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DIVISION 13 – SCADA AND INSTRUMENTATION

SECTION NO.	SECTION NAME
13010	PROCESS – CONTROL GENERAL
13050	SCADA INSTRUMENTATION AND CONTROL DOCUMENTATION
13105	GENERAL INSTRUMENTATION REQUIREMENTS
13106	PROCESS INSTRUMENTATION
13120	MAGNETIC FLOW METERS
13140	DIFFERENTIAL PRESSURE TRANSMITTER
13190	GAS DETECTORS
13305	FIELD WIRING
13390	PACKAGE CONTROL SYSTEMS
13400	REMOTE PROCESSING UNITS SPECIFICATION
13452	HUMAN MACHINE INTERFACE
13453	SCADA SOFTWARE
13480	SCADA INTEGRATOR
13520B	SCADA 5.8 GHz WIDE AREA RADIO NETWORK
13700	BUILDING AUTOMATION SYSYSTEM
13700-01	SCHEDULE FOR SYSTEM CONTROL AND MONITORING
13710	SECURITY SYSTEM
13930	INSTRUMENT AND EQUIPMENT TESTING
13930A	INSTRUMENTATION INSTALLATION SHEET
13933	SITE ACCEPTANCE TESTING
13933B	SOFTWARE SITE ACCEPTANCE TEST PLAN – EXAMPLE
13961	ELECTRICAL CONTROL PANELS, CONTROLS AND DEVICES

PART 1. GENERAL

1.1 Scope

.1 The general requirements for the supply of all hardware and software, installation of all software and hardware, and programming of software for all process control equipment as specified herein and as shown in the Drawings are covered in the various Sections of Division 13 – SCADA and Instrumentation.

.2 Modify the existing the SCADA software programming located on the SCADA Server and modify all existing Programmable Logic Controllers, including but not limited to:

- .1 Software programming to remove references to disconnected devices and systems.
- .2 Complete re-programming of the existing SCADA software to modify all programmed software tag references, such that the final program meets the Region's published Section 13960 - SCADA Tagging Standard included as an appendix to the Contract Documents.
- .3 Software programming for the addition of new instrumentation and control systems.

.3 All services and supplies related to Division 13 - SCADA and Instrumentation shall be performed by the Contractor's SCADA System Integrator Subcontractor (referred to as "SCADA System Integrator").

.4 Comply with the requirements of Division 1 – General Requirements.

.5 Refer to Division 11 - Equipment, Division 15 - Mechanical and Division 16 - Electrical for additional requirements.

.6 Coordinate all Contract Drawings to ensure completeness of installation for all items and that all systems related to Division 13 - SCADA and Instrumentation are compatible with the control and operational intent of the design of this Contract.

.7 Coordinate all Contract Drawings provided as part of a packaged system instrumentation and control to ensure completeness of installation for all items and that all systems related to Division 13 - SCADA and Instrumentation are compatible with the control and operational intent of the design of this Contract.

.8 Without limitation to the following Sections of this Division, the equipment supplied shall be complete with all accessory items, whether specifically mentioned or not in the Contract Documents, so as to provide completeness of installation, controls, functionality and operation as intended by the Contract. All equipment installation shall be as recommended by the equipment manufacturer or as described in the manufacturer's installation drawing provided with the equipment.

.9 Process control equipment and wiring as specified in the Contract Documents, or as shown on the Drawings, are sized for the process, electrical and mechanical equipment as specified in the Contract Documents, or as may be necessary in the future. Any additional expense or delays incurred because of approved substituted process control equipment from that specified in the Contract Documents shall be the responsibility of the Contractor.

.10 Provide all necessary equipment, tools, etc. and labour for installing and testing all equipment supplied under this Division.

.11 Modify and/or remove existing equipment as shown on the Contract Drawings.

1.2 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13010 – Process Control General Requirements as indicated in Schedule ‘A’ of the Bid Form.

1.3 Submittals

.1 Comply with the requirements of Division 01300 – Submittals. Detailed requirements for instrument submittal requirements are included in Section 13105 – General Instrumentation Requirements.

.2 Working drawings must be submitted and reviewed for all equipment in Division 13 – SCADA and Instrumentation, before ordering or fabrication.

.3 Provide a complete listing of recommended spares for each type of supplied equipment.

1.4 Project Coordination

.1 Comply with the requirements of Division 1 – General Requirements.

1.5 Standards

.1 All equipment and workmanship shall conform to the applicable standards established by ASTM, CEC, OESC, IEEE, ISA, CGSB, CSA, OBC and the Electrical Safety Authority (ESA), including all bulletins issued by the standards authority. Where conflicting standards occur, the more stringent standard shall be applied.

.2 All field devices are to be suitable for the area classification in which they are installed.

.3 Comply with all the applicable municipal, provincial, and federal regulations and by-laws including the Ontario Building Code, Ontario Electrical Safety Code, Canadian Electrical Code and other applicable regulations. Provide all necessary licenses, permits, approvals and certificates required in order to complete the Work.

.4 Provide regular inspections and a final inspection with the local Electrical Safety Authority office(s).

1.6 General Requirements

.1 Provide all supplies used during and prior to acceptance of the equipment. In addition, provide an estimated one year's supply of materials necessary for normal operation and scheduled maintenance of all equipment.

.1 Supplies shall be furnished in their original sealed containers, correctly identified as to brand and grade, and with reference to the particular piece of equipment for which the supplies are intended.

.2 Refer to the individual equipment Specifications Sections for additional details on required supplies.

.2 The equipment specified in the Contract Documents shall generally be an "all electronic" control system, with 4-20mA DC linear outputs from all instruments, unless otherwise noted in the Contract Documents. Equipment shall be suitable for 120 VAC, 60 Hz, single phase operation, or 120 VDC, or 24 VDC operation as shown on the Contract Drawings. Where noted in the Contract Documents, the equipment shall also be capable of digital communication to the PAC (Process Automation Controller) using the protocol identified in the individual equipment Specification Sections or shown on the Contract Drawings.

.3 Transmitting equipment shall generally be based on the force balance principle with the minimum amount of movement of any part and having the receiving and control equipment compatible with the transmitting equipment. All equipment shall have a demonstratively good maintenance record.

.4 Supply and install all required components, which may or may not be shown in the Contract Drawings, but which are required for the entire control and instrumentation system to operate as intended.

.5 Supply and install all intrinsically safe relays (ISRs) required for equipment installed in hazardous locations. ISRs are to be installed in separate panels and are not to be installed in PAC panels.

.6 The entire system has been designed for operation on standby power. All instrument components shall have ample margin to withstand any transient and other surge voltages which may occur, including transient periods required as part of the construction related cut over process.

.7 All instrument local indicators shall be in metric engineering units unless specified otherwise in the Contract Documents.

.8 All instruments requiring wet taps shall be installed plumb such that all wetted parts are below the elevation of the lowest pipe wall tap. All process connections shall be 25 mm NPT - female, with pressure instruments to 25 mm NPT - male.

.9 All panels and instruments shall be complete with factory applied finishes. Repaint all damaged factory applied finishes.

1.7 Warranty

.1 Refer to Division 1 – General Requirements, the Articles of Agreement and the General Conditions.

END OF SECTION

PART 1. GENERAL

1.1 Scope

.1 This Section describes the requirements for the Operations and Maintenance (O&M) Documentation related to SCADA and Instrumentation and Control (I&C). The purpose of this Specification Section is to ensure that complete documentation for instrumentation and control is obtained by the Region from the Contractor. This Section supplements the general submittal requirements defined in Division 1 – General Requirements and Division 13 – SCADA and Instrumentation.

1.2 Application

.1 This Specification applies to all instrumentation and control Work completed under the Contract One complete set of documentation will be maintained at the Site at all times for the duration of the Contract The reference copy for all documentation as well as a software version of the documentation will reside at the Region's Bayview Operations Centre (380 Bayview Parkway; Newmarket ON) and the Leslie Street Sewage Pumping Station (7033 Leslie Street, Markham, Ontario.

1.3 Preparation

.1 Refer to Division 1 – General Requirements.

1.4 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13050 – SCADA I&C Documentation as indicated in Schedule 'A' of the Bid Form.

1.5 Submittals and Format:

.1 Refer to Division 1 – General Requirements.

.2 The O&M Manual shall be submitted in both hardcopy (printed) and digital format as specified under Division 1 – General Requirements. All digital files are to be provided in an indexed PDF format as well as in native AutoCAD dwg format (drawings).

.3 All manuals, process control narrative and other files are to be submitted in an editable format.

1.6 O&M Manual,
Division 13 Section 1:

.1 Process Control Narrative: Include an updated and complete version of the Process Control Narrative that includes all as-built data.

.2 SCADA User Manual: Include the following sections and content as indicated below
  .1 Provide a description of HMI navigation indicating how to open each screen and popup display.
  .2 Provide specific instructions on how to operate pop-ups including basic equipment operation, set point entry, and operating mode selection. Include at least one example for each major type of equipment in the process.
  .3 Provide a description and applicable screenshots for use of alarm displays and alarm acknowledgement actions.
  .4 Provide instructions on how to access available data trends and how to make user selected adjustments to those trends.

.3 Software Manuals:
  .1 Purchase and provide software user manuals with any supplied third party software.

.4 Software SAT Certificates:
  .1 Refer to Section 13933 – Software Site Acceptance Testing for SAT specification.

.5 Allow adequate space within the manual for the insertion of record drawings which will be provided by the Consultant as follows (at a minimum):
  .1 Process and Instrumentation Drawings (P&ID's): Provide 11" x 17" size landscape copies of P&IDs.
  .2 Process Flow Diagram (PFD): Provide 11" x 17" size landscape copies of PFDs.

.6 Allow adequate space within the manual for the insertion of any relevant Ministry of Environment documents pertaining to the facility. Documents will be provided by the Region.

1.7 O& M Manual,
Division 13, Section 2
Instrumentation / Hardware:

.1 Panel Drawings:
  .1 Provide 11" x 17" size landscape copies of panel drawings.
  .2 All drawings shall be developed using published ANSI standards for drawing development.

.2 Canadian Standards Association Certificates:
  .1 Provide a copy of CSA certificate for all control panels.

.3 Network Drawings and Communication Settings:
  .1 Provide 11" x 17" size landscape copies of all network drawings associated with the facility.
  .2 Where communication settings do not appear in the network drawings, provide settings on a separate sheet in tabular format with supplementary notes where explanation is required.

.4 Electrical Drawings:
  - .1 Provide 11” x 17” size landscape copies of all control schematics.
  - .2 Provide 11” x 17” size landscape copies of all single line power distribution diagrams.

.5 Field I/O Check:
  - .1 Refer to Section 13930 - Instrument and Equipment Testing for I/O loop check verification specification. Provide copies of only the certificates from the I/O loop check process.

.6 Instrument Index:
  - .1 Provide a tabular list of all instruments. Indicate the instrument type, manufacturer, model, calibration span and instrument tag name. The list shall be sorted by instrument tag name.

.7 Instrument Data, Specification, Calibration Sheet, and Manual:
  - .1 This sub-section of the O&M Manual shall be grouped by instrument providing each required submittal in the given order.
  - .2 Provide an instrument data sheet for each instrument. Refer to Section 13105 – General Instrumentation Requirements, Section 13930 – Instrument and Equipment Testing, and specific instrument specification for the instrument data sheet format and content.
  - .3 Provide the instrument specification sheet for each instrument. Refer to Section 13105 -– General Instrumentation Requirements, Section 13930 - Instrument and Equipment Testing, and specific instrument specification for specification sheet format and content.
  - .4 Provide calibration certificates from the manufacturer for each instrument calibrated prior to installation.
  - .5 If the instrument is calibrated on Site provide calibration sheet for each instrument. Refer to Section 13105 - General Instrumentation Requirements, Section 13930 - Instrument and Equipment Testing, and specific instrument specification for calibration sheet format and content. Calibration certificates to be provided in pdf version.
  - .6 Provide the manufacturer’s instrument manual for each instrument. Where multiple instruments of the same manufacturer and model appear consecutively in the instrument index, provide only one copy of the instrument manual with the first instrument in that group.

.8 PAC Hardware Manuals:
  - .1 Provide the manufacturer’s PAC manual.
  - .2 Provide the manufacturer’s manual for any other hardware device that is not covered by other requirements in this specification.

.3 Provide sheets to explain the specific models and options of the equipment provided.

.9 Spare Parts and Supplier List

.1 Provide a detailed list of recommended spare parts including manufacturer, model and product revision.

.2 Provide a list and contact information for a minimum of two suppliers of each component specified on the recommended spare parts list.

END OF SECTION

PART 1. GENERAL

1.1 General

.1 The Contractor shall supply and install all instrumentation and control wiring required to provide a fully functional system.

.2 Comply with the requirements of Section 13010 - Process Control: General Requirements.

.3 Comply with the requirements of Division 1 – General Requirements.

.4 Refer to Division 11 - Equipment, Division 15 – Mechanical and Division 16 – Electrical for additional requirements

.5 Coordinate all related Work to ensure completeness of installation for all items, and that all items covered under Division 13 – SCADA and Instrumentation are compatible with the control and operational intent of the design of this Contract.

.6 Without limitation to the following sections of this Division, the equipment supplied shall be complete with all accessory items, whether specifically mentioned or not in the Contract Documents, so as to provide completeness of installation, controls and operation as intended. All equipment installation shall be as recommended by the equipment manufacturer or as described in the installation Drawing.

.7 Process control equipment and wiring as specified in the Contract Documents, or as shown on the Drawings, are sized for the process, electrical and mechanical equipment as specified in the Contract Documents, or as may be necessary in the future. The Contractor shall be responsible for all costs associated with any equipment substitutions.

.8 Provide all necessary equipment, tools, labour, etc., for installing and testing all equipment supplied under this Division.

.9 Modify and/or remove existing equipment as shown on the Contract Drawings and required to meet the design intent of the Contract.

.10 Provide programming of all programmable logic controllers used throughout the pumping station.

.11 Provide programming of all operator interface terminals.

.12 This Section provides general instrumentation requirements for the Work to be performed under Division 13 – SCADA and Instrumentation.

1.2 Related Sections

.1 The Contractor is to refer to Section 13933 – Software Site Acceptance Testing in its entirety. Instrument and equipment testing will form a component of the Site Acceptance testing.

