	Analyzer Element	Clearwell Turbidity						Contractor	Contractor		I162	WT-P001		WT-I0301	WT-I0001
16	0	AT-T105A	Turbidity Analyzer/Transmitter	Clearwell Turbidity			120V	0-1 NTU		Contractor	Contractor		I162	WT-P001	WB-A0459	WT-I0301	WT-I0001
17	0	LE-T201A	Level Element	Clearwell Cell No.2 Level						Contractor	Contractor		I120	WT-P001	WB-A0455	WB-A0401	
18	0	LT-T201A	Level Indicator Transmitter	Clearwell Cell No.2 Level			120V			Contractor	Contractor		I120	WT-P001	WB-A0455	WB-A0402	
19	0	LE-T201B	Level Element	Clearwell Cell No.2 Level						Contractor	Contractor		I120	WT-P001	WB-A0455	WB-A0401	
20	0	LT-T201B	Level Indicator Transmitter	Clearwell Cell No.2 Level			120V			Contractor	Contractor		I120	WT-P001	WB-A0455	WB-A0402	
21	0	FI-T202A	Sample Flow Indicator	Clearwell Chloramination Analyzer Sample Flow				To suit required instrument sample flow rate		Contractor	Contractor	Rotameter Complete With Low Flow Switch		WP-P0001		WT-I0301	WT-I0001
22	0	AE-T202A	Analyzer Element	Clearwell Total Chlorine, Total Ammonia, Free Ammonia and Monochloramine						Contractor	Contractor		I180	WT-P001		WT-I0301	WT-I0001
23	0	AT-T202A	Analyzer/Transmitter	Clearwell Total Chlorine, Total Ammonia, Free Ammonia and Monochloramine			120V	Total Chlorine 0-5mg/L, Free Ammonia 0-2mg/L, Monochloramine 0-5mg/L		Contractor	Contractor		I180	WT-P001	WB-A0465	WT-I0301	WT-I0001
24	0	FI-T203A	Sample Flow Indicator	Clearwell Free Chlorine Analyzer Sample Flow				To suit required instrument sample flow rate		Contractor	Contractor	Rotameter Complete With Low Flow Switch		WP-P0001		WT-I0301	WT-I0001
25	0	AE-T203A	Analyzer Element	Clearwell Free Chlorine						Contractor	Contractor		I170	WT-P001		WT-I0301	WT-I0001
26	0	AT-T203A	Free Chlorine Analyzer/Transmitter	Clearwell Free Chlorine			120V	0-5mg/L		Contractor	Contractor		I170	WT-P001	WB-A0465	WT-I0301	WT-I0001
27	0	FI-T204A	Sample Flow Indicator	Clearwell pH Analyzer Sample Flow				To suit required instrument sample flow rate		Contractor	Contractor	Rotameter Complete With Low Flow Switch		WP-P0001		WT-I0301	WT-I0001
28	0	AE-T204A	Analyzer Element	Clearwell pH						Contractor	Contractor		I165	WT-P001		WT-I0301	WT-I0001
29	0	AT-T204A	pH Analyzer/Transmitter	Clearwell pH			120V	5.5-9pH		Contractor	Contractor		I165	WT-P001	WB-A0465	WT-I0301	WT-I0001
30	0	FI-T205A	Sample Flow Indicator	Clearwell Turbidity Analyzer Sample Flow				To suit required instrument sample flow rate		Contractor	Contractor	Rotameter Complete With Low Flow Switch		WP-P0001		WT-I0301	WT-I0001
31	0	AE-T205A	Analyzer Element	Clearwell Turbidity						Contractor	Contractor		I162	WT-P001		WT-I0301	WT-I0001
32	0	AT-T205A	Turbidity Analyzer/Transmitter	Clearwell Turbidity			120V	0-1 NTU		Contractor	Contractor		I162	WT-P001	WB-A0459	WT-I0301	WT-I0001
33																	
34																	
35	0	LS-H920A	Level Switch	Generator Building Sump Pit High Level Switch			120V		Bracket	Contractor	Contractor		I125	WG-P0001	WB-A0463	WB-A0406	

