INSTRUMENTATION AND CONTROL
GENERAL REQUIREMENTS

1. GENERAL

1.1 Requirements of Work

.1 Supply, Install, Performance Verification, 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.

.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.

.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.

Reference	Title
API 550	Manual on Installation of Refinery Instruments and Control Systems, Part I – Process Instrumentation and Control Section one (1) through thirteen (13)
ASME BPVC-VIII-1-2004	Rules for Construction of Pressure Vessels
ASTM B68-02	Seamless Copper Tube
ASTM D883-00	Terms Relating to Plastics
IEEE 100-00	Dictionary of Electrical and Electronic Terms
ANSI/ISA-7.0.01 1996	Quality Standard For Instrument Air
ISA 5.4-1999	Instrument Loop Diagrams
ISA S18.1-79(1992)	Annunciator Sequences and Specifications
ISA S51.1-79(1993)	Process Instrumentation Terminology
NEMA 250-2003	Enclosures for Electrical Equipment (1000 V Max)
NEMA ICS 1-00(R2005)	General Standards for Industrial Controls and Systems
NEMA ICS 2-2000	Industrial Control and Systems, Controllers, Contactors
NFPA 70-2005	National Electrical Code
SAMA PMC 17-10-63	Bushings and Wells for Temperature Sensing Elements
UBC-88	Uniform Building Code
UL 1012-05	Power Supplies
UL 94-06	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
Weik, Martin H.	Communications Standard Dictionary, Van Nostrand Reinhold Co., 1983

.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.

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:

.1 All I&C components supplied for work carried out 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.

.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 Section 01300 – Submittals for further information on Shop Drawing submittals.

.2 O&M Manuals

.1 Refer to Seciton 01730 – Operation and Maintenance Manuals, 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 Operation and maintenance 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 operating and maintenance 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.

.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 E12, 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 has 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.

.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 .

.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.

.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.

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.

Segregation between circuits	Very Noisy	Noisy	Indifferent	Sensitive	Very Sensitive
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 the Contractor. The equipments performance will also be verified by the Contractor.

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.

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.

.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

Form No.	Title
.1 ITR	Instrument Test Report.
.2 LCR	Loop Check Report.

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**	
PROCESS	**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: _____

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. _____									
INSTALLATION COMPLETE									
Primary Element.									
Impulse Lines.									
Block and Drain Valves.									
Air Supply/Filter/Reg.									
Wiring.									
Tracing/Insulation/Housing.									
Mounting and Location.									
PLC/SCADA I/O & Status.									
CALIBRATED									
Impulse Lines Press. Tested.									
LOOP CHECKED									
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: _____

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

1. GENERAL

.1 Supply and Install 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 Install I&C equipment required to operate the WTP including the WTP control system PLC equipment and all vendor packages and City Supplied Equipment as indicated on the P&ID'S and in these Specifications.

2.2 General Requirements

.1 Shop Drawings

.2 Record Drawings

.3 Operation and Maintenance 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 Supply and Install all control system communications equipment as shown on the drawings listed and as described in Specification Section 17275 – Miscellaneous Panel Devices.

.3 Supply and install fibre optic communication cables and all necessary communications equipment to interface the WTP SCADA system to the Dewatering Pump Station control system. A spare fibre optic cable shall also be installed.

.4 Supply and Install a local panel to house the complete Dewatering Pump Station Control System, the panel will also act as a marshalling panel for other instrumentation installed in the Pump Station but not directly associated with the control of the pumps.

.5 Supply and Install an air gap monitoring conductivity type level switch in Cell 3 Raw Water Valve Chamber.

.6 Carry out all I&C work associated with the Sanitary sump adjacent to the DBPS.

.7 Terminate all spare fibre optic cores to patch panels at each drop point and label accordingly.

.8 Supply and install 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 Supply and Install 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.

.12 Supply and install Ethernet connections from the following equipment to the WTP control system: VFD's, transformer power meters, neutral grounding resistors, switchgear protection relays, and large motor protection relays.

.13 All WTP control system PLC programming and WTP monitoring system HMI software development shall be performed by others.

.14 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 assistance 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

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.

.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 EEEMAC 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 line-up. 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.

.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 Marshalling 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 as specified in B6.

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.

.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 including spares, 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.

.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

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.

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 Four (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 µm multi-mode glass fibres, spiral 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.

.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:

.1 Attenuation values grater 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.

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

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 PLC'S, 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.

.4 Non-critical loads include control panel interior lights and receptacles.

.5 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

TRANSMITTERS AND INDICATORS

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. Trerice, Budenberg.