1.3 Standards of Conformance

.1 All equipment and workmanship shall conform to the applicable standards established by the following organizations. In the event of a conflict between the requirements of standards and/or the Contract Documents, the Contractor shall follow the more stringent standard or requirement.
  .1 International Society of Automation (ISA)
  .2 National Electrical Manufacturers Association (NEMA)
  .3 Canadian Standards Association (CSA)
  .4 Ontario Electrical Safety Code (OESC)
  .5 National Fire Protection Association (NFPA)
  .6 Electrical Safety Authority (ESA)

.2 All field devices shall be rated as noted on the Device Data Sheets.

.3 Comply with all the applicable municipal, provincial, and federal regulations and by-laws including Ontario Building Code, Ontario Electrical Safety Code, Canadian Electrical Code and all other applicable regulations. Provide all necessary licenses, permits, approvals and certificates.

.4 Provide regular inspections and a final inspection with the local Electrical Safety Authority office(s).

1.4 General Requirements

.1 All equipment and components shall be selected from a manufacturer indicated within Division 13 – SCADA and Instrumentation.

.2 Provide all supplies used during and prior to acceptance of equipment. In addition, provide a one year’s supply of materials necessary for normal operation and scheduled maintenance of all equipment in accordance with the manufacturer’s recommendations.
  .1 Supplies shall be furnished in the original sealed containers, correctly identified as to brand and grade, and with reference to the particular piece of equipment for which it is intended.
  .2 Please see the individual equipment Specification Sections for details regarding required supplies.

.3 The equipment specified in the Contract Documents shall generally be an "all electronic" control system, with 4-20mA DC linear outputs from all instruments, unless otherwise noted in the

Contract Documents. Equipment shall be suitable for 120 VAC, 60 Hz, single phase operation, or 24 VDC operation as shown on the Contract Drawings.

.4 Supply and install all required current isolators, signal conditioners, etc., which are shown on the Contract Drawings as required for the entire control and instrumentation system to operate as intended by the Contract Documents.

.5 The entire system has been designed for operation on standby power. All instrument components shall have ample margin to withstand transient and other surge voltages which may occur, including transient periods under change over conditions.

.6 All equipment mounted outdoors shall be installed in enclosures as identified in the Contract Drawings, NEMA 4X service, with heaters, and be suitable for operating in temperatures from -30 degrees Celsius to +50 degrees Celsius.

.7 All instrument local indicators shall be in metric engineering units unless specified otherwise in the Contract Documents.

.8 All panels and instruments shall be complete with factory applied finishes. Repaint all damaged factory applied finishes.

.9 Provide instruments complete with all necessary mounting hardware, floor stands, wall brackets or instrument racks as required by the manufacturer.

.10 In hazardous areas, meet the OESC Class, Group, and Division (or Class, Zone) as shown or specified in the Contract Documents. Provide intrinsically safe relays (ISRs) as required for instruments mounted in hazardous locations.

.11 Electronic configuration files for all smart instruments shall be provided to the Region after successful commissioning of each instrument.

1.5 <u>Measurement and Payment</u>

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13105 – General Instrumentation Requirements as indicated in Schedule ‘A’ of the Bid Form.

1.6 <u>Submittals</u>

.1 Comply with the provisions of Section 01300 – Submittals and Division 13 – SCADA and Instrumentation.

.2 Submit the following for each instrument provided:

- .1 Shop Drawing Submittals:
  1. Manufacturer’s design and performance specification data and descriptive literature.
  2. Complete manufacturer model number, identifying all required and optional accessories to be provided.

3. Instrument Data Sheets with all fields completed. The Contractor shall provide Instrument Data Sheets using the typical Instrument Data Sheets, provided in Division 13 – SCADA and Instrumentation of the Specifications.
4. Catalog literature edited to indicate specific items provided.
5. Equipment dimensioning, installation requirements and recommendations
6. Mounting details for all typical installation requirements and any special details for non-typical applications.
7. Methods and materials required for installation. Include power and signal connection details.
8. Electrical/pneumatic signal and power connection diagrams.
9. Other specific submittal information as specified in the particular instrument Specification Section.

.2 List of recommended spare parts and spare parts to be provided.
1. List of optional accessories.

.3 As-Built Documentation:
1. Operation and maintenance documentation for each type instrument after Product approval based on shop drawing review.
2. Calibration certifications from the manufacturer for each calibrated instrument.
3. Provide electronic configuration file for all smart instruments.
4. Update shop drawings, Instrument Data Sheets, calibration reports and “As Built” drawings including: P&ID, control schematics and electrical drawings as required in order to match field conditions.

.3 Submit the following documents prior to conducting the Instrument Acceptance Testing:
1. Calibration Procedure(s) to be followed in the test. The calibration method and tools will not cause greater than +/- 0.5 percent error in any test;
2. Any special Procedure(s) to be followed in the test;
3. Identify Site verification, set-up and calibration to be performed by the equipment manufacturers.

.4 Electronic and hard copies of all shop drawings are to be provided.

1.7 Quality Assurance

.1 Provide instrumentation of rugged construction designed for the Site conditions. Provide only new materials throughout, and so marked or labeled, together with manufacturer's brand or trademark.

.2 Use a single source manufacturer for each instrument type. Use the same manufacturer for different instrument types whenever possible. Instruments to be purchased through the local authorized distributor/representative located in Ontario.

.3 Instruments to be commissioned by the manufacturer or the manufacturer's local authorized distributor/representative located in Ontario. Authorized distributor representative is to be factory trained by the manufacturer. Supporting documentation to be provided if requested.

.4 Coordinate instrumentation to ensure proper interface and system integration. Provide signal processing equipment, to include, but not be limited to, process sensing and measurement, transducers, signal converters, conditioners, transmitters, receivers, surge suppressors, and power supplies.

1.8 Delivery, Storage, and Handling

.1 Provide and securely attach the tag number in accordance with the approved control panel shop drawings and instructions for proper field handling and installation to each instrument prior to packaging.

.2 Package instrumentation to provide protection against shipping damage, dust, moisture and atmospheric contaminants.

.3 Include a shipping label which contains the following information:
   .1 Tag number and description in accordance with the approved control panel shop drawings.
   .2 Instructions for unloading, transporting, storing and handling at the Site.

.4 Unload, transport, store and handle instrumentation at the Site. Inspect instrumentation for damage in shipment and return damaged instrumentation to the manufacturer.

.5 Do not store instrumentation outdoors. Provide dry, clean, and warm storage facilities.

1.9 Warranty

.1 Refer to the Contract Documents including the General Conditions for warranty requirements. Where additional warranty information is provided in Division 13 – SCADA and Instrumentation, the more stringent warranty terms are to be provided.

.2 The Consultant will arrange and conduct, with the Region and the Contractor, a warranty inspection at the site prior to the expiration of the warranty period. Any deficiencies or outstanding work identified during this inspection shall be remedied by the Contractor forthwith at no cost to the Region.

.3 Contractor is to provide a 24 month warranty period commencing on the date of the Total Performance of the Work.

PART 2. EXECUTION

2.1 Installation

.1 Install instruments as shown on the typical installation detail Drawings in Division 13 – SCADA and Instrumentation. The Contractor shall use installation details as applicable to the project requirements of the Contract.

.2 The instrument installation details furnished with the Specification Sections are not to scale and are to be used as a guideline for installation.

.3 Where the instrument installation details furnished with the Specification conflict with the manufacturer’s installation details, mount the instrument in accordance with manufacturer’s specifications and instructions.

.4 Instruments on liquid service shall be specified to be mounted below sensing lines, with process tapping points taken from the side of the process line.

.5 Install instruments where indicated on the Contract Drawings.

.6 Install the instrumentation and auxiliary devices such that they are accessible for operation and maintenance.

- .1 Generally, install instrumentation to be accessible from floor level or grade.
- .2 Locate the indicators such that the indicator display is readily readable at eye level (1500 mm –1600 mm) from floor elevation.
- .3 Locate the field mounted devices with adequate clearance and accessibility for service. Pipe /rack mounted instruments shall be mounted at a minimum clearance of 1000 mm from the wall.
- .4 Allow sufficient clearance for cover removal and adjustment of switches.
- .5 Provide adequate clearance (50 mm minimum) from piping and other obstructions for operation of valve handles.
- .6 Provide safe access to all installed components.

.7 Coordinate with the requirements of Division 15 - Mechanical and Division 16 - Electrical disciplines to provide power, conduits, process pipe-fittings, clearances and devices required for installation.

.8 Route signals in flexible, PVC coated armoured conduit for up to one metre (as appropriate to allow removal of all field mounted devices) and thereafter in PVC coated rigid steel conduit unless otherwise indicated on the Contract Drawings.

.9 Support sensor heads and electronic enclosures with a separate support bracket where the :
  .1 Process pipe or tank is not adequate to support the additional weight.
  .2 Process pipe or tank vibrates excessively (beyond manufacturer's recommendation).
  .3 Instrument head extends more than 200 mm from the pipe or tank wall.

.10 For all gas detectors, the gas sensors are not to be supplied, installed and calibrated, until the date of Substantial Completion of the Work.

2.2 Calibration

.1 After the instrument is fully installed, (including mounting, process connections, signal connections and power connections) and after the process is put into test mode or actual operation, perform preventative maintenance tasks and calibrate the instrument. Calibration of each instrument is to be repeated again 28 Days after the date of Substantial Completion of the Work.

.2 Completed test procedures for Equipment Testing and Calibration shall be submitted for approval to Consultant prior to commencement of testing and calibration.

.3 Calibrate measurements over the range of the instrument including zero, full range and five (5) intermediate points at 0 percent, 25 percent, 50 percent, 75 percent and 100 percent in both increasing value and decreasing value during calibration. Repeat three (3) times.

.4 Demonstrate alarms by varying process conditions. Repeat three (3) times.

.5 Prepare an instrumentation installation and calibration certification sheet for each primary element sensor and electronic indicator/analyzer/transmitter for each instrument uniquely specified in the Contract Documents.

.6 For each certification sheet include the following information at a minimum:
  .1 Project name.
  .2 Tag number and description.
  .3 Manufacturer.
  .4 Model and serial number.
  .5 Date, time and person who performed calibration.
  .6 Calibration data to include:
    1. Input, output, and error at 0, 25, 50, 75, and 100 percent of span for analog instruments.
    2. Switch setting, contact action, and deadband, if applicable, for discrete elements.
  .7 Space for comments.

.8 Certification of installation by installer and acknowledgment by the Contractor that all data on the certification sheet is accurate and dated.

.7 In the Instrument Data Sheet(s), document the results of the calibration and note any settings or adjustments made.

.8 Electronic copies shall be provided to Region.

.9 All parameter settings for each instrument to be provided.

.10 A Calibration Certificate shall be provided from a certified manufacturer's representative who actually performed the calibration and a sticker indicating the date of calibration is to be placed on the instrument.

.11 A Calibration Certificate is also required to be provided indicating the calibration of the calibrating equipment used in the calibration process.

.12 Calibration is to be repeated 28 Days after the date of Substantial Completion of the Work.

.13 Calibration certificates for tools and standards are to be provided by the Contractor.

2.3 Testing Scope

.1 The instrument and equipment testing shall confirm in detail that the field instruments and other equipment have been supplied and installed in accordance with the Contract Documents. Testing shall include:

.1 Confirmation that the units have been correctly installed.
.2 Confirmation that the units have been correctly calibrated.
.3 Confirmation that all discrete and analog signals (both new and existing) to be transmitted to and from the units are available and functioning correctly.
.4 Verification that the units are capable of working as specified in the Contract Documents.
.5 Verification that all panel FAT deficiencies have been completed.
.6 Complete facility PAC panel(s) I/O check to verify field wiring from field device to PAC I/O.
.7 Complete manufacturer PAC/PLC panel(s) I/O check to verify field wiring from field device to PAC/PLC I/O.
.8 Verification that all hardwired interlocks are functioning as intended and are present in the correct mode of operation.
.9 Acceptance of the Work done by the Contractor.

.2 The Start Up Team consisting of individuals from the Consultant, the Contractor, the System Integrator, Region PCS Group and Region Operations Group will jointly develop the testing plan, Software Site Acceptance Test (SAT) and Start Up Plan. Refer to Section 13933 - Software Site Acceptance Testing for requirements.

.3 The instrument and equipment testing is to be conducted and witnessed by the Start Up Team and instrument suppliers as required.

.4 The Start Up Team will review the testing plan, SAT and Start Up Plan and revise, if necessary, at a pre-SAT and Start Up meeting to be scheduled a minimum of 42 Days in advance of the proposed SAT period. The Contractor shall be responsible for expanding and providing details for the SAT and Start Up Plan in order to clearly identify the proposed test procedure for the equipment and software.

.5 Members of the Start Up Team are to be identified at the pre-SAT and Start Up meeting. Team members can only be revised with the approval of the Consultant and Region.

.6 Where it is identified through testing that the requirements of the Contract have not been met, the Contractor shall rectify all deficiencies immediately to allow re-testing during the same test phase at no additional cost to the Region.

.7 Testing will be deemed to be complete by the Region when all features, functions and information required in the Contract Documents have been verified as present and functioning, and documented as accurate within the anticipated operating range for the process being monitored.

.8 Region PCS Scope:

.1 Region PCS will ensure network switches are programmed/configured. The Contractor will be required to supply and/or install switches as specified in the Contract Documents.

2.4 Testing Schedule

.1 Submit testing procedures and schedules of Work a minimum of 28 Days prior to the projected test date for the individual component. This will include specific dates for when the various test procedures are to be carried out and an identification of any assistance required from Region’s staff.

.2 A review of the PAC panel on Site to ensure that all panel FAT deficiencies have been corrected is to be completed prior to the completion of any field wiring being completed. This review is to be coordinated with the Consultant and the sign off sheet shall be completed by the Contractor.

.3 The Contractor shall conduct its own I/O check and instrument and equipment verification. The Contractor completed and signed off I/O Checksheets and instrument and equipment verification sheets are to be completed and submitted to the Consultant for review.

.4 The Contractor I/O check shall not be completed until a minimum of 90 percent of all I/O is wired to each PAC.

.5 The Consultant may, at its discretion, choose to witness a subsequent I/O check and instrument and equipment verification with the Contractor. The Contractor and all required Subcontractors will participate as required.

.6 Contractor/Consultant completed and signed off I/O Checksheets and Equipment/Instrument verification sheets are to be submitted to the Region for review a minimum of 14 Days prior to scheduling the Region to witness its own I/O check and instrument and equipment verification.

.7 Following the Contractor's own I/O check and instrument and equipment verification and the Consultant review, the Region will witness an I/O check and instrument and equipment verification in the presence of the Contractor and Consultant. The Contractor and all required Subcontractors shall participate as required.