**INSTRUMENT INDEX**

RECORD NO.	REV. No.	TAG NAME	DESCRIPTION		MANUFACTURER	MODEL	POWER SUPPLY	CALIBRATED RANGE	MOUNTING	SUPPLIED BY	INSTALLED BY	COMMENTS	SPEC. DATA SHEET	P&ID DRAWING	INSTRUMENT LOOP DIA.	INSTALLATION DETAIL	LOCATION DWG.
			INSTRUMENT TYPE	SERVICE													
36	0	LE-E901A	Level Element	Generator GN-E901A Day Tank Leak Detection						Supply Contractor	Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
37	0	LS-E901B	Level Switch	Generator GN-E901A Day Tank Level						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
38	0	LS-E901D	Level Switch	Generator GN-E901A Day Tank Level						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
39	0	SOL-E901A	Solenoid Valve	Generator GN-E901A Day Tank Fill Valve						Supply Contractor	Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
40	0	LE-E902A	Level Element	Generator GN-E902A Day Tank Leak Detection						Supply Contractor	Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
41	0	LS-E902B	Level Switch	Generator GN-E902A Day Tank Level						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
42	0	LS-E902D	Level Switch	Generator GN-E902A Day Tank Level						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
43	0	SOL-E902A	Solenoid Valve	Generator GN-E902A Day Tank Fill Valve						Supply Contractor	Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
44	0	LE-E903A	Level Element	Generator GN-E903A Day Tank Leak Detection						Supply Contractor	Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
45	0	LS-E903B	Level Switch	Generator GN-E903A Day Tank Level						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
46	0	LS-E903D	Level Switch	Generator GN-E903A Day Tank Level						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
47	0	SOL-E903A	Solenoid Valve	Generator GN-E903A Day Tank Fill Valve						Supply Contractor	Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
48	0	LT-H901A	Level Transmitter	Bulk Fuel Storage Tank TNK-H901A Level						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
49	0	LE-H901A	Level Element	Bulk Fuel Storage Tank TNK-H901A Leak Detection						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
50	0	LT-H902A	Level Transmitter	Bulk Fuel Storage Tank TNK-H902A Level						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
51	0	LE-H902A	Level Element	Bulk Fuel Storage Tank TNK-H902A Leak Detection						Supply Contractor	Supply Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
52	0	LE-H904A	Level Element	Fuel Transfer System Leak Detection						Supply Contractor	Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110
53	0	LE-H905A	Level Element	Fuel Transfer System Leak Detection						Supply Contractor	Contractor	Wired to Fuel System Control Panel LCP-H908A		WG-P0002			WG-H0110

**INSTRUMENT SPECIFICATION SHEETS**

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**1. GENERAL**

**1.1 References - General**

- .1 The Work includes the provision of all instrument specification sheets.
- .2 Refer to Section 17010 – Instrumentation and Control General Requirements for general instrumentation and control requirements related to instrument specification sheets.

**1.2 Instrument Specification Sheets**

- .1 Provide data sheets to itemize detailed as-built information regarding the specification of instruments included as part of this Work for each instrument supplied. The data sheets already included in this Section list specific minimum requirements for particular applications.
- .2 Use forms in accordance with the ISA Standard S20 as a template for the preparation of the specification sheets.

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**

**INSTRUMENT SPECIFICATION SHEETS**

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<b>INSTRUMENT SPECIFICATION NUMBER:</b>	I102
<b>DEVICE:</b>	Compact Inline Flowmeter
<b>TAG:</b>	Refer to Instrument Index, Section 17700
<b>SERVICE:</b>	Refer to Instrument Index and P&ID
<b>PROCESS FLOW:</b>	Refer to Instrument Index, Section 17700
<b>OUTPUT:</b>	4 to 20 mA DC
<b>ACCURACY</b>	<3%
<b>REPEATABILITY</b>	<1%
<b>POWER SUPPLY:</b>	24V DC max 100 mA
<b>FLOWTUBE MATERIAL:</b>	To suit liquid being measured, size as shown on drawings
<b>ELECTRONICS ENCLOSURE:</b>	IP65
<b>MOUNTING:</b>	Inline sensor pipe
<b>ACCESSORIES:</b>	2 m moulded oilflex cable
<b>MANUFACTURER AND MODEL:</b>	Weber flow captor