.3 Ultrasonic Level Transmitters: Siemens Multiranger 100/200, Magnetrol, Endress & Hauser.

.4 Temperature Transmitters (RTD): Rosemount, ABB, Foxboro.

3. EXECUTION

3.1 References - General

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

END OF SECTION

SWITCHES AND RELAYS

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.

.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

MISCELLANEOUS PANEL DEVICES

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.

.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.

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.

.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

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 10% spare slot capacity for each PLC panel assembly.

.6 Supply 25% spare power supply capacity for each PLC panel assembly.

.7 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 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 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 Fibre 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.

3. EXECUTION

3.1 References – General

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

END OF SECTION

PLC I/O INDEX

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

			DESCRIPTION			I/O SPECIFICATION							
RECORD NO.	REV. N0.	TAG NAME	FUNCTION	SERVICE	P&ID DRAWING	ENG. UNITS	SCALE LOW	SCALE HIGH	ALARMS LOW	ALARMS HIGH	PLC CABINET	I/O TYPE	I/O ADDRESS
		LI-L920A	Level Indication	Dewatering Pump Station Level	WL-P0002						LCP-L11A	AI	
		LF-L920A	Level Fault	Dewatering Pump Station Level Fault	WL-P0002						LCP-L11A	DI	
		LS-L920A	Level Alarm	Dewatering Pump Station High High Level	WL-P0002						LCP-L11A	DI	
		LS-L920B	Level Alarm	Dewatering Pump Station Low Low Level	WL-P0002						LCP-L11A	DI	
		MM-L921A	Running Status	Dewatering Pump Station Pump P-L921A Running	WL-P0002						LCP-L11A	DI	
		MN-L921A	Start Command	Dewatering Pump Station Pump P-L921A Start	WL-P0002						LCP-L11A	DO	
		YS-L921A	C/O/H Switch in Computer Position	Dewatering Pump Station Pump P-L921A in Computer Mode	WL-P0002						LCP-L11A	DI	
		UF-L921A	No Fault	Dewatering Pump Station Pump P-L921A Fault	WL-P0002						LCP-L11A	DI	
		MM-L922A	Running Status	Dewatering Pump Station Pump P-L922A Running	WL-P0002						LCP-L11A	DI	
		MN-L922A	Start Command	Dewatering Pump Station Pump P-L922A Start	WL-P0002						LCP-L11A	DO	
		YS-L922A	C/O/H Switch in Computer Position	Dewatering Pump Station Pump P-L922A in Computer Mode	WL-P0002						LCP-L11A	DI	
		UF-L922A	No Fault	Dewatering Pump Station Pump P-L922A Fault	WL-P0002						LCP-L11A	DI	
		AI-L924A	TSS Indication	Dewatering Pump Station TSS	WL-P0002						LCP-L11A	AI	
		AF-L924A	TSS Monitor Fault	Dewatering Pump Station TSS Analyser Fault	WL-P0002						LCP-L11A	DI	
		TI-L924A	Temperature Indication	Dewatering Pump Station Metering Chamber Ambient Temperature	WL-P0002						LCP-L11A	AI	
		FI-L924A	Flow Indication	Dewatering Pump Station Outlet Flow	WL-P0002						LCP-L11A	AI	
		FQ-L924A	Flow Pulse	Dewatering Pump Station Outlet Flow Total	WL-P0002						LCP-L11A	DI	
		LA-L924A	Level Alarm	Dewatering Pump Station Metering Chamber Flood	WL-P0002						LCP-L11A	DI	
		ZS-L953A	Switch Position	Transfer Switch Position	WL-P0002						LCP-L11A	DI	
		TI-L951A	Temperature Indication	Transformer A Temperature	WL-P0002						LCP-L11A	AI	
		TI-L952A	Temperature Indication	Transformer B Temperature	WL-P0002						LCP-L11A	AI	
		JA-L950A	Power Alarm	Site Power Failure	WL-P0002						LCP-L11A	DI	
		EA-L955A	Voltage Alarm	24VDC PSU A Failed	WL-P0002						LCP-L11A	DI	
		EA-L955B	Voltage Alarm	24VDC PSU B Failed	WL-P0002						LCP-L11A	DI	
		EA-L960A	Voltage Alarm	UPS Failed	WL-P0002						LCP-L11A	DI	
		TI-L965A	Temperature Indication	Ambient Cabinet Temperature	WL-P0002						LCP-L11A	AI	
		LA-H521A	Level Alarm	DBPS Sanitary Sump High High Level	WH-P0009						CP-D21	DI	
		LA-****	Level Alarm	Raw Water Cell 3 Valve Air Gap Flooded							CP-D21	DI	