.8 In some cases, testing may be scheduled outside normal business hours to accommodate operating issues and/or low flow conditions.

.9 Testing may be interrupted by the Region's staff for emergency process operation.

.10 Submit test results to the Consultant at the end of each day of testing. Final test reports are to be accepted ad signed off by the Consultant, the Contractor's System Integrator and Region PCS Group.

2.5 Testing Execution

.1 Provide a qualified electrician and/or instrument technician with a minimum 5 years of experience to assist in testing and quickly repairing minor deficiencies for re-testing in the same test phase.

.2 Have the following documents on hand prior to conducting Instrument Acceptance Testing:

- .1 Reviewed shop drawings, including data sheets, for each instrument installed (multiple copies for multiple installations);
- .2 "For Construction" P&IDs, process narratives, control schematics and electrical drawings;
- .3 Configuration and calibration certificates from the manufacturer(s) for each calibrated instrument, where specified in the Contract Documents;
- .4 PAC panel FAT report identifying deficiencies identified during the panel FAT process;
- .5 Results of factory performance tests, where specified in the Contract Documents;
- .6 Instrument field calibration reports, where specified in the Contract Documents;

.3 Inspect and document that each instrument matches the reviewed shop drawing. The inspection shall include, but not be limited to the following (as applicable):
  .1 Verifying that instrument Product details match shop drawings and Contract Documents, (including Instrument Data Sheets);
  .2 Confirming soundness of instrument, and that the instrument is without any damaged parts;
  .3 Confirming completeness in all respects as specified for instrumentation;
  .4 Confirming correctness of setting, alignment, and relative arrangement;
  .5 Confirm that all PAC panel FAT deficiencies have been corrected;
  .6 Inspecting power, signal, and grounding wiring identified on the control schematics and documenting the results. All wiring is to be verified for continuity.

2.6 <u>I/O Loop Check</u>

.1 I/O loop check shall be performed for the complete loop where possible by exercising the field device and monitoring the input at the PAC. Some I/O loops may be confirmed during the instrument and equipment calibration and testing when approved by the Consultant.

.2 Where an instrument loop cannot be checked with the instrument functioning, a current generator shall be used to verify the continuity of the analog loop.

.3 Where a digital loop cannot be checked with the field device, jumpering is permitted to verify the continuity of the digital loop.

.4 PAC output loops shall be verified by forcing the corresponding output from PAC program.

.5 I/O loop check will be accepted and signed off by the Consultant when all I/O points pass loop checks.

2.7 <u>Instrument Acceptance</u>

.1 Devices are also to be tested for their repeatability, accuracy and operation by varying the process and simultaneously measuring and recording the information displayed by:
  .1 An independent measuring instrument;
  .2 The local transmitter indicator;
  .3 All remote digital/mechanical indicators;
  .4 The 4-20mA (or digital value) measured at terminal blocks in PAC panels and operator panels.

.2 Compare test results against the instrument calibration reports and planned PAC analog input range. As an example, flow sensors will require testing using a “draw and fill” test of a local container.

.3 Where no field calibration has been done, perform a calibration test. Go up, down and then back up the instrument range, testing at five (5) points each time: 0 percent, 25 percent, 50 percent, 75 percent and 100 percent.

.4 The instrument switches, such as pressure switches or building flood alarms, are to be tested for their accuracy and operation by varying the process conditions (for example: high then low pressure) and simultaneously measuring and recording the information displayed by:
   .1 An independent measuring instrument;
   .2 The instrument switch;
   .3 All remote lights and indicators;
   .4 The digital input status measured at both the PAC and operator panels’ terminal blocks.

.5 Test results are to be compared against the instrument calibration/setting reports and planned PAC discrete input setting.

.6 Verify that all instrument/equipment interlocks function as intended by the Contract Documents.

.7 ISO calibration labels to be applied to instrument following successful calibration and testing.

2.8 <u>Testing Tools and Equipment</u>

.1 Protect instruments and equipment that may be damaged by testing. If damages occur, the respective parties shall be fully responsible for replacement of damaged parts and/or components.

.2 Use calibration tools that will not cause greater than +/- 0.5 percent error in any test. The accuracy of the calibration tools must be traceable to National Standards. The Contractor shall use electronic calibration equipment that will provide a form of electronic documentation, transferable in a standard spreadsheet format.

.3 Calibration certificates for tools and standards are to be provided by the Contractor.

.4 Follow the applicable Region’s safety requirements, including those specified in Section 01351 – Heath and Safety. Provide the proper safety equipment for entering (manholes and other) confined spaces, and hazardous gas locations.

2.9 <u>Training</u>

.1 Provide comprehensive training session by the manufacturer or the manufacturer’s local authorized distributor/representative for each instrument type for the Region’s operating and PCS group.

.2 Provide separate single training sessions for the Region's operations and PCS group.

.3 The Contractor shall complete and submit the Region's "Training Form" for the instrumentation supplied and installed under this Contract. This form will be provided to the Contractor prior to the commencement of training.

.4 Refer to Division 1 – General Requirements for additional training requirements. A minimum of two (2) hours field training for each instrument type shall be provided by the Contractor.

END OF SECTION

PART 1. GENERAL

1.1 Summary

.1 This Section includes requirements for process instrumentation and instrumentation assemblies used throughout the Contract, including but not limited to instrumentation provided as part of a packaged system where provided by an equipment manufacturer.

.2 Coordinate instrumentation requirements, including but not limited to ratings, system interface voltages, wiring requirements and termination requirements in order to ensure compatibility between control panels, instrumentation and all connected devices for a fully functional system

.3 Coordinate communication protocols in order to ensure proper data transfer and compatibility between all connected devices.

1.2 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13106 – Process Instrumentation as indicated in Schedule ‘A’ of the Bid Form.

1.3 Related Sections

.1 Section 13105 – General Instrumentation Requirements

.2 Section 13120 – Magnetic Flow Meters

.3 Section 13140 – Pressure Indicator Transmitter

.4 Section 13305 – Field Wiring

.5 Section 13390 – Package Control Systems

.6 Section 13400 – Programmable Automation Controllers

.7 Section 13452 – Human Machine Interface

.8 Section 13930 – Instrument and Equipment Testing

.9 Section 13961 – Electrical Controls and Devices

.10 Division 16 – Electrical

1.4 References

.1 National Electrical Contractors Association (NECA) Standard of Installation

.2 ASTM International (ASTM):
- .1 A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
- .2 A276, Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.

.3 A312, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
.4 B32, Standard Specification for Solder Metal.
.5 B88, Standard Specification for Seamless Copper Water Tube.

.3 Instrumentation, Systems, and Automation Society (ISA):
.1 S5.1, Instrumentation Symbols and Identification.
.2 PR12.6, Installation of Intrinsically Safe Systems for Hazardous Locations
.3 S5.4, Standard Instrument Loop Diagrams.
.4 S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
.5 S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.4 National Electrical Manufacturers Association (NEMA):
.1 ICS 1, Industrial Control and Systems: General Requirements.
.2 ICS 2, Industrial Control Devices, Controllers and Assemblies.
.3 ICS 4, Industrial Control and Systems: Terminal Blocks.
.4 ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
.5 ICS 6, Industrial Control and Systems: Enclosures.
.6 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.5 National Institute of Standards and Technology (NIST).

1.5 Definitions

.1 Analog Signals: 4-20mA DC two-wire circuits conforming to ANSI/ISA S50.1

.2 Discrete Signals: Two state based logic signals that are either DC or 120-Vac

.3 I/O: Input and/or Output

.4 PLC: Programmable Logic Controller.

1.6 System Description

.1 Instrumentation: Provide sensor elements, transmitters, switches, actuated valve controllers, power and control devices, raceways, wiring, power circuits, control circuits and all appurtenances for controlling, monitoring and alarming of the various functions, for a complete operating system as specified and indicated within the Contract Documents.

.2 Provide instrumentation hardware, instrumentation installation, instrument calibration and third party verification of installed systems. Coordinate with other trades for installation and connection requirements.

.3 Where instrumentation is provided as part of a packaged system, coordinate the requirements specified for a complete operating system.

.4 Provide all wiring between field devices and control panels: Provide and terminate control and instrumentation cables for each piece of equipment and each device and test to confirm operation as intended by the Contract Documents.

1.7 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13106 – Process Instrumentation as indicated in Schedule ‘A’ of the Bid Form.

1.8 Submittals

.1 General Product Data:
  .1 The Contractor shall be responsible for the accuracy and completeness of all aspects of the controls submittal.
    1. Within thirty (30) Days of the notice to commence, provide Controls and Instrumentation Integrator Subcontractor qualifications.
    2. Within sixty (60) Days of the notice to commence, provide:
      1. Hardware Product information submittal, including but not limited to Product data sheets, shop drawings, related calculations, layout diagrams and interconnection diagrams.
      2. Power supply load calculations
      3. Interconnection diagrams.
      4. Testing Submittals: Indicate proposed testing procedures and methods, testing firm biography and contact information.

.2 All diagrams and drawings shall be provided as standard 11”x17” size format at a scale that is readily legible and prepared in accordance with ANSI standards. Submit equipment layout, point-to-point wiring diagrams, interconnection wiring diagrams, equipment dimensions, support points, weights, and external power requirements.

.3 Product Data:
  .1 Submit catalog data for each component being furnished showing operational characteristics and connection requirements, including supply voltage, frequency, electrical load, listed accuracies, description of operation, operating instructions, and calibration procedures.

.2 For measuring instruments and devices, submit completed ISA S20 forms for each device including device ratings, features, physical dimensions manufacturer’s recommended upstream and downstream straight piping lengths, recommended location of any pressure taps and estimates of pressure losses through the device.

.4 Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.

.5 Parts List: Submit a Parts List with current net prices and a list of recommended spares

.6 Coordinate and identify all interconnection wiring between installed control panels, motor control centers, field devices, and other devices.

.7 Factory Testing and Calibration: All measuring devices and meters shall be factory tested. Provide a certification of calibration from an independent test laboratory. Calibration curves based on factory and/or laboratory testing (see option below) shall be provided for the Consultant’s review. Furnish calibration curves in units of output versus measured flow. Upon receipt of the Consultant’s review, the Contractor may release the meter(s) for shipment to the Site.

.1 As an option to laboratory testing each meter, the calibration curves of six (6) “like devices” may be substituted provided the calibration data is available from at least one identical device (pipe size, flow range, and type plus accessories such as extension registers).

.8 Test Documentation: Upon completion of each required test, document the test and submit a copy of the test procedures used with accompanying documentation indicating name of testing firm and name of person performing test.

1.9 Closeout Submittals

.1 Project Record Documents: Include as-built layout diagrams, interconnection diagrams, cabling information, loop reports and component calibration sheets.

.2 Affidavits: Furnish affidavits from the manufacturers stating that the meters have been properly installed and tested, and each is ready for full time operation.

.3 Operation and Maintenance (O&M) Manuals:

.1 Furnish manufacturer’s installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.

.2 Submit bound copies of O&M manuals for each device, including project record documents, instructions for adjustments, calibration and preventative maintenance.

.3 Include copies of all submitted documentation in Adobe Acrobat PDF format, supplied on compact disc (CD) media format.

1.10 Maintenance Materials

.1 Provide any special tools or instrumentation necessary for normal operation and maintenance.

.2 Maintenance material shall be suitably packaged with labels indicating the contents of each package. The material shall be delivered to the Region prior to system commissioning.

1.11 Warranty

.1 Furnish 24 month manufacturer's warranty from date of Total Performance of the Work for defective parts and labour to install the part. Third party warranties shall not be acceptable.

1.12 Delivery, Storage, and Handling

.1 Deliver instrumentation and control devices individually wrapped for protection and in suitable packaging to protect against damage.

.2 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic. Provide space heaters if required, to prevent condensation and keep equipment dry.

1.13 Qualifications

.1 Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum of five (5) years of experience.

1.14 Field Measurements

.1 Verify field conditions, field measurements, connections, interface locations and interface requirements prior to fabrication.

1.15 Coordination

.1 Coordinate requirements and installation requirements of the systems that are being interfaced with.

.2 Coordinate location of all field located equipment and instrumentation with other trades prior to commencing the Work.

PART 2. PRODUCTS

2.1 Instrumentation

.1 Ultrasonic Level Transmitter (LE/LIT)

.1 Description: Non-contact ultrasonic level transmitter shall utilize a method of measure using a transmitted and received ultrasonic soundwave or pulse to determine the depth to top of surface being measured. The signal is compensated for temperature variation.

.2 Transducer Construction:

1. Housing: Hermetically sealed housing.
2. Transducer shall be suitable for Class I, Div. 2, and shall be rated NEMA 4X.
3. Ultrasonic Operational Frequency: 11 kHz through 90 kHz, as required.
4. Encapsulated enclosure housing constructed of PVC, Kynar or other durable corrosion resistant material.
5. Connect using methods approved by the Region that include water tight attachment at transducer housing and junction box.
6. Field mount transducer so that the transducer is readily removable for servicing.
7. Provide with submergence shield.

.3 Measurement Range: 0 percent through 100 percent level.

.4 Measurement Resolution: 2.54 mm or less.

.5 Measurement Accuracy:

1. +/- 0.25 percent of measured distance for distances greater than 1 meter.

.6 Mounting:

1. Wall mounting bracket.
2. Minimum distance from measured surface: 300 mm.
3. Provide PVC coated rigid steel conduit between transducer and transmitter.

.7 Signal Converter.

1. Description: The signal converter shall be a microprocessor-based unit with an adjustment for calibration.
2. Interface: Keypad and LCD screen for calibration, viewing status and viewing levels.
3. Type: Remote cabinet or wall mounted as indicated in the Contract Drawings.
4. Housing: Nema 4X polycarbonate.
5. Temperature Compensation: Automatic.
6. Output: 4 - 20 milliamp DC signal proportional to the measured level.

7. Communication: HART protocol for remote diagnostics, configuration and calibration.
8. Supply Voltage: Loop Powered

.8 Manufacturers:
1. Signal Converter:
2. Siemens Industry, Inc., MultiRanger 100 Model 7ML503
   1. Or approved equal
3. Level Transducer:
   1. Siemens Industry, Inc, Echomax XPS-10
   2. Or approved equal

.2 Submersible Level Transducer (LE/LIT)

.1 Description: Hermetically sealed submersible level transducer using differential pressure to determine the depth of the liquid being measured. The signal is compensated for temperature variation.

.2 Construction:
1. Housing: Hermetically sealed 316 stainless steel housing.
2. Diaphragm: Teflon.
3. Transducer shall be suitable for Class I, Div. 2, NEMA 4X.