**INSTRUMENT SPECIFICATION SHEETS**

---

**INSTRUMENT SPECIFICATION NUMBER:** I105

**DEVICE:** Flow Switch

**TAG:** Refer to Instrument Index, Section 17700

**TYPE:** Thermal Dispersion

**SERVICE:** Refer to Instrument Index and P&ID

**RANGE:** Refer to Instrument Index, Section 17700

**REPEATABILITY:** <1%

**OUTPUT:** SPDT contacts rated 10 Amps @ 120 VAC

**POWER SUPPLY:** 120 VAC, 60 Hz, 1 Ø

**ENCLOSURE:** Polymer-coated aluminum, NEMA 4X rating

**MOUNTING:** ¾" NPT with 1" insertion length

**MANUFACTURER AND MODEL:** IFM  
Weber

**INSTRUMENT SPECIFICATION SHEETS**

---

**INSTRUMENT SPECIFICATION NUMBER:** I115

**DEVICE:** Pressure Switch

**TAG:** Refer to Instrument Index, Section 17700

**SERVICE:** Refer to Instrument Index and P&ID

**PROCESS CONNECTION:** ½" NPTF

**SENSOR:** Brass Bellows

**RANGE:** Refer to Instrument Index, Section 17700

**MOUNTING:** Bottom, Stem mounted

**ENCLOSURE:** NEMA 4X

**OUTPUT:** Form C Contacts rated 5 amps @ 120 VAC

**MANUFACTURER AND MODEL:** Ashcroft  
United Electric  
Barksdale

**INSTRUMENT SPECIFICATION SHEETS**

---

**INSTRUMENT SPECIFICATION NUMBER:** I120

**DEVICE:** Liquid Level Transmitter

**TAG:** Refer to Instrument Index, Section 17700

**TYPE:** Ultrasonic

**SERVICE:** Refer to Instrument Index and P&ID

**RANGE:** Refer to Instrument Index, Section 17700

**INACCURACY:**  $\pm 0.5\%$  of span

**OUTPUT:** 4 to 20 mA DC into 500 ohm load  
5 configurable alarm relays

**POWER SUPPLY:** 120 VAC, 60 HZ

**ENCLOSURE:** NEMA 4X Transmitter Housing  
NEMA 4X Sensor

**MOUNTING:**

(TRANSMITTER)	Wall Mount
(SENSOR)	Provide PVC pipe stilling well where shown on the drawings and in accordance with manufacturer's recommendations to ensure stable readings in turbulent locations. Mount sensor on stilling well. Install sensors at least 300 mm above maximum liquid level. Provide PVC blind flange for mounting sensor.

**ACCESSORIES:** 1 - hand-held programmer

**MANUFACTURER AND MODEL:** Siemens Multiranger 100/200  
Magnetrol  
Endress & Hauser



**INSTRUMENT SPECIFICATION SHEETS**

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<b>INSTRUMENT SPECIFICATION NUMBER:</b>	I125
<b>DEVICE:</b>	Float Switch
<b>TAG:</b>	Refer to Instrument Index, Section 17700
<b>SERVICE:</b>	Refer to Instrument Index and P&ID
<b>OUTPUT:</b>	SPDT Contacts
<b>ENCLOSURE:</b>	Polypropylene float casing with preterminated signal cable
<b>MOUNTING:</b>	Provide strain relief-type connectors to suspend float at desired location. Fabricate mounting brackets from 316 SS. Provide anti-sway rings to prevent sway in turbulent tanks.
<b>MANUFACTURER AND MODEL:</b>	Flygt ENM-10 Consolidated Electric Warwick Magnetrol

**INSTRUMENT SPECIFICATION SHEETS**

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<b>INSTRUMENT SPECIFICATION NUMBER:</b>	I126
<b>DEVICE:</b>	Conductivity Level Switch
<b>TAG:</b>	Refer to Instrument Index, Section 17700
<b>SERVICE:</b>	Refer to Instrument Index and P&ID
<b>RANGE:</b>	4 conductivity measuring ranges selectable via dip switches
<b>OUTPUT:</b>	SPDT Contacts
<b>POWER SUPPLY:</b>	120 VAC, 60 HZ
<b>ENCLOSURE:</b>	PBT Housing; Polypropylene rod insulation
<b>MOUNTING:</b>	Provide PVC blind flange for mounting probes.
<b>MANUFACTURER AND MODEL:</b>	Endress & Hauser

**INSTRUMENT SPECIFICATION SHEETS**

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**INSTRUMENT SPECIFICATION NUMBER:** I130

**DEVICE:** Temperature Indicating Transmitter with RTD Sensor

**TAG:** Refer to Instrument Index, Section 17700

**SERVICE:** Ambient Air

**RANGE:** 0°C to 50°C

**INACCURACY:** ±0.5% of span

**INDICATION:** 3½ Digit LED display scaled in engineering units

**OUTPUT:** 4 to 20 mA DC into 500 ohm load

**POWER SUPPLY:** Loop powered

**ENCLOSURE:** Transmitter: NEMA 4X  
RTD Probe: 5 mm dia x 100 mm L ambient air probe

**MOUNTING:** Wall mounting

**MANUFACTURER AND MODEL:** Rosemount Type 3044C  
ABB  
Foxboro

**INSTRUMENT SPECIFICATION SHEETS**

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**INSTRUMENT SPECIFICATION NUMBER:** I131