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

INSTRUMENT INDEX

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													
		LE-L920A	Level Element	Dewatering Pumping Station Level					Flange	Contractor	Contractor		I120	WL-P0002	WB-A0455	WB-A0401	
		LT-L920A	Level Indicator Transmitter	Dewatering Pumping Station Level			120V		Wall/ Stand	Contractor	Contractor		I120	WL-P0002	WB-A0455	WB-A0402	
		LS-L920A	Level Switch	Dewatering Pumping Station Level High High			120V		Flange	Contractor	Contractor		I125	WL-P0002	WB-A0463	WB-A0406	
		LS-L920B	Level Switch	Dewatering Pumping Station Level Low Low			120V		Flange	Contractor	Contractor		I125	WL-P0002	WB-A0463	WB-A0406	
		PI-L924B	Pressure Indicator	Dewatering Pumping Station Pump Discharge Pressure						Contractor	Contractor		I112	WL-P0002		WB-A0410	
		AE-L924A	TSS Analyser Sensor	Dewatering Pumping Station Turbidity/ Suspended Solids Level					Pipe	Contractor	Contractor		160	WL-P0002			
		AT-L924A	TSS Analyser Indicator Transmitter	Dewatering Pumping Station Turbidity/ Suspended Solids Level			120v		Wall/ Stand	Contractor	Contractor		160	WL-P0002			
		FE-L924A	Flow Element	Dewatering Pumping Station Outlet Flow					Flange	Contractor	Contractor		I100	WL-P0002	WB-A0453	WB-A0453	
		FT-L924A	Flow Indicator Transmitter	Dewatering Pumping Station Outlet Flow			120V		Wall/Stand	Contractor	Contractor	150mm	I100	WL-P0002	WB-A0453	WB-A0402	
		TT-L924A	Temperature Transmitter	Dewatering Pumping Station Meter Chamber Ambient Temperature						Contractor	Contractor		I133	WL-P0002			
		LS-L924A	Level Switch	Dewatering Pumping Station Meter Chamber Flood Switch			120V		Bracket	Contractor	Contractor	Mounted to monitor flood in chamber	I126	WL-P0002	WB-A0458		
		TT-L965A	Temperature Transmitter	Dewatering Pumping Station Meter CabinetAmbient Temperature						Contractor	Contractor		I133	WL-P0002			
		LS-LxxxA	Level Switch	Cell 3 Raw Water Valve Chamber Air Gap Flooded			120V		Bracket	Contractor	Contractor	Mounted to monitor air gap flooding. Switch mounted in container connected to drain	I126	WH-P0010	WB-A0458		
		LS-H540A	Level Switch	DBPS Sanitary Pumping Station High High Level			120V		Flange	Contractor	Contractor		I125	WH-P0009	WB-A0463	WB-A0406	

INSTRUMENT SPECIFICATION SHEETS

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

INSTRUMENT SPECIFICATION NUMBER:	I100A
DEVICE:	Magnetic Flow Meter
TAG:	FIT-L924A
SERVICE:	De-watering pumping station outlet flow
SIZE AND MATERIAL:	150mm
END CONNECTIONS:	Flanged
LINER MATERIAL:	PFA
ELECTRODES:	Stainless Steel
GROUNDING:	Stainless Steel grounding rings
RANGE:	TBC
INACCURACY:	±1% of span
OUTPUT:	4 to 20 mADC into 500 ohm load Scaled pulse output
POWER SUPPLY:	120 VAC, 60 Hz
INDICATION:	Local indication of flow rate and totalized flow
ELECTRONIC ENCLOSURE:	NEMA 4X. Remote wall-mount.
MANUFACTURER AND MODEL:	Rosemount 8700 Series ABB Magmaster Krohne Endress and Hauser.

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION NUMBER:	I120
DEVICE:	Liquid Level Transmitter
TAG:	Refer to Section 17700 – Instrument Index
TYPE:	Ultrasonic
SERVICE:	Refer to Instrument Index and P&ID
RANGE:	Refer to Section 17700 – Instrument Index
INACCURACY:	±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/ Stand Mount
(SENSOR)	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 NUMBER:	I125
DEVICE:	Float Switch
TAG:	Refer to Instrument Index, Section 17700
SERVICE:	Refer to Instrument Index and P&ID Diagrams
OUTPUT:	SPDT Contacts
ENCLOSURE:	Polypropylene float casing with preterminated signal cable
MOUNTING:	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.
MANUFACTURER AND MODEL:	Flygt ENM-10 Consolidated Electric Warwick Magnetrol