.3 Sensing Range: 112 kPa (1.5 psig) to 308 kPa (30 psig).

.4 Measurement Range: 0 percent through 100 percent level.

.5 Measurement Accuracy: +/- 0.25 percent

.6 Mounting:
1. 25mm NPT pipe mount.
2. Mounting bracket as shown in project documents.
3. Distance From Floor Surface: 76.2 mm.
4. Connecting cable includes integral air tube for pressure compensation.

.7 Signal Converter.
1. Description: The signal converter shall be a microprocessor-based unit with adjustment for calibration.
2. Interface: Keypad and LCD screen for calibration, viewing status and viewing levels.
3. Type: Remote Pole/Wall Mounted
4. Temperature Compensation: Automatic.
5. Output: 4 - 20 milliamp DC signal proportional to the measured level.
6. Supply Voltage: 120 VAC, Loop Powered Sensor

.8 Manufacturers:
1. Siemens, A1000i with terminal housing
2. Or approved equal

.3 Float Level Switch (LS/HS)

.1 Description: Liquid level sensing float-type switch, with restraint device to allow adjustment of contact elevation.

Contact elevation shall be adjustable from 152 mm to 3,048 mm below mounting location.

.2 All wetted parts of float shall be constructed from stainless steel or similar non-corrodible material, hermetically sealed and suitable for Class I, Division 2 hazardous environment.

.3 Float control rod shall also be impervious to corrosion.

.4 Sensing unit housing must be acceptable for mounting in a Class I, Div. 1 hazardous location.

.5 Operate in environment temperatures from -25 to 120 degrees Celsius (–15 to +250 degrees Fahrenheit).

.6 Switching actuator shall use a magnetic couple, such that the electrical contacts have no physical contact with the actual floatation device.

.7 Output switch shall be of the mercury wetted contact type, capable of conducting a minimum of 5-Amp of current at 120 VAC.

.8 Switch contacts shall be form A or B, as required.

.9 Manufacturers:

1. Anchor Scientific Incorporated - Type S
2. Flygt, Xylem Incorporated - ENM-10

.4 Gage Pressure Transmitter (PE)

.1 Accuracy: 0.1 percent of range.

.2 Minimum Stability: 2-years.

.3 Options:

1. 4-20 mA signal output proportional to pressure, loop powered;
2. Capacitance measuring cell with ceramic process isolating diaphragm;
3. Enclosure: NEMA 4X;
4. Mounting: 12.7 mm MNPT (Male National Pipe Thread);
5. Sensing Port Bore: 11 mm;
6. Engineering Units: kPa and psig;

.4 Accessories:

1. Mounting hardware.

.5 Calibrated Ranges:

1. 4 mA: 0 kPa;
2. 20 mA: 1,378 kPa.

.6 Manufacturer:

1. Endress+Hauser Consult AG, PMC 131
2. Or approved equal.

.5 Vibration Transducer

.1 Description: Loop powered transducer to monitor vibration of attached system, with the ability to not be affected by high frequencies generated elsewhere.

.2 Output: 4-20 mA, Full scale 25.4-mm per second

.3 Frequency Response: 6 Hz – 20 Hz

.4 Accuracy: 2 percent of range.

.5 Minimum Stability: 2-years.
.6 Power Requirements: 10 VDC - 30 VDC
.7 Temperature range: -40 to 85 degrees Celsius
.8 Vibration Limit: 250 g Peak
.9 Shock Limit: 2,500 g Peak
.10 Sealing: Hermetically sealed
.11 Sensing Element: Lead Zirconate Titanate (PZT) ceramic
.12 Mounting: 1/4-28 tapped hole, Motor and Pump Housing
.13 Construction: 316L stainless steel
.14 Mating Connector: RG6 type
.15 Cabling: J9T2A
.16 Manufacturer:
1. Meggitt, Model PC420VP-10-B3041
2. Or approved equal.

.6 Process Transmitter
.1 Options:
1. 5 digit, 7 segment backlit liquid crystal display;
2. 4-20 mA signal output proportional to input;
3. 4-20 mA source for connected loop powered devices;
4. 24-Vdc power source required;
5. Digital status output, 2 relay output;
6. Mounting: DIN rail Mount;
.2 Manufacturer:
1. Endress+Hauser Consult AG, RMA42 series
2. Or approved equal.

.7 Bubbler Level System (Bubbler)
.1 Accuracy: 0.2 percent of range.
.2 Calibrated Range: 0 to 30 meters.
.3 Sensitivity: 0.1 percent of span.
.4 Repeatability: 0.1 percent of span.
.5 Minimum Stability: 2 years.
.6 Operating Temperature: 0 to 50 degrees Celsius.
.7 Power: 120V AC, 60 Hz.
.8 Construction:
1. Level measurement utilizing one bubble tube per wet well.
2. Normal air supply to be from existing pumping station air supply with a local panel mounted air compressor sized, connected, configured and installed for intended operation.
3. 6.35 mm stainless steel tubing and stainless connectors shall be utilized for all air and sample lines.
4. 19 mm PVC coated rigid galvanized schedule 80 piping for air distribution to wet well. 19 mm PVC Schedule 40 piping where submerged in wet well.

5. Air grill and filter shall be provided. Ten (10) spare air filters to be provided.
6. Enclosure: Nema 4X, Stainless Steel
7. Local-Off-Remote selector switches to be provided for local and remote control.
8. Momentary start push buttons to be provided for local blow down operation.
9. Provide one (1) isolated 4-20 mA at 600Ω output for each pressure transmitter.
10. Provide low pressure switch alarm output signal.
11. Provide power OK alarm output signal for each bubbler air system.
12. Differential pressure regulator shall be utilized to limit use of air.
13. Provide input connection for remote control of solenoid valves for each bubbler air compressor system.
14. Bubbler panel to be panel Factory Acceptance Tested to prove functionality prior to shipment. The Contractor is responsible for setting up appropriate test bed to fully test and verify panel functionality. The Consultant and Region PCS to witness tests and sign off on proposed test methods.

.9 Installation:

1. Bubbler piping entering the wet well shall be located in an area representative of liquid and where liquid agitation is at a minimum.
2. Bubbler tubing and piping assembly shall be rigidly fixed in position using stainless steel clamps and hardware.
3. Bottom of bubble tubes shall be notched to allow air to flow out in a steady stream in order to prevent intermittent streams of bubbles that would otherwise introduce errors.
4. Instrument calibration to the desired range shall be completed prior to placing bubbler panel into operation.

.10 Manufacturer:

1. Air Compressor: Gast, IDEX Corporation, 08P-21F8619
2. Air Tank: Wainbee Limited, 19840
3. Pressure Regulator: Swagelok Company, R07-200-RGEA
4. Constant Differential Relay: Siemens AG, 62VNA
5. Gauge Pressure Transmitter: Endress+Hauser Consult AG, PMC71-UAC1F6RAAAA
6. 3 Way Solenoid Valve: Asco Valve Incorporated, 8320G200
7. Pressure Switch: Ashcroft Incorporated, 8424B

8. Solenoid Valve: Asco Valve Incorporated, 8262G262
9. Or approved equal.

.8 Process Transmitter
.1 Options:
1. 5 digit, 7 segment backlit liquid crystal display;
2. 4-20 mA signal output proportional to input;
3. 4-20 mA source for connected loop powered devices;
4. 24-VDC power source required;
5. Digital status output, 2 relay output;
6. Mounting: DIN rail Mount;
.2 Manufacturer:
1. Endress Hauser, RMA42 series
2. Or approved equal.

PART 3. EXECUTION

3.1 Existing Work

.1 Disconnect and remove abandoned instrumentation.

.2 Maintain operation of existing instrumentation for installations and equipment remaining active.

.3 Extend existing system installations using materials and methods compatible with existing electrical installations and as specified by manufacturer.

.4 Calibrate, clean and repair existing instrumentation that will remain or that will be relocated.

3.2 Installation

.1 Equipment Locations: The locations of equipment and instrumentation are approximate. The exact locations shall be governed by structural conditions, Site conditions, and physical interferences of related systems.
.1 Install instrumentation so that access to device ports, enclosures and interface points are readily accessible.
.2 Where Site conditions require changes in locations and arrangements, or when the Region exercises the right to require changes in location of equipment that do not impact material quantities or cause material rework, the Contractor shall make such changes without additional cost to the Region.

.2 Install in accordance with NECA “Standard of Installation.”

.3 Install instrumentation plumb. Anchor and secure in accordance with the manufacturer’s recommendations and as specified elsewhere within the Contract Documents.

.4 Install, calibrate and test individual components.

.5 Install instrumentation in accordance with manufacturer recommendations.

.6 Make electrical wiring interconnections.

.7 Install instrumentation nameplates.

.8 Provide grounding and bonding of instrumentation in accordance with the manufacturer’s requirements and as specified elsewhere within the Contract Documents.

3.3 Instrumentation Calibration

.1 General: Prior to commissioning, calibrate devices according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the functional and tolerance requirements indicated in the Contract Documents.

.2 Calibration Points: Each instrument shall be calibrated at 20 percent, 40 percent, 60 percent, 80 percent and 100 percent of span using calibrated test instruments to simulate inputs. The test instruments shall have accuracies in accordance with National Institute of Testing Standards.

.3 Bench Calibration: Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment prior to commissioning.

.4 Field Calibration: Instruments that were not bench-calibrated shall be calibrated in the field in order to ensure proper operation in accordance with the instrument loop diagrams or specification data sheets.

.5 Calibration Tags: A calibration and testing tag shall be affixed to each piece of equipment or system indicating date and name of calibration firm. The Contractor shall ensure that the calibration firm retained by the Contractor signs the calibration tag upon completion of calibration is complete affirming calibration has occurred and the instrumentation is ready to be put into service.

3.4 Adjusting

.1 Each device shall be field tested, adjusted and tuned to operate with the process loop. Field test results shall be recorded and submitted to the Region for its records.

3.5 Field Testing and Commissioning

.1 Electrical Tests
.1 Insulation Tests

1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter.
2. Measure insulation resistance of each control circuit-to-ground.
3. Perform an insulation resistance test at 1,000 Volts DC on all control wiring. For units with solid-state components, follow the manufacturer's recommendations.

.2 Test Values: Control wiring insulation test resistance shall be a minimum of two megohms.

.3 Check electrical circuits for continuity and for short circuits.

.2 Each hardwired point shall be tested and approved with a point verification test prior to the start of the operational tests.

.1 Point testing shall include point to point testing of all field connected devices and where modifications have been made to factory provided control panels.

.2 Point testing shall not occur until after calibration of devices has occurred.

.3 Make corrections and repairs to each hardwired point prior to proceeding to operational testing.

.3 Operational Tests:

.1 Procedures, Forms, and Checklists:

1. Conduct all testing in accordance with, and ensure all tests are documented on, Consultant-accepted procedures, forms, and checklists developed by the Contractor.
2. Describe each test item to be performed.
3. Include a space after each test item description for sign off by appropriate party after satisfactory completion.

.2 Control Valves: Verify calibration and adjustment of positioners and transducers. Verify correct control action, opening, closing travel speeds and travel stops.

.3 Each loop shall have a Loop Report to organize and track its inspection, adjustment, and calibration. Reports shall include the following information and checkoff items with spaces for comment and signoff by the contractor:

1. Project Name.
2. Component Identification.
3. Check offs/signoffs for each component.
    1. Tag/identification.
    2. Installation.
    3. Termination-wiring.
    4. Termination-tubing.
    5. Calibration/adjustment.
4. Check offs/signoffs for the loop.
    1. Interface terminations.

2. I/O signal operation. Verified inputs/outputs operational. Sent/Received, processed, and adjusted.
3. Total loop operational.

.4 Each active instrumentation element and shall have a Component Calibration Sheet. Sheets shall have the following information, spaces for data entry, comments and signoff by the contractor:
1. Project Name.
2. Loop Number.
3. Component Identification.
4. Manufacturer.
5. Model Number/Serial Number.
6. Summary of Functional Requirements.
    1. For Indicators: Scale and ranges
    2. For Transmitters/Converters: Input and output ranges
    3. For Computing Elements: Function
    4. For Controllers: Action (direct/reverse) control modes (PID)
    5. For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)
7. Calibration Settings:
    1. For Analog Devices: Required and actual inputs and outputs at 0, 10, 50, and 100 percent of span, rising and falling
    2. For Discrete Devices: Required and actual trip points and reset points
    3. For Controllers: Mode settings (PID)

.5 Maintain Loop Reports and Component Calibration Sheets at the Site and make them available to the Region.

.6 Verify manual operation of devices, where provided for correct operation.

.7 Make corrections and repairs where equipment or components are found be defective or not meet the design intent prior to proceeding to functional performance testing.

.4 Functional Performance Testing:

.1 Test procedures shall be developed and submitted for approval by the Consultant prior to commencing Work and shall indicate comprehensive step-by-step procedures.

.2 Functional Performance Test shall not occur until after operational check, electrical checks and point testing has occurred.

.3 Verify sequence of operation including testing of safety controls, interposing controls, loop checks, alarm annunciation, remote annunciation, local control operation without automation, etc.

.4 Equipment to be tested shall include all installed systems.

.5 Instrumentation Testing:
.1 All flow devices shall be field tested against a secondary standard at the normal (or expected) process flow rates specified in the Contract Documents.
.2 The Contractor may select, at its option, to either install a second flow device of known calibration in the line to verify flow device calibration or perform fluid capacity tests such as volumetric measurement per unit time.

3.6 Demonstration and Training

.1 Furnish a minimum of eight (8) hours of instruction for Operators, to be conducted at the Site with the Controls and Instrumentation Integrator. Coordinate the times and dates of training with the Region. Training times and dates shall be as directed by the Region.
.1 Demonstrate device operation and function.
.2 Identify project specific instrumentation and its function.
.3 Identify special features and interface points.
.4 Review standard maintenance practices and calibration procedures.

END OF SECTION

PART 1. GENERAL

1.1 General

.1 The specifications in this section include additional requirements to those set forth in Section 13105 – General Instrumentation Requirements. In the event of a conflict between the requirements specified in Section 13105 – General Instrumentation Requirements and the requirements specified in this specification section, the Contractor shall follow the more stringent requirement.

.2 The flow meters are to deploy the following basic design principles:

- .1 General Application: Pulsed DC powered flow tube coils
- .2 Solids over 5%: AC powered flow tube coils and low noise electrodes. Use these meters only with prior approval from the Region.