**DEVICE:** Temperature Indicating Transmitter with RTD Sensor

**TAG:** Refer to Instrument Index, Section 17700

**SERVICE:** Process Water

**RANGE:** 0 - 100°C

**INACCURACY:** ±0.5% of span

**INDICATION:** 3½ Digit LED display scaled in engineering units

**OUTPUT:** 4 to 20 mA DC into 500 ohm load

**POWER SUPPLY:** Loop powered

**ENCLOSURE:** Transmitter: NEMA 4X  
RTD Probe: Platinum 100 OHM Spring Loaded

**MOUNTING:** Direct to process, use a thermowell with 50 mm insertion at a pipe tee or elbow fitting

**MANUFACTURER AND MODEL:** Rosemount Type 3044C  
ABB  
Foxboro

**INSTRUMENT SPECIFICATION SHEETS**

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<b>INSTRUMENT SPECIFICATION NUMBER:</b>	I162
<b>DEVICE:</b>	Inline Turbidimeter
<b>TAG:</b>	Refer to Instrument Index, Section 17700
<b>SERVICE:</b>	Refer to Instrument Index and P&ID
<b>MOUNTING:</b>	Wall mount.
<b>RANGE:</b>	0.001 – 100 NTU
<b>INACCURACY:</b>	±2% of reading from 0 to 40 NTU; ±5% of reading from 40 to 100 NTU
<b>REPEATABILITY</b>	Less than 1% of reading
<b>OUTPUT:</b>	4 to 20 ma DC into 500 ohm load 2 Configurable alarm relays including a dedicated fault relay
<b>POWER SUPPLY:</b>	120 VAC, 60 Hz
<b>INDICATION:</b>	Local indication of Turbidity
<b>ELECTRONIC ENCLOSURE:</b>	NEMA 4X.
<b>MANUFACTURER AND MODEL:</b>	Hach 1720E Turbidimeter and sc100 Controller Rosemount Endress & Hauser

**INSTRUMENT SPECIFICATION SHEETS**

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<b>INSTRUMENT SPECIFICATION NUMBER:</b>	I165
<b>DEVICE:</b>	Flow Through pH/Temperature Analyzer
<b>TAG:</b>	Refer to Instrument Index, Section 17700
<b>SERVICE:</b>	Refer to Instrument Index and P&ID
<b>SENSOR MATERIAL:</b>	Glass electrode
<b>SENSOR MOUNTING</b>	Wall mount
<b>TEMPERATURE COMPENSATION:</b>	Automatic, 0 to 100 Deg. C
<b>RANGE:</b>	0-14 pH
<b>INACCURACY:</b>	Less than $\pm 0.5\%$ of span
<b>REPEATABILITY</b>	Less than 0.01 pH
<b>OUTPUT:</b>	Two 4-20 mA DC outputs for process measurement and temperature 4 Configurable alarm relays including a dedicated fault relay
<b>POWER SUPPLY:</b>	120 VAC, 60 Hz
<b>INDICATION:</b>	Local indication of pH and temperature
<b>ENCLOSURE:</b>	NEMA 4X transmitter housing. Wall-mount sensor and transmitter.
<b>ACCESSORIES:</b>	1 – Hand-held programmer
<b>MANUFACTURER AND MODEL:</b>	Rosemount 320B Sensor and 54e Analyzer Endress & Hauser ABB Foxboro

**INSTRUMENT SPECIFICATION SHEETS**

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<b>INSTRUMENT SPECIFICATION NUMBER:</b>	I170
<b>DEVICE:</b>	Online Chlorine Residual Analyzer
<b>TAG:</b>	Refer to Instrument Index, Section 17700
<b>SERVICE:</b>	Refer to Instrument Index and P&ID
<b>MEASUREMENT METHOD:</b>	Amperometric
<b>MOUNTING:</b>	Wall mount
<b>RANGE:</b>	0-5 mg/L
<b>INACCURACY:</b>	Less than $\pm 1.0\%$ of span
<b>REPEATABILITY</b>	Less than $\pm 1.0\%$ of span
<b>OUTPUT:</b>	4 to 20 mA DC into maximum 600 ohm load 3 Configurable alarm relays including a dedicated fault relay
<b>POWER SUPPLY:</b>	120 VAC, 60 Hz
<b>INDICATION:</b>	Local indication of Free/Total Chlorine
<b>ENCLOSURE:</b>	NEMA 4X transmitter housing. Wall-mount sensor and transmitter.
<b>MANUFACTURER AND MODEL:</b>	Wallace & Tiernan Micro/2000