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION NUMBER:	I126
DEVICE:	Conductivity Level Switch
TAG:	Refer to Section 17700 – Instrument Index
SERVICE:	Refer to Instrument Index and P&ID
RANGE:	4 conductivity measuring ranges selectable via dip switches
OUTPUT:	SPDT Contacts
POWER SUPPLY:	120 VAC, 60 HZ
ENCLOSURE:	PBT Housing; Polypropylene rod insulation
MOUNTING:	Bracket mounted.
MANUFACTURER AND MODEL:	Endress & Hauser

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION NUMBER:	I133
DEVICE:	Outdoor Air Temperature Transmitter
TAG:	Refer to Instrument Index, Section 17700
TYPE:	Platinum RTD Sensor with Transmitter
RANGE:	-40 to 50°C
INACCURACY:	±0.5% of span
OUTPUT:	4 to 20 mA DC
POWER SUPPLY:	Loop powered
ENCLOSURE:	Stainless steel temperature probe and weatherproof electronics enclosure.
ACCESSORIES:	Wall mount bracket

INSTRUMENT SPECIFICATION SHEETS

INSTRUMENT SPECIFICATION NUMBER:	I160
DEVICE:	Inline TSS Monitor/Transmitter
TAG:	Refer to Instrument Index, Section 17700
SERVICE:	Dewatering cells supernatant, plant sanitary flows
SENSOR MATERIAL:	Stainless Steel with wiper
SENSOR MOUNTING	Inline with proprietary Carbon Steel mounting kit. See drawing WB-A0410 for details
RANGE:	0-500 mg/L
INACCURACY:	Less than 5% of reading
REPEATABILITY	Less than 3% of reading
OUTPUT:	4 to 20 mADC into 500 ohm load
POWER SUPPLY:	120 VAC, 60 Hz
INDICATION:	Local indication of TSS
ELECTRONIC ENCLOSURE:	NEMA 4X. Remote wall-mount.
MANUFACTURER AND MODEL:	Hach Cerlic

END OF SECTION

INSTRUMENT LOOP DRAWINGS

1. GENERAL

1.1 References - General

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

1.2 Instrument Loop Drawings

.1 The following four (4) 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.

WS-A0453	Instrument Loop Diagram - Typical Magnetic Flow Meter
WB-A0455	Instrument Loop Diagram – Typical Ultrasonic Level Transmitter
WB-A0458	Instrument Loop Diagram - Typical Conductivity Level Switch – Single Point
WB-A0463	Instrument Loop Diagram - Typical Discrete Input

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

INSTRUMENT STANDARD DETAILS

1. GENERAL

1.1 References – General

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

1.2 Instrument Standard Details

.1 The following three (3) Drawings provide standard instrumentation installation details as referenced by this Specification Section:

WB-A0401	Instrumentation Standard Details - Ultrasonic Level Transducer
WB-A0406	Instrumentation Standard Details – Float Switch
WB-A0410	Instrumentation Standard Details – TSS Sensor

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

EARTH TECH
ENGINEERING LIMITED
A tyco INTERNATIONAL LTD. COMPANY

Vendor List for Instrumentation and Control Devices

Earth Tech Inc
850 Pembina Highway
Winnipeg
Manitoba
R3M 2M7
Tel: 204 477-5381
Fax: 204 284-2040

AMENDMENT RECORD

Issue	Date	Author	Checked	Approved	Amendment Details
A	7TH April 2005	N TOULSON			
B	May 11, 2005	S Tormey			Added Magnetic Level Indication. Added Magnetrol for Radar Level (Guided wave). Modified PLC's to Modicon Unity
C	Nov. 2, 2005	S Tormey			Added Krohne Magnetic Flow meters as per instructions from Vaughn Martin (City of Winnipeg)
D	Nov. 14, 2005	N TOULSON			Added Hach Water Hardness Monitor
E	Feb. 25 2006	N TOULSON			Added Differential Pressure Flowmeter, Compact Inline Flowmeter, Ammonia Analyser, Free Chlorine Analyzer, Total Chlorine Analyzer Added Chemtrac Particle Counter
F	March 14, 2006	S Tormey			Revised Column Titles

1 Introduction

The purpose of this document is to compile a list of acceptable suppliers and manufacturers for the instrumentation and control equipment used as part of the City of Winnipeg's Water Treatment Program.