.3 The Contractor shall clearly identify on the shop drawings any deviation from the Specifications.

.4 The Contractor shall provide the following O&M documentation: manufacturers' printed recommendations; installation instructions; specifications; operation manuals, including electrical drawings, and plumbing diagrams; sales literature; materials; and training materials as applicable.

.5 The Contractor shall furnish copies of the manufacturer's warranties.

.6 The Contractor shall provide, through its Instrumentation Supplier, magnetic flow meters, complete and operable, in accordance with the Contract Documents.

.7 The Contractor shall ensure that its Instrumentation Supplier will configure the flowmeter Modbus scan list/poll table for passing data to SCADA.

1.2 Performance

.1 Process Temperature: 0 to 25 degrees Celsius

.2 Rated accuracy: +/- 0.25 percent of measured value, maximum error over entire velocity range

.3 Measured repeatability: +/- 0.1 percent of stated accuracy

.4 Response time: <1 second for 2 m/s step change to stated accuracy

.5 Warm up time: <10 minutes from cold start to stated accuracy

.6 Velocity range: 0.1 to 10 m/s under normal flow conditions

.7 Electronics Temperature: -25 to 60 degrees Celsius

1.3 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13120 – Magnetic Flow Meters as indicated in Schedule ‘A’ of the Bid Form.

PART 2. PRODUCTS

2.1 Sensor (Primary Element)

.1 Flow Tube: 316L Stainless Steel, Epoxy Painted.

.2 316L Stainless Steel Flanges: AWWA C-207 Class D.

.3 Flow Meter Body: 316L Stainless Steel construction, Polyurethane Coated, Silicone Rubber Housing Sealant.

.4 Minimum Liner Requirement: Polyurethane.

.5 Maximum fluid pressure: Entire flow tube must meet the ratings of the flanges.

.6 Minimum submergence rating: 4.5 meters NEMA 6P (IP68)

.7 Minimum Conductivity: General Application 5 μS/cm.

.8 Liners and electrode are to be reviewed with the manufacturer on an application-by-application basis. If the manufacturer suggests a different combination of sensor materials to be superior to what is listed herein for a particular application, the Region is to be provided with the option to select either the materials listed or those recommended by the manufacturer at no additional cost to the Region.

2.2 Transmitter

.1 Design: Continuous automatic re-zeroing calibration and auto ranging adjustable low flow cut-off circuitry locks output signal at 4 mA and provides contact signal output for alarm.

.2 Display: Rate of flow and flow totalized displayed in engineering units.

.3 Output: 4-20 mA and additional scaled pulse output contact for totalizing flow. Totalizer is to have Reset Digital Input.

.4 Signal Cable: Manufacturer's recommended sensor signal cable connection direct from sensor to instrument without joints or splices via flexible weatherproof conduit.

.5 Communication: Smart with HART Communication Protocol and Modbus for totalizer.

.6 Tagging: SST tag wire to transmitter and to sensor.

2.3 Magnetic Flow Meters

Service:	General
Process:	
Tag name:	_RSP_FIT1, _RSP_FIT2

Installation DWG.:	Process Drawings
Fluid:	Sewage
Velocity min/max:	0 - 10 m/s
Temp min/max:	0 to 25 °C
Press min/max:	0 – 1,034 kPa
Flow min/max:	0 – 4,300 L/s
Up/Down Stream:	5/2 Min.
Bi-directional Flow:	No
Flow Tube:	
Flow Tube Size:	750 mm (30")
Body Material, Flange Material:	SS 316L / Epoxy Painted
End Conn.:	AWWA C-207 Class D Flanged
Minimum Liner Material:	Polyurethane
Electrode Material:	Hastelloy C-276 / Alloy C-22 Bullet Nose
Lining Protection:	SS 316L
Empty Pipe Detect:	Yes
Transmitter:	
Enclosure:	Locally Mounted at the Magmeter - NEMA 6P (IP68)
Power Supply:	120 VAC, 60 Hz
Communication:	Modbus (totalizer)
Sensor Cable:	5 meters
Analogue Output:	4 - 20 mA isolated (600 Ω)
Pulse Output:	1 Pulse / Cubic Meter
Calibr. Range:	0 to 4,300 L/s
Accuracy:	± 0.25% of Rate
Indication:	Local LCD, Eng units
	LCD indication of both: flow (L/s) & totalized flow (m^3)
Options:	Not applicable
Electrical:	
Approval:	CSA
Enclosure:	NEMA 6P (IP68)
Class/Div/Group:	Unclassified
Grounding:	Grounding Ring

2.4 Approved Suppliers

.1 Acceptable manufacturers are listed in the following table in order of preference. The design has been completed around the first named manufacturer. The Contractor is responsible for all costs associated with any changes required to the design to accommodate one of the other manufacturers.

Preference	Manufacturer	Model
1	Siemens AG	Sitrans F M Mag 5100W, c/w Remote

		Transmitter Mag6000
2	Endress + Hauser Consult AG	ProMag 53W c/w Remote Transmitter

.2 The Contractor is to select the appropriate options to suit the application and the requirements of the specification.

.3 Where second and third named manufacturers are provided, they are to meet the performance specifications of the first named manufacturer.

PART 3. EXECUTION

3.1 General Installation

.1 The following installation requirements are in addition to or deviations from the requirements set forth for instrumentation in the Section 13105 - General Instrumentation Requirements.
- .1 Install the meters on the discharge headers at each location, as shown on the Contract Drawings.
- .2 Install separate conduits for signal and power wiring to the meter and between the transmitter and control panel.
- .3 Install the transmitter at the flowmeter.
- .4 Ground the meter in accordance with manufacturer's instructions.

END OF SECTION

PART 1. GENERAL

1.1 General

.1 This Section defines the requirements for pressure transmitters for gauge pressure, and flow applications.

.2 The Specifications in this Section define additional requirements or deviations from the requirements set forth in Section 13105 – General Instrumentation Requirements. Where a conflict exists between a requirement specified in this section and a requirement specified in Section 13105, the Contractor shall follow, the more stringent requirement.

.3 The Contractor shall clearly identify on the shop drawings any deviation from the Specifications.

.4 The Contractor shall provide the following O&M documentation: manufacturers' printed recommendations; installation instructions; specifications; operation manuals, including electrical drawings, and plumbing diagrams; sales literature; materials; and training materials as applicable.

.5 The Contractor shall furnish copies of the manufacturer's warranties.

.6 The Contractor shall provide, through its Instrumentation Supplier Subcontractor, pressure transmitters, complete and operable, in accordance with the Contract Documents.

1.2 Performance

.1 Accuracy: +/- 0.1 percent of calibrated span

.2 Repeatability: +/- 0.5 percent of range

.3 Response time: 0.5 seconds for one time constant

.4 Warm up time: < 5 seconds

.5 Operating Range: 0 – 1034 kPa (0 – 150 psi)

.6 Sensor Temperature Range: -40 degrees Celsius to 40 degrees Celsius

.7 Electronics Temperature Range: -40 degrees Celsius to 60 degrees Celsius

1.3 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13140 – Pressure Indicating Transmitter as indicated in Schedule 'A' of the Bid Form.

PART 2. PRODUCTS

2.1 Sensor

.1 Dual sensing ports connect to pressure source and atmosphere for pressure.

.2 Diaphragm type, type process isolating cell.

.3 Microprocessor based electronics shall generate output proportional to pressure.

.4 Snubbers, when applicable, shall be standard equipment from the primary element supplier.

.5 Seals, when applicable, shall be standard equipment from the primary element supplier. Provide appropriate seals as required to suit the process connections, 316L stainless steel housing, stainless steel diaphragm material.

.6 Provide front flush high-pressure diaphragm, diaphragm material to be stainless steel and diaphragm extension length to suit application.

.7 Process connections and adapters on flow applications: 316L Stainless Steel Material, only.

.8 Wetted o-rings: Viton, or Graphite Filled PolyTetraFluoroEthylene (PTFE)

.9 Fill fluid: Silicone oil or inert fluid

.10 Bolts: 316L Stainless Steel

.11 Isolating diaphragm and drain and vent valves: 316L Stainless Steel.

.12 Electronics housing: Epoxy Painted copper free aluminum.

.13 Cover O-rings: Buna-N.

.14 Paint: Epoxy-polyester.

.15 Electrical connections: 3/4 inch (20 mm) - NPT weather proof conduit.

.16 Process connections: 3/4 inch (20 mm) NPT.

2.2 Transmitter

.1 Failure mode alarm will drive the analog signal to either high or low full scale (selectable).

.2 Provide an operating range between 40 percent and 80 percent of the maximum adjustable range.

.3 Over pressure / under pressure alarm will drive the signal to either high or low full scale (selectable).

.4 Internal security switch which prevents unauthorized changes to calibrated configuration.

.5 Adjustable damping 0 to 16 seconds.

.6 24 V DC loop powered with a 4-20 mA @ 600 Ω output with superimposed digital signal based on HART protocol. Linear or square root output shall be field selectable.

.7 The transmitter shall have zero drift for a minimum of five (5) years.

.8 Provide an integral 4 digit LCD meter.

.9 Provide a SS tag wired to transmitter.

.10 Provide buttons for calibration and configuration without HART modem.

2.3 Pressure Indicating Transmitter

Service:	Sewage
Process:	
Tag Name:	_RSP_PIT-01, _RSP_PIT-02, _RSP_PIT-03, _RSP_PIT-04, _RSP_PIT-05, _RSP_PIT-06
Installation DWG.:	Process Drawings
Fluid:	Sewage
Temp min/max:	0-25 °C
Press min/max:	0 – 1,034 kPa
Sensor:	
Sensor Type:	Gauge Pressure
Element:	SS Diaphragm c/w Silicon Fill
Body Material:	316L SS
Connection:	20 mm (3/4")
Block & Bleed Man:	20 mm (3/4") 316L SS
Diaphragm Seal:	Yes
Transmitter:	
Output:	4 - 20 mA isolated (600 Ω)
Power Supply:	24 Vdc 2 Wire Loop
Enclosure:	NEMA 4X / Pipe Stand Mounting
Indication:	Local LCD display in Eng. Units
Pressure Range-ability:	0 – 1,034 kPa
Calibr. Range:	0 – 1,034 KPa
Accuracy:	±0.075% of Calibrated Range
Turn Down:	100:1
Dampening:	Adjustable 0-16 sec (0.1 sec units)
Options:	Mount. Hardware for 2" Pipe Stand
Electrical:	
Approval:	CSA
Electrical Conn.	3/4" NPT
Class/Div/Grp:	Unclassified

2.4 Approved Suppliers

.1 Acceptable manufacturers are listed in the following table in order of preference. The design has been completed around the first named supplier. The Contractor is responsible for all costs associated with any changes required to the design to accommodate one of the other manufacturers.

Preference	Manufacturer	Model
1	Siemens AG	Sitrans PDS3
2	Endress+Hauser Consult AG	PMP75

.2 The Contractor is to select the appropriate options to suit the application and the requirements of the specification.

.3 Where second and third named manufacturers are provided, they are to meet the performance specifications of the first named manufacturer.

PART 3. EXECUTION

3.1 General Installation

.1 Provide mounting bracket for the pressure gauge and transmitter assembly per the detail on the Contract Drawings.

.2 Provide stainless steel valve manifold assembly with line shutoff valves for pressure, c/w calibration test port.

.3 Stainless steel valve manifold to be provided for mounting to the orifice flanges.

.4 When routing conduit avoid areas subject to chemical and physical abuse and areas with high EMI/RFI conditions.

.5 Transmitter unit shall be mounted on a wall at 1.8 m off the floor in a readily accessible location for ease of reading and in order to facilitate maintenance and calibration.

.6 Locate such that indicator display is readily readable at eye level from floor elevation.

.7 Locate transmitter with adequate clearance and accessibility for service.

.8 Locate transmitter as close as possible to the process connection.

.9 Ground the transmitter through a 16 AWG or larger copper wire from transmitter grounding screw to a low resistance ground.

.10 Any zero shift due to mounting position to be calibrated out.

.11 Connection unit to liquid process lines horizontally. Slope lines 8 cm/metre (1 inch/foot) downward to allow gas bubbles to bleed back to the process line.

.12 Provide for air or water flushing lines where contaminant fouling may occur.

.13 Provide filled diaphragm seals for severe process fluids where contamination, corrosion, or fouling will occur.

.14 Provide a local pressure gauge for gauge pressure and absolute pressure applications.

.15 Provide one (1) Universal HART Communicator for every three (3) pressure indicating transmitter instruments. A total of two (2) Universal HART Communicators are required for the six pressure indicating transmitter instruments to be supplied and installed as part of the Contract.

END OF SECTION

PART 1. SPECIFICATIONS

1.1 General

.1 The specifications in this Section define additional requirements to those set forth in Section 13105 –General Instrumentation Requirements. Where a conflict exists, the more stringent requirement is to be provided.

.2 The Contractor is to clearly identify on the shop drawings any deviation from the specification.

.3 The Contractor shall provide the following O&M documentation: manufacturers' printed O&M documentation; installation instructions; specifications; operation manuals, including electrical drawings, and plumbing diagrams; sales literature; materials; and training materials as applicable.

.4 The Contractor shall furnish copies of the manufacturer's warranties.

.5 The Contractor shall provide, through the its Instrumentation Supplier Subcontractor, gas detectors, complete and operable, in accordance with the Contract Documents.

1.2 Measurement and Payment

.1 The work outlined in this Section shall be included in the lump sum price for Section 13190 – Gas Detectors as indicated in Schedule 'A' of the Bid Form.

1.3 Sensor

.1 Sensors are to be provided for each gas to be monitored, as a minimum Hydrogen Sulfide (H_2S), Oxygen (O_2) and Methane (CH_4).

.2 Sensors:

  .1 Catalytic Bead Sensor Type: Poison-resistant combustible gas sensor.

  .2 Infrared Point Sensor Type: Point Type Infrared Absorption.

  .3 Infrared Open Path Sensor Type: Open Path Infrared Source / Receiver Type Infrared Absorption.

.3 Calibration: Provide Tygon Tubing for one man non-intrusive calibration.

.4 Mounting: Surface / Conduit mounting on 8 metre centers.

.5 Cable Type: As recommended or provided by the manufacturer.

.6 Power: Obtained from transmitters via interconnecting cable.

.7 Compensation: Temperature / Pressure / Humidity.

.8 Material: Stainless Steel or Copper Free Aluminum

.9 Sensor Life: 8 months minimum usable life from time of successful commissioning.

.10 Where both Catalytic Bead and Infrared technologies are available, Infrared is to be provided.

.11 Infrared technology to be used always for LEL.

1.4 Transmitter

.1 Use in applications where a single or up to three sensors are required.

.2 Local backlit LCD display of % LEL with additional indicators for alarms and status conditions, minimum 12 mm high characters. Front of enclosure display, readable from 3 meters.

.3 Non-intrusive set-up and calibration from user programmable and/or predetermined choices, accessible from menu prompts.

.4 One 4-20 mA at 600 Ω analog output.

.5 Three alarms with adjustable set-points, isolated output SPDT contacts, 5 amp 120 VAC per channel.

.6 NEMA 7 corrosion resistant housing and mounting hardware.

.7 Up to three sensors installed for each transmitter.

.8 SST tag wired to transmitter and to sensors.

1.5 Sample Pump

.1 Gas sample pumps shall be used to draw gas sample from Wet Well area and Bar Screen area through sample lines to gas sensor locations.

PART 2. INSTALLATION

2.1 General

.1 The following installation requirements are in addition to the requirements set forth for instrumentation in Section 13010 – Process Control: General Requirements.

  .1 Locate the sample point to minimize unnecessary delay time in the LEL measurement. Take care to ensure the sample is representative of the surrounding atmosphere, and not in dead air.

  .2 Mount sensors for each application in accordance with the manufacturers installation recommendations and accessible for routine maintenance and calibration.

  .3 Mount the transmitter unit at 1.8m off the floor in a readily accessible location to facilitate maintenance and calibration.

  .4 Use infrared point sensors in areas of high humidity and in areas with high levels of contamination.

.5 Use infrared open path sensors in tunnels and across large open rooms.

.6 Where installed in the area being monitored, mount sensors on 8 metre diameter centers.

.7 Manufacturer mounting brackets to be used for installation.

.8 Mount sensor and sampling pump within an enclosure..

.9 Provide three (3) alarm outputs minimum to be wired as followed:

1. Alarm 1: To PAC.
2. Alarm 2: To Alarm lamp outside building/room.
3. Fault: To PAC.

.10 Provide No Flow alarm output from sample pump to PAC.

.11 Provide remote (outside of the area being monitored) indication of the combustible gas monitoring point in alarm on multiple sensor installations.

.12 Provide a panel mounted alarm horn with a sealed external push-button for alarm reset and audio alarm silencing.

.13 Provide zero and span gas, remote testing connection, and portable calibration kit c/w carrying case to allow for one man non-intrusive calibration. Gas to be utilized prior to expiry – current to within one (1) month.

.14 Do not paint the sensors.

.15 Provide the interconnecting wiring between the sensors and transmitter/controller units in rigid conduit, following the OESC for Class I-Division 1 areas (explosion proof).

.16 Ensure that the system is on-line 24 hours before start up and calibration for adequate warm up.

.17 Provide a one (1) year supply of consumables and spare parts.

.18 Sensors are not to be ordered until prior to proposed Site start up. Sensor and consumables must be supplied with 12 months of operating life after substantial completion. Sensors/consumables with less than 12 months operating life will be replaced by the Contractor at no expense to the Region.

.19 Instrument supplier is to supply their own calibration gas and calibrators for instrument start up.

.20 Transmitter/Electronics not mounted/installed indoors must be installed within fiberglass enclosure with viewing window, thermostat and heater. Panel heater to be powered from separate lighting panel circuit than instrument.

PART 3. ACCEPTABLE MANUFACTURERS

.1 Acceptable manufacturers are listed in the following table in order of preference. The design has been completed around the first named supplier. The Contractor is responsible for all costs associated with any changes required to the design to accommodate one of the other manufacturers.

Preference	Manufacturer	Model
1	Mine Safety Appliances Corporation (MSA)	Ultima X
2	Scott Health & Safety Limited	Freedom 6000

.2 The Contractor is to select the appropriate options to suit the application and the requirements of the specification.

.3 Where a second manufacturer is provided, they are to meet the performance specifications of the first named manufacturer.

3.2 Gas Detection

First Named Manufacturer:

Service:	Catalytic Bead	Catalytic Bead
Process:		
Gas:	H_2S	CO
Temp min/max:	-40 to 90 º C	-40 to 90 º C
Humidity:	0 - 100%	0 - 100%
Class/Div/Grp:	Class 1 Division 1 Group D	Class 1 Division 1 Group D
Device Data:		
Model:	Explosion Proof with Display	Explosion Proof with Display
Gas Code:	Hydrogen Sulfide 0-100 ppm	Carbon Monoxide 1-100 ppm
Configuration:	CSA Approval w/NPT Threads	CSA Approval w/NPT Threads
Sensor Output:	3 Wire mA Output	3 Wire mA Output
Sensor Mounting Style:	Sensor Mounted on Remote Housing	Sensor Mounted on Control Unit
Relays and LEDs:	Relays and LEDs	Relays and LEDs
Display Language/Features:	English	English
Optional Power Supply:	None	None
Gas Sample Selection:	None – Standard Diffusion Method	None – Standard Diffusion Method
Integrated Accessories	None	None
Installation Hardware:	Brackets	Brackets
Manuals:	Standard	Standard
Custom Features:	None	None
Manufacturer:	MSA	
Part Number:	A-ULTIMAX-XP-E-17-C-3-D-2-0-0-0-0-1-0-0	A-ULTIMAX-XP-E-11-C-3-S-2-0-0-0-0-1-0-0
Sample Pump:		
Manufacturer:	MSA	MSA
Part Number:	10043264	10043264
Tubing:	600771	600771
In-Line Filter	10051406	10051406

Service:	Infrared Gas Detection	Catalytic Bead
Process:		
Gas:	CH_4	O_2
Temp min/max:	-40 to 90 º C	-40 to 90 º C
Humidity:	0 - 100%	0 - 100%
Class/Div/Grp:	Class 1 Division 1 Group D	Class 1 Division 1 Group D
Device Data:		
Model:	Explosion Proof with Display	Explosion Proof with Display
Gas Code:	IR Combustible 0-100% LEL – Methane	Oxygen 0-25%
Configuration:	CSA Approval w/NPT Threads	CSA Approval w/NPT Threads
Sensor Output:	3 Wire mA Output	3 Wire mA Output
Sensor Mounting Style:	Sensor Mounted on Remote Housing	Sensor Mounted on Control Unit
Relays and LEDs:	Relays and LEDs	Relays and LEDs
Display Language/Features:	English	English
Optional Power Supply:	None	None
Gas Sample Selection:	None – Standard Diffusion Method	None – Standard Diffusion Method
Integrated Accessories	None	None
Installation Hardware:	Brackets	Brackets
Manuals:	Standard	Standard
Custom Features:	None	None
Manufacturer:	MSA	
Part Number:	A-ULTIMAX-XP-E-38-C-3-D-2-0-0-0-0-1-0-0	A-ULTIMAX-XP-E-14-C-3-S-2-0-0-0-0-1-0-0
Sample Pump:		
Manufacturer:	MSA	MSA
Part Number:	10043264	10043264
Tubing:	600771	600771
In-Line Filter	10051406	10051406

Second Named Manufacturer:

Service:	Catalytic Bead
Process:	
Gas:	CO
Temp min/max:	-40 to 90 º C
Humidity:	0 - 100%
Class/Div/Grp:	Class 1 Division 1 Group D
Device Data:	
Sensor Type:	6V Poison Resistant
Sensor Connection:	6V (Gold Bell) Sensor Integral With Transmitter
Power:	24VDC
Transmitter Output:	4-20 mA Non-Isolated & Relays
Manufacturer:	Scott Instruments
Part Number:	488-1-1-2-4

END OF SECTION

PART 1. GENERAL

1.1 Field Wiring

.1 Field Wiring is the wiring that connects the field equipment (instruments, control stations, control panels, MCC, etc) to the Process Automation Controller. Use only CSA approved and labeled cables and conductors.

.2 This specification applies to equipment field wiring only that is 600 V and less.

1.2 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13305 – Field Wiring as indicated in Schedule 'A' of the Bid Form.

PART 2. PRODUCTS

2.1 Analog Signals

.1 Definition: Analog signals are 4-20 mA inputs received from field instruments.

.2 Conductors: #16 AWG, 7 strand minimum, tinned copper, unless otherwise indicated in the Contract Documents, 300 V minimum insulation.

.3 Construction: Twisted pair, triplet and quad grouping with nominal 50 mm staggered lay and 100 percent aluminum-Mylar tape shield with minimum 25% overlap.

.4 Drain wire: Over each group, bare, #20 AWG minimum, tinned copper, in direct continuous contact with shield.

.5 Jacket: PVC (-40°C) low acid gas, FT4 rated low flame spread.

.6 Identification: Each grouping (pair, triplet, quad) by consecutive number coding, permanently marked at 25 mm intervals.

.7 Armour: For exposed or direct buried cables, aluminum or steel interlocking armour with overall PVC jacket.

.8 General purpose instrumentation cable: Type #9316 by Belden Wire and Cable.

.9 Shields: Signal shields shall have one ground point located at the PAC panel. Shields shall be continuous through cabinets, panels, and junction boxes.

.10 Colour Coding Analog Signals:
- .1 Black (-)
- .2 White (+)

.11 The power supply connection for each individual two or three wire field device shall be wired through a fuse.
   .1 RS232 and RS422 cables: 4 pair, 22 AWG stranded copper, separately twisted pairs, overall 100% aluminum-polyester shield, tinned copper stranded drain wire, type #9305 by Belden Wire and Cable.
   .2 Termination fittings: Type, configuration and gender required to connect cable directly to equipment without additional adapters or fittings.
   .3 Data highway communication cable: Stranded, tinned copper conductor with aluminum armour and overall PVC jacket, Type #9463 by Belden Incorporated.

2.2 DC Digital Input Signals

.1 DC digital input signals are at 24 VDC sourced from the PAC panel.

.2 Single Cable: For individual contact closure circuits use single pair, two inch lay, #14 AWG, twisted, 19 X .0147 stranded copper conductors CSA labeled tray cable at 600 Volts, type T90, PVC insulation and nylon jacket, 90°C.

.3 Multi-pair Cable: TECK cable.

.4 Color Coding: Blue.

.5 The conductor designation is that green conductors are always at ground.

2.3 AC Digital Input Signals

.1 AC digital input signals are 120 VAC and less than 20 amperes, and sourced from the PAC panel.

.2 Single Cable: For individual contact closure circuits use single pair, two inch lay, #14 AWG, twisted, 19 X .0147 stranded copper conductors CSA labeled tray cable at 600 volts, type T90, PVC insulation and nylon jacket, 90°C.

.3 Multi-Conductor: TECK Cable.

.4 Color Coding – Red.

.5 Color Coding – Control from External: Yellow.

.6 The conductor designation is that green conductors are always at ground.

2.4 Multi-Conductor Cable Control Cabling

.1 Low Voltage Armoured Wire and Cable (1000 V and Below)
   .1 Construction: Stranded, annealed copper conductors, 1000 V rating, RW90 cross-linked polyethylene (XLPE) insulation, suitable for handling at minus 40°C ambient, 90°C maximum conductor temperature, flame test rated FT4.

.2 Power cabling: TECK construction.
.3 Control cabling: TECK construction.
.4 Minimum conductor size: Unless otherwise indicated in the Contract Documents, #12 AWG for power and current transformer circuits and #14 AWG for control and fire alarm circuits.
.5 Grounding conductor: Stranded, soft, bare copper conductor in multiconductor cables, concentric copper wires over insulation in single conductor cable.
.6 Multi-conductor cables: With inner jacket of suitable PVC (minus 40°C).
.7 Interlocking armour: Flexible, galvanized steel or aluminum for multi-conductor cables and aluminum for single conductors, spirally wound over inner jacket.
.8 Outer jacket: PVC (minus 40 °C), flame-retardant, FT4 flame test rated, low acid gas evolution, black outer jacket extruded over the armour.
.9 Colour coding: For insulated conductors, conform to the following:

1.	1-conductor power	-	Black
2.	1-conductor control	-	Red
3.	2-conductor cable	-	Black, White
4.	3-conductor cable	-	Red, Black, White (Neutral)
		-	Red, Black, Blue
5.	4-conductor cable	-	Red, Black, Blue, White
6.	Multi-conductor cables	-	Manufacturer's standard

.10 Hazardous area installations: Where indicated in the Contract Documents, TECK cables and fittings accepted for the application. Stamp outer jacket, "HL".

2.5 Ethernet Patch Cables

.1 Cables shall conform to IEC 11801. Twisted-pair. Category 6. Red. Link and performance requirements in TIA/EIA-568-B.2.1. Cables to be Belkin International, Inc. - FastCAT Snagless Molded Cables.

2.6 Access Closet Power Supply

PART 3. INSTALLATION

3.1 General

.1 For new installations, all field wiring is to enter the PAC panel from the bottom.

.2 For retrofit installations, filed wiring is permitted to enter the PAC panel form the top, run behind the panel back plane and come up into the wire ways from the bottom.

.3 Power cabling, I/O cabling and communications cabling is to be run through conduit from field device to PAC panel.

.4 Every I/O point shall have its own common to the field device: two (2) wires are to be run for each I/O point from the panel to the field device. Jumpering/combining commons in the field resulting in a single common for multiple I/O points is not acceptable.

.5 Avoid running cables inside or under power cable trays. Where field wiring is in power cable trays, insulation must be equal to or greater than the highest voltage in the cable tray.

.6 Where power or signal cables must cross, make them cross at an angle of 90 degrees.

.7 Communication cables will not be mixed with power or signal cables.

.8 If using TECK cable, the TECK cable is not to be run directly into the PAC control panel. The TECK cable is to terminate in an intermediate junction box installed above the PAC panel. Field wiring is to be extended from the junction box to the PAC panel through conduit. For a valve or metering camber, TECK cable may be run directly into the control panel.

3.2 Signal Separation

.1 Signal separation of different signal types to be maintained.

.2 Analog and 24 VDC Discrete Signals: Analog 4-20 mA signals and 24 VDC discrete signals shall be in separate conduits. An exception to this standard may be made in cases where it would cause parallel conduit runs to the same device and combining signals would eliminate one conduit. This exception will be limited to 3 metres only.

.3 AC Digital and Control: AC digital signals and AC control wiring may occupy the same conduit but all instrument power circuits should be isolated by a separate conduit from all AC digital and control circuits.

.4 All conduits for signal cables shall be rigid PVC conduit with the last meter flexible connecting to the field instrument unless otherwise noted in the Contract Documents.

3.3 Miscellaneous

.1 Thermocouple Extension Wire: Thermocouple extension circuits shall be solid conductors and same gauge as the T/C of the same material as the associated thermocouple. Thermocouple signal lines shall be continuous from the thermocouple connection head to the final termination point.

.2 Spare Conductors: Spare conductors in each conduit shall be equal to no less than 15% of the number or required conductors in the conduit. Each cable shall have 10% spare conductors but not less than two conductors. Spare conductors shall be labeled at both ends.

.3 All field wiring, including wiring in MCCs, junction cabinets and wiring not terminating in the PAC panel, is to have thermal heat shrink labels installed and heat shrunk.

END OF SECTION

PART 1. GENERAL

1.1 References

.1 The following is a list of standards which are referenced in this Section:
  .1 The Instrumentation, Systems and Automation Society (ISA): S50.1, Compatibility of Analog Signals for Electronic Process Instruments.
  .2 National Electrical Manufacturers Association (NEMA):
    1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    2. AB 1, Molded Case Circuit Breakers and Molded Case Switches.
    3. ICS 2, Industrial Control Devices, Controllers and Assemblies.
  .3 Canadian Standards Association (CSA):
    1. C22.2 Electrical Safety Code
  .4 Ontario Electrical Safety Code (OESC).
  .5 National Fire Code, National Fire Protection Association (NFPA): 820, Fire Protection in Wastewater Treatment Plants.
  .6 Underwriters Laboratory, Inc. (UL): 508, Standards for Safety, Industrial Control Equipment.

1.2 Related Sections

.1 Comply with the requirements of Division 13 – SCADA and Instrumentation.

.2 Section 13420 - HMI Programming Manual (included as an appendix to the Contract Documents).

.3 Coordinate the Work of this Section with the requirements of Division 15 - Mechanical. The requirements identified within these specifications apply to any mechanical packaged vendor equipment supplied with a Programmable Automation Controller (PAC) and to be integrated into control network and SCADA system.

.4 Coordinate the Work of this Section with the electrical requirements of Division 16 – Electrical for electrical requirements.

.5 Refer to the Region of York SCADA Tagging Standard (Section 13960 included as an appendix to the Contract Documents) for development of panel equipment tagging and, wire tagging and terminal tagging.

1.3 System Description

.1 Assemble panels and install instruments, plumbing, and wiring in equipment manufacturer's factories.

.2 Perform FAT on panels and panel assemblies for proper operation prior to shipment from equipment manufacturer's factory. The Region, the Consultant and the Contractor's SCADA System Integrator will attend such FAT. Refer to Section 13930 – Instrument And Equipment Testing and Section 13933 – Software Site Acceptance Testing for additional requirements.

1.4 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13390 – Package Control Systems as indicated in Schedule 'A' of the Bid Form.

1.5 Submittals

.1 Shop Drawings:
  - .1 Bill of material, catalog information, descriptive literature, wiring diagrams, and Shop Drawings for components of control system.
  - .2 Catalog information on electrical devices furnished with system.
  - .3 Shop Drawings, catalog material, and dimensional layout drawings for control panels and enclosures.
  - .4 Panel elementary diagrams of prewired panels. Include in diagrams control devices and auxiliary devices, for example, relays, alarms, fuses, lights, fans, and heaters.
  - .5 Plumbing diagrams of preplumbed panels and interconnecting plumbing diagrams.
  - .6 Interconnection wiring diagrams that include numbered terminal designations showing external interfaces.

.2 Information Submittals:
  - .1 Manufacturer's Certificate of Proper Installation.
  - .2 Programmable Controller Submittals:
    1. Complete set of user manuals.
    2. Fully documented ladder logic listings. Paper and electronic copy.
    3. List of addresses to be interfaced to SCADA system.
    4. Function listing for function blocks not fully documented by ladder logic listings. Provide a hard (paper) copy and an electronic copy.
    5. Cross-reference listing. Provide a hard (paper) copy and an electronic copy.
    6. Process Control Narrative.

.3 Manufacturer's list of proposed spares, expendables, and test equipment.
.4 Provide process control narrative detailing the functional operation Narratives in accordance with the York Region Standard for Process Control Narrative Guidelines including Section 13021, Section 13021A and Section 13021C (included as appendices).

.3 Allow for minimum of five (5) Days for coordination between the supplier of the package control system ("Supplier") and SCADA System Integrator Subcontractor ("SCADA System Integrator") unless noted otherwise in the Contract Documents.

.4 The Contractor shall ensure that the Supplier will provide all PAC and local OIT programming, testing and commissioning required for the vendor package. The Contractor shall ensure that the SCADA System Integrator will be developing the SCADA system screens and database points for the vendor package. The Contractor shall ensure that the vendor will provide a list of PAC addresses to the SCADA System Integrator for development of the SCADA screens and database.

.5 The Contractor shall ensure that the Supplier will coordinate with the System Integrator for development of the SCADA screens and provide the System Integrator with copies of the package PLC and OIT programs.

1.6 Delivery, Storage, and Handling

.1 Prior to shipment, remove PAC CPU (Central Processing Unit)and I/O cards for separate shipment. Re-install after panel installation is complete.

1.7 Extra Materials

.1 Spares, Expendables, and Test Equipment:
.1 Selector Switch, Pushbutton, and Indicating Light: 20 percent, a minimumof one of each type used.
.2 Light Bulb: 100 percent, a minimum of 2 of each type used.
.3 Fuse: 100 percent, a minimum of 20 of each type used.

.2 Surge Suppressors: 20 percent, a minimum of one of each type used.

PART 2. PRODUCTS

2.1 General

.1 Controls shall meet requirements of Division 13 – SCADA and Instrumentation.

PART 3. EXECUTION

3.1 Installation

.1 Local network switches installed in package control panels are not permitted, with the exception of control panel CP-GMCP. All ports on the Work Area Outlet (WAO) are to be home run back to the Network Access Closet or Process Control System (PCS) switch. Patch cables to be installed in the package control panel for connection of Ethernet equipment to the WAO.

.2 Panel Factory Acceptance Test (FAT) is to be completed prior to panel shipment and must be conducted on a fully functional system.

.3 Upon completion of on Site installation, the Contractor shall ensure that the vendor will conduct its own functional tests and assist in functional tests integrated into overall SCADA system with the SCADA System Integrator to comply with the requirements of Section 13933 - Site Acceptance Testing.

3.2 Integration

.1 Vendor PAC shall include functionality to provide communications handshaking or heartbeat with the plant PAC or SCADA system. The handshaking is intended to provide a method to monitor communications with the supplier package.

.2 The Contractor shall ensure that the Supplier will allow for coordination and on-Site testing/verification with the SCADA System Integrator for SCADA screen development, testing and commissioning.

.3 The Contractor shall ensure that an editable copy of the Supplier’s Process Control Narrative will be provided to SCADA System Integrator for integration into overall facility Process Control Narrative.

END OF SECTION

PART 1. GENERAL

1.1 Summary

.1 This Section includes Programmable Logic Controller (PLC) hardware for control and interface of process and measurement equipment, control systems and ancillary systems.

.2 Supply network hardware, network interconnections, communication hardware, interface components and all necessary programming for a fully functional system.

.3 Coordinate instrumentation requirements, including but not limited to interface voltages, wiring requirements and termination requirements to ensure compatibility between instrumentation, control panels and connected PLC's.

.4 Coordinate communication protocols to ensure proper data transfer and compatibility between all connected devices, including but not limited to; instrumentation, modems, radios, connected devices and control panels.

.5 The Contract Drawings have been developed to convey the design intent. Provide devices, components and accessory items necessary for the operation of the control system in accordance with the requirements of the Contract.

.6 Existing systems shall remain functional at all times. Shut down or cutover procedures of any of the existing equipment or systems shall only to be performed under the direction of the Region and the Consultant. The Contractor shall provide, 10 Working Days prior to commencing Work on any existing system, , a written method of the cutover procedures for approval by the Consultant and the Region with dates, times, duration of Work and a detailed description of proposed activities.

1.2 Related Sections

.1 Section 13106 – Process Instrumentation

.2 Section 13452 – Human Machine Interface

.3 Section 13480 – SCADA Integrator

.1 Section 13961 – Electrical Controls and Devices

.2 Division 16 - Electrical

.3 13415 - PAC Base Load standard (included as an appendix)

.4 13410 - PAC Programming Manual (included as an appendix)

1.3 References

.1 Instrumentation, Systems, and Automation Society (ISA):
  .1 S5.1, Instrumentation Symbols and Identification.

.2 PR12.6, Installation of Intrinsically Safe Systems for Hazardous Locations
.3 S5.4, Standard Instrument Loop Diagrams.
.4 S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
.5 S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.2 National Electrical Manufacturers Association (NEMA):
.1 ICS 1, Industrial Control and Systems: General Requirements.
.2 ICS 2, Industrial Control Devices, Controllers and Assemblies.
.3 ICS 3, Industrial Control and Systems: Factory Built Assemblies.
.4 ICS 4, Industrial Control and Systems: Terminal Blocks.
.5 ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
.6 ICS 6, Industrial Control and Systems: Enclosures.
.7 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
.8 IA 2.2, Programmable Controllers - Equipment Requirements and Tests.
.9 IA 2.3, Programmable Controllers - Programming Languages.

1.4 Definitions

.1 Analog Signals: 4-20 mA DC two-wire circuits conforming to ANSI/ISA S50.1

.2 Control Loop: The control scheme describing the control of a single process variable or a group of related process variables. The control loop includes the relevant part of the process, the process variable sensor and associated transmitter(s), the input signals, the controller, the control output signal, and the actuator.

.3 Controller: A primary element that functions to provide loop control. Controllers have provisions for a process variable input signal, a control output signal, setpoint adjustment, tuning of the PID control parameters and provide for an interface of the values within the process variables and the setpoints. Controllers are panel mounted programmable logic controllers, which are microprocessor-based systems having provisions for multiple inputs and outputs for both discrete and analog control capability, with the ability for advanced Human Machine Interface.

.4 Dead-time Compensation: A time based offset algorithm derived value used to predicatively control systems that have a delayed feedback process variable.

.5 Discrete Signals: Two state based logic signals that are either DC or 120 VAC.

.6 HART: Highway Addressable Remote Transducer (Communications Protocol).

.7 HMI: Human Machine Interface.

.8 Loop Tuning: Part of the control system startup and commissioning process and includes the process of adjusting the gain, reset and rate parameters to obtain effective and stable response of the system to changes in the setpoint or external disturbances.

.9 PID: Control action, Proportional-Integral-Derivative. Control feed-back or feed-forward algorithm used as a mechanism to tune a system for intended operation.
  - .1 Proportional determines the reaction to the error.
  - .2 Integral determines the reaction based on the sum of the errors.
  - .3 Derivative determines the reaction to the rate at which the rate has been changing.

.10 PLC: Programmable Logic Controller.

.11 Programmable Automation Controller: Used interchangeably with PLC. Refers to a PLC that is part of a control panel.

.12 Redundancy: Redundant configurations of systems and equipment are referred to using mathematical formulas based on the parameter “N”, such as; “N + 1” or “2N”. In this convention, N is the number of systems or pieces of equipment which must be operational to accomplish normal operation of the system.
  - .1 N + X redundancy refers to a system configuration in which the total number of units provided is equal to the number needed to meet the load, N, plus some number of operationally redundant units, X. For example, if a system requires 1 PLC to normally function and another for hot standby, the system would be described as N + 1, where N = 1.
  - .2 XN redundancy refers to a system configuration in which the total number of units provided is some multiple, X, of the number required to meet the load. For example, if a system requires 1 PLC to normally function and another is provided for hot standby, it would be described as 2N, where N = 1.

.13 SCADA: Supervisory Control and Data Acquisition. A SCADA System is a group of computers and servers running software dedicated for SCADA purposes. This SCADA software collects and exchanges data over industrial networks with PLCs, device level controllers, and all other connected or networked devices. The SCADA software will allow for control, trending, graphic display, alarming, alarm tracking, historical logging of values in a database and reporting of collected data.

1.5 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13400 – Programmable Automation Controllers as indicated in Schedule ‘A’ of the Bid Form.

1.6 System Description

.1 Configuration:
 .1 Non-proprietary networked programmable controllers shall be incorporated into fully assembled control panels for controlling, communicating with and monitoring of controls, control systems, instrumentation and SCADA system with all required components and programming for a fully functional system.
 .2 Programmable controller shall use a combination of discrete, analog, PID functions, programmable logic and programmable algorithms to control, annunciate and interface with connected systems.
 .3 Programmable controller shall be part of a completely assembled control panel with all components required for operation, including all associated components shown in the Drawings and where specified in the Contract Documents. Control panels shall be assembled by a UL508A certified Subcontractor and contain labeling indicating UL508A compliance with a unique UL serial number.

.2 Special Requirements:
 .1 For consistency, the Region has standardized on the rack layout for ControlLogix. Additional racks are to be connected to the main (Programmable automation controllers) PAC CPU rack through a dedicated Ethernet card. I/O shall be distributed based on device using multiple cards for common devices.
 .2 Provide a minimum of four (4) spare slots per control panel for future expansion.

1.7 Submittals

.1 Programming Approach: Indicate listing of I/O Points, Device specific communications translation protocols (for example, HART), HMI to PLC programming approach and SCADA I/O interface description, complete with tag designations for new and existing system.

.2 Process Control Narrative: Include a narrative that describes device and I/O functionality, process functionality and system operation. Narrative shall include connected devices, derived values and runtime scenarios to demonstrate function. Provide updated Process Control Narrative with initial submittal and at Contract close-out.

.3 Shop Drawings: Provide shop drawings indicating the arrangement and layout of panel, component spacing, enclosure and bill of materials, and size. Indicate electrical characteristics and connection requirements, including layout of completed assemblies, interconnecting cabling, dimensions, weights, and external power requirements.

.4 Product Data: Submit catalog data for each component specified in the Contract Documents showing electrical characteristics and connection requirements.

.5 Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

.6 Manufacturer's Field Reports: Indicate activities on Site, adverse findings, and recommendations.

1.8 Closeout Submittals

.1 Project Record Documents: Record actual locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information, and terminal block layouts in controller cabinets. Include copy of as-built drawings.

.2 Operation and Maintenance Data: Submit bound copies of operating and programming instructions, and include card replacement, adjustments, and preventive maintenance procedures and materials.

.1 Provide 1 Compact Disk (CD) containing all programmable logic codes to the Region upon Contract closeout for each unique program.

1.9 Warranty

.1 The warranty for all PAC and OIT components to be honoured by a local Canadian distributor located within the Region.

1.10 Environmental Requirements

.1 Conform to service conditions specified in the Contract Documents during and after installation of programmable controllers. Maintain area free of dirt and dust during and after installation of products.

1.11 Maintenance Materials

.1 Provide one spare PAC, equal to the largest PAC on the project. The spare PAC shall include PLC Racks, PLC power supply, all PLC I/O cards (one card of each type including communications cards), cases, etc. such that this unit can be used for programming, debugging and training.

PART 2. PRODUCTS

2.1 Programmable Controller

.1 Manufacturers:
  .1 Rockwell Automation, Inc. Allen Bradley #1756-L65 Controller and 1756 Series input/ouput interface cards.
  .2 Substitutions: Not Permitted.

.2 All PLC's shall be provided with firmware Version 19.

.3 Product Description: Controller conforming to NEMA IA 2.2, and with required memory and functional capacity to perform specified sequence of operation with scheduled input and output points, communications capability with HMI and SCADA interfacing functionality.

.4 Backplane mounted plug-in card design to allow quick field replacement of faulty devices.

.5 Programming Language: Coordinate with the Region for preferred programming language. Where the Region elects not to choose programming language, provide ladder logic. Programming shall conform to NEMA IA 2.3.

.6 Networking Connections: Ethernet and Modbus as indicated within the Contract Drawings.

.7 Minimum Spare Input/Output Capacity for each type provided: twenty (20) percent.

.8 Supply Voltage: As specified within the Contract Drawings and specifications.

.9 Rack: 17 slot chasis.

.10 PLC Rack Layout, Configuration Methodologies and Programming Methodologies: Refer to 13410 PAC Programming Manual included as an appendix for requirements.

.11 Central Processing Unit (CPU)
  .1 CPU shall provide communications with other control systems and human-machine interfaces as specified in the Contract Documents.
  .2 The CPU module shall incorporate a minimum of a 16 bit processor running at a minimum of 16 MHz.
  .3 Flash RAM shall be utilized for storage of the system executive program, operating instruction set, and critical system parameters.
  .4 Memory:
    .1 Battery-backed RAM.
    .2 Electrically Erasable Programmable Read-Only Memory (EEPROM) program back-up:

.3 Automatically download to RAM in the event RAM is corrupted.
.4 Memory battery backup shall be capable of 60 Days memory retention with fresh battery.
.5 Status of battery shall be monitored by SCADA system and reported as an alarm if battery is low.
.6 Provide visual indication of battery status and alarm low battery voltage.
.7 Memory battery backup shall be capable of 14 days of memory retention after the 'low battery' indicating lamp has been illuminated.
.8 Provide unit designed for field replacement and expansion of memory without requiring rewiring or use of special tools.
.9 Fifty (50) percent minimum spare useable memory capacity after all required programming is in place, operating and accepted.

.5 Capable of executing all control functions required by the Contract Documents.
.6 Built-in three-mode (proportional-integral-derivative) control capabilities.
.7 Directly selectable algorithms requiring no user knowledge of programming languages.
.8 On-line reconfigurable programming.
.9 Lighted status indicators indicating "RUN" and "FAILURE" based on condition module status.

.12 Input And Output Modules (I/O Modules)

.1 Analog input, analog output, digital input and digital output modules shall be of the same form factor and construction. All wiring shall be terminated on a removable terminal assembly such that future module replacement will require minimal effort without disconnecting existing devices. All terminals shall be screw type and shall provide a location for identifying associated wire numbers.
.2 I/O modules shall be intelligent maintaining their own high-speed I/O scanning of points and communication through the PLC backplane. Module diagnostics shall be integral to the module.
.3 Analog Input Modules: Each module shall have 8 channels and shall be factory calibrated. Each input shall accept a zero to 20 mA signal and support a minimal resolution of 12 bits in its A/D converter. These signals shall be scaled such that 4 mA represents a value of zero and 20 mA represents a value of 4096.

.1 The module shall provide electrical isolation for externally generated noise between field wiring and the backplane through the use of optical isolation. Modules shall provide a frame ground connecting point for cable shields.

.2 Each module shall contain an LED representing the status of each channel and these LEDs shall be viewable from the front of the card.

.3 Power for the module shall be obtained from the backplane. An isolated 24 VDC supply shall provide power to the A/D converters and loop power.

.4 Analog Output Modules: Each module shall have 8 channels and shall be factory calibrated. Each channel shall provide a zero to 20 mA signal and support a minimal resolution of 8 bits in its Digital-to-Analog (D/A) converter. These signals shall be scaled such that 4 mA represents a value of zero and 20 mA represents a value of 256. A sign bit (9th bit) shall be utilized in data transfers between the CPU and analog output module.

.1 The module shall provide electrical isolation for externally generated noise between field wiring and the backplane through the use of optical isolation. Modules shall provide a frame ground connecting point for cable shields.

.2 Each module shall contain an LED representing the status of each channel and these LEDs shall be viewable from the front of the card.

.3 Power for the module shall be obtained from the backplane. An isolated 24 VDC source shall be generated by the module to drive the current loop outputs and the D/A converter. The current loop drivers on the module shall be source type drivers.

.5 Digital Input Modules: Each module shall be rated for use at 24 VDC and provide 16 input points separated onto a minimum of two isolated input power groups.

.1 The input module shall be designed to have either positive or negative logic capabilities. Power to operate the field devices shall be supplied by field power or be obtained from the isolated 24 VDC supply on the power supply module.

.2 Integral LED indicators shall be provided for indicating the status of each input point of the module and shall be located such that they are visible from the front of the card.

.6 Digital Output Modules: Each module shall provide normally-open relay contact outputs and provide 16 output points separated onto a minimum of two isolated common power groups.

.1 Power for the internal relays shall be provided by the backplane. Power to operate the field devices shall be supplied by either field power or obtained from the isolated 24 VDC supply on the power supply module. All relay contacts shall be protected by internal fuses.

.2 Integral LED indicators shall be provided for indicating the status of each input point on a module and shall be located such that they are visible from the front of the card. A blown fuse indicator shall be visible from the front of this module.

.13 System shall be fully assembled, programmed and tested offsite.

.1 The Contractor shall submit off-Site test results in writing for approval to the Consultant and the Region indicating tests performed and subsequent results.

.2 Tests shall include device connected simulation of systems.

.3 Where required by the Region, the Contractor shall provide additional tests at no additional cost to the Region.

2.2 Source Quality Control

.1 Test programmable controller in accordance with NEMA IA 2.2.

PART 3. GENERAL

3.1 Existing Work

.1 Disconnect and remove abandoned programmable controller components.

.2 Extend existing programmable controller installations using materials and methods as specified by the Contract Documents.

.3 Clean and deliver existing programmable controllers to be salvaged to the Region.

.4 Disconnect, remove and deliver existing Remote Terminal Unit (RTU) radio equipment to the Region.

3.2 Installation

.1 Do not install Products until major construction is complete and building interior is enclosed and heated.

.2 Install and connect control panel assembly.

.3 Connect and configure input and output devices.

.4 Establish network communications over SCADA network.

.5 Participate in commissioning activities that include testing and verify that all controls and systems function as intended.

.6 Perform loop tuning and PID control adjustments for intended operation.

3.3 Field Quality Control

.1 Procedures, Forms, and Checklists:

- .1 Conduct all testing in accordance with, Division 1, Division 13, and Division 16.documented on Region approved procedures, forms, and checklists.
- .2 Describe each test item to be performed.
- .3 Have a space after each test item description for sign off by the Consultant after satisfactory completion.

.2 Perform operational testing on control systems to verify proper operation and on field wiring connections to verify intended system function as part of the Contract commissioning.

.3 Calibrate connected devices and adjust programming characteristics, where required to provide a fully functional system.

.4 Provide a written list of all passwords, keywords, serial numbers, configurations, that are encountered during the installation of the operating system and application software.

.5 Assign all warranties, licenses and product registration to the PCS/SCADA Manager at the Regional Municipality of York.

.6 Turn over to the Region all installation software, user manuals, accessory cables, calibration units, or any other material accompanying the installed equipment.

.7 Site Acceptance Testing and commissioning to be carried out in accordance with specification Section 13930 – Instrument and Equipment Testing and Section 13933 – Software Site Acceptance Testing.

3.4 <u>Integrators Field Services</u>

.1 Install, prepare and start up programmable controller in accordance with the requirements of Division 1 – General Requirements, Division 13 – SCADA and Instrumentation and Division 16 - Electrical Contract Specifications.

.2 All PAC program development, testing and implementation shall be coordinated with the Region's representative.

3.5 <u>Demonstration and Training</u>

.1 Furnish eight (8) hours of instruction, to be conducted at the Site with manufacturer's representative. Coordinate with the Region for times and locations of training. Training times and locations shall be as directed by the Region.

.2 Training shall cover detailed instruction on standard, preventative and emergency maintenance repairs including but not limited to:

- .1 Uploading/downloading program;
- .2 Review of functionality;
- .3 Battery replacement;
- .4 Module replacement; and
- .5 Troubleshooting.

3.6 PLC Loop Descriptions

.1 General:

.1 For each loop being issued a control command, a 'Fail To Start,' 'Fail To initialize' or 'Fail To Respond' execution alarm shall be generated upon failure of device to execute a command within an adjustable time delay for response from 2 seconds to 99 seconds.

.1 The initial time delay for the execution alarm shall be programmed for 10 seconds.

.2 The alarm is displayed at the HMI.

.2 On pickup of any device network failure, a 'Device Network Failure' alarm is generated and displayed at the HMI.

.2 (Existing) Loop 101A – Influent Channel 1 Motorized Sluice Gate (MG-1)

.1 Hand switch at the local control panel and HMI allows a user to select Full Open or Full Closed.

.1 When the local control panel Local/Remote switch is placed in LOCAL, local hand operation is permitted.

.2 When the local control panel is Local/Remote switch is placed in REMOTE, HMI hand operation is permitted.

.3 An alarm is generated at the HMI upon pickup of Fail to Open, Fail to Close or Uncommanded Change in State from Open to Closed.

.2 Status of sluice gate is displayed at the HMI.

.3 (Existing) Loop 101B – Influent Channel 2 Motorized Sluice Gate (MG-2)

.1 Hand switch at the local control panel and HMI allows a user to select Full Open or Full Closed.

.1 When the local control panel Local/Remote switch is placed in LOCAL, local hand operation is permitted.

.2 When the local control panel is Local/Remote switch is placed in REMOTE, HMI hand operation is permitted.

.3 An alarm is generated at the HMI upon pickup of Fail to Open, Fail to Close or Uncommanded Change in State from Open to Closed.

.2 Status of sluice gate is displayed at the HMI.

.4 (Existing) Loop 101C – Influent Channel 3 Motorized Sluice Gate (MG-3)

.1 Hand switch at the local control panel and HMI allows a user to select Full Open or Full Closed.

.1 When the local control panel Local/Remote switch is placed in LOCAL, local hand operation is permitted.

.2 When the local control panel is Local/Remote switch is placed in REMOTE, HMI hand operation is permitted.

.3 An alarm is generated at the HMI upon pickup of Fail to Open, Fail to Close or Uncommanded Change in State from Open to Closed.

.2 Status of sluice gate is displayed at the HMI.

.5 (Existing) Loop 101D – Influent Channel 4 Motorized Sluice Gate (MG-4)

.1 Hand switch at the local control panel and HMI allows a user to select Full Open or Full Closed.

.1 When the local control panel Local/Remote switch is placed in LOCAL, local hand operation is permitted.

.2 When the local control panel is Local/Remote switch is placed in REMOTE, HMI hand operation is permitted.

.3 An alarm is generated at the HMI upon pickup of Fail to Open, Fail to Close or Uncommanded Change in State from Open to Closed.

.2 Status of sluice gate is displayed at the HMI.

.6 (Existing) Loop 101E – Wet Well No. 1 Motorized Sluice Gate (MG-5)

.1 Hand switch at the local control panel and HMI allows a user to select Full Open or Full Closed.

.1 When the local control panel Local/Remote switch is placed in LOCAL, local hand operation is permitted.

.2 When the local control panel is Local/Remote switch is placed in REMOTE, HMI hand operation is permitted.

.3 An alarm is generated at the HMI upon pickup of Fail to Open, Fail to Close or Uncommanded Change in State from Open to Closed.

.2 Status of sluice gate is displayed at the HMI.

.7 (Existing) Loop 101F – Wet Well No. 2 Motorized Sluice Gate (MG-6)

.1 Hand switch at the local control panel and HMI allows a user to select Full Open or Full Closed.

.1 When the local control panel Local/Remote switch is placed in LOCAL, local hand operation is permitted.

.2 When the local control panel is Local/Remote switch is placed in REMOTE, HMI hand operation is permitted.

.3 An alarm is generated at the HMI upon pickup of Fail to Open, Fail to Close or Uncommanded Change in State from Open to Closed.

.2 Status of sluice gate is displayed at the HMI.

.8 Loop 102 – Influent Channel 1 Bar Screen

.1 Process Variable (PV): measured differential water level from LE/LIT-102A and LE/LIT-102B.

.2 Control Variable (CV): Control command to screening motor.

.3 Hand switch at the local control panel allows a user to run the bar screen in either Hand or Auto.

.1 Bar screen operation in Hand mode;

.1 The bar screen can be run either in the forward or reverse direction.

.2 Bar screen operation in Auto Mode;

.1 Screen operation is modulated based on fixed timer based operation, where bar screen is incrementally run in the forward position.

.2 Bar screen conveyor and press is modulated based on fixed timer based operation, where conveyor and press is incrementally run in the forward direction.

.3 Bar screen, conveyor and press ON status indicating state mode is displayed at the local control panel and HMI.

.4 Bar screen, conveyor and press running status as FORWARD or REVERSE is displayed at the local control panel.

.5 Bar screen channel PV values are displayed at the HMI

.1 On pickup of the following PV setpoints, an alarm is generated at the HMI:

1. Differential level High;
2. Differential level High/High;
3. Differential level Low;
4. Differential level Low/Low;
5. Fail to start;
6. General fault;
7. Bar screen E-Stop button enabled.

.6 Conveyor run status is displayed at the local control panel and HMI.

.1 On pickup of the following conveyor faults, an alarm is generated at the HMI:

.1 Conveyor general fault;

.2 Conveyor E-Stop button enabled.

.7 Press run status is displayed at the local control panel and HMI.

.1 On pickup of the following press faults, an alarm is generated at