**INSTRUMENT SPECIFICATION SHEETS**

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<b>INSTRUMENT SPECIFICATION NUMBER:</b>	I180
<b>DEVICE:</b>	Online Total Chlorine, Free Ammonia, Total Ammonia, Monochloramine Analyzer
<b>TAG:</b>	Refer to Instrument Index, Section 17700
<b>SERVICE:</b>	Clearwell
<b>MEASUREMENT METHOD:</b>	UV Absorbance
<b>MOUNTING:</b>	Wall mount
<b>RANGE:</b>	0-5 mg/L Total Chlorine, Free Ammonia, Total Ammonia, Monochloramine
<b>INACCURACY:</b>	Less than $\pm 5.0\%$ of span
<b>OUTPUT:</b>	Four 4-20 mA DC Dedicated fault relay
<b>POWER SUPPLY:</b>	120 VAC, 60 Hz
<b>INDICATION:</b>	Local LCD and keypad for indication of Measured Parameters Ammonia Residuals
<b>ENCLOSURE:</b>	NEMA 4
<b>MANUFACTURER AND MODEL:</b>	Chemscan UV-4100

**END OF SECTION**



## INSTRUMENT LOOP DRAWINGS

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### 1. GENERAL

#### 1.1 References - General

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements.

#### 1.2 Instrument Loop Drawings

- .1 The following sixteen (16) Drawings show typical instrument loop wiring diagrams as referenced by this Specification Section. One (1) Drawing per loop shall be completed by the Contractor and submitted for approval after award of Contract.

WB-A0451	Instrument Loop Diagram - Typical Motorized Valve - Open/Close
WB-A0452	Instrument Loop Diagram - Typical Motorized Valve - Modulating
WB-A0453	Instrument Loop Diagram - Typical Magnetic Flow Meter
WB-A0454	Instrument Loop Diagram - Typical Thermal Mass Flow Meter
WB-A0455	Instrument Loop Diagram – Typical Ultrasonic Level Transmitter
WB-A0456	Instrument Loop Diagram - Typical Thermal Dispersion Flow Meter
WB-A0457	Instrument Loop Diagram - Typical Chlorine Residual Analyzer
	Instrument Loop Diagram - Typical Conductivity Level Switch – Single
WB-A0458	Point
WB-A0459	Instrument Loop Diagram - Typical Turbidity Analyzer
WB-A0460	Instrument Loop Diagram - Typical pH Analyzer
WB-A0461	Instrument Loop Diagram - Typical MCC Starter
WB-A0462	Instrument Loop Diagram - Typical Turbidity/TSS Analyzer
WB-A0463	Instrument Loop Diagram - Typical Discrete Input
WB-A0464	Instrument Loop Diagram - Typical Valve Limit Switch Monitoring
WB-A0465	Instrument Loop Diagram - Typical Loop Powered Analog Input
WB-A0466	Instrument Loop Diagram - Typical 3-wire RTD

### 2. PRODUCTS (NOT USED)

### 3. EXECUTION (NOT USED)

**END OF SECTION**

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**INSTRUMENT STANDARD DETAILS**

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**1. GENERAL**

**1.1 References – General**

- .1 Refer to Section 17010 – Instrumentation and Control General Requirements.

**1.2 Instrument Standard Details**

- .1 The following ten (10) Drawings provide standard instrumentation installation details as referenced by this Specification Section:

WB-A0401	Instrumentation Standard Details - Ultrasonic Level Transducer
	Instrumentation Standard Details - Loop Powered Remote Indicating
WB-A0402	Transmitter
WB-A0403	Instrumentation Standard Details – Hand Switch Mounting
WB-A0404	Instrumentation Standard Details – Pressure Gauge
WB-A0405	Instrumentation Standard Details – Pressure Switch
WB-A0406	Instrumentation Standard Details – Float Switch
WB-A0407	Instrumentation Standard Details – Thermowell Mounted RTD
	Instrumentation Standard Details – Pressure Transmitter and Inline Pressure
WB-A0408	Sensor
WB-A0409	Instrumentation Standard Details – Raw Water pH/ Turbidity Analyzer
WB-A0410	Instrumentation Standard Details – Turbidity/TSS Sensor

**2. PRODUCTS (NOT USED)**

**3. EXECUTION (NOT USED)**

**END OF SECTION**