Description Of Equipment	**Acceptable Manufacturer** No.1	**Acceptable Manufacturer** No.2	**Acceptable Manufacturer** No.3	**Acceptable Manufacturer** No.4
Power Supplies, Conditioning, Suppression etc.				
DC Power supplies for instrumentation power	Wiedmuller	Sola Hevi Duty		
Transient Voltage Surge Suppression (TVSS)	Sola Hevi Duty STV100K	Leviton	Square D	Cutler Hammer
Power conditioning	Oneac			
UPS	Powerware	APC		
Flow Measuring and Monitoring				
Magnetic Flow Meters	Rosemount 8700	ABB Magmaster	Krohne	Fischer and Porter
Coreolis Flow meter				
Thermal Flowswitch	Ifm	Weber		
Thermal Mass Flowmeter	ABB	Brooks		
Variable Area Flowmeter	Omega	Kobold		
Differential Pressure Flowmeter	McCrometer			
Compact Inline Flowmeter	Weber			
Pressure Measurement and Monitoring				
Absolute Pressure Indicator Transmitter	Rosemount model 3051	ABB	Foxboro	
Differential Pressure Indicator Transmitter with integral manifold	Rosemount model 3051	ABB	Foxboro	

Description Of Equipment	**Acceptable Manufacturer** No.1	**Acceptable Manufacturer** No.2	**Acceptable Manufacturer** No.3	**Acceptable Manufacturer** No.4
Pressure Switches (electronic type)	Ifm	United Electric		
Pressure Switches (conventional type)	Ashcroft	United Electric	Barksdale	
Pressure Gauges	Ashcroft	H.O. Trerice	Budenberg	
3 Valve Manifolds	Anderson Greenwood			
Level Measurement and Monitoring				
Ultrasonic Level Indicator Transmitter	Siemens Multiranger 100/200	Magnetrol	Endress & Hauser	
Radar Type Level Indicator Transmitter	Endress & Hauser	Siemens	Magnetol	
Conductivity Level Switch	Endress & Hauser			
Vibration type level switch	Endress & Hauser			
Bypass Level Indicator	Krohne	Magnetrol		
Magnetic Level Indication	Magnetrol (Orion)	K-Tek KM26		
Float Switch	Flygt	Consolidated Electric	Warwick	Magnetrol
Sludge Blanket Level	Partech	Siemens		
Capacitance Level Switch	Siemens	Endress & Hauser		
Admittance Level Switch	Magnetrol	Bestobell		
Temperature Measurement and Monitoring				
Temperature Transmitter (RTD)	Rosemount	ABB	Foxboro	
Temperature Switch	Ifm			

Description Of Equipment	**Acceptable Manufacturer** No.1	**Acceptable Manufacturer** No.2	**Acceptable Manufacturer** No.3	**Acceptable Manufacturer** No.4
Analytical Instrumentation				
Ph/ Temp	Rosemount	Endress & Hauser	ABB	Foxboro 870
Turbidity	Hach	Rosemount	Endress & Hauser	GLI
Free Chlorine Analyzer	Wallace & Tiernan	Rosemount	Endress & Hauser	Hach
Total Chlorine Analyzer	Wallace & Tiernan	Rosemount	Endress & Hauser	Hach
Ozone Analyzer	Crowcon			
Dew/Moisture Measurement	Veronics			
Particle Counter Analyzer	Hach	Chemtrac		
Suspended Solids Analyzer	Hach			
Ammonia Analyzer	Hach	Waltron	ATi	
Water Hardness Monitor	Hach			
Valve Control				
Electric Actuators	Limitorque	Rotork		
Solenoid Valves	Asco Redhat			
I/P Converters	Omega	Moore		
Relays, Barriers etc				

Description Of Equipment	**Acceptable Manufacturer** No.1	**Acceptable Manufacturer** No.2	**Acceptable Manufacturer** No.3	**Acceptable Manufacturer** No.4
Plug in Relays	Omron	Idec	Potter& Brumfield	
Plug in Timers	Omron	Idec	Potter& Brumfield	
Analog I/S Barriers	MTL	Stahl	Peperl & Fuchs	
Digital Barriers	MTL	Stahl	Peperl & Fuchs	
I/S Relays	Gems	Warwick		
Signal Converters	Moore	Pheonix	Weidmuller	
Miscellaneous Items				
PLC'S	Modicon Unity			
Power Meters	PML			
Control Devices (pushbuttons, lamps etc.)	Allen Bradley 800 series	Cutler Hammer Type T		
Panel Instruments (analog indicators etc)	Crompton Instruments	Simpson	Newport	
Gas Detection Systems	Draeger	MSA	Crowcon	
Variable Frequency Drives				
LV Drives	ABB			
MV Drives	ABB			

Description Of Equipment	**Acceptable Manufacturer** No.1	**Acceptable Manufacturer** No.2	**Acceptable Manufacturer** No.3	**Acceptable Manufacturer** No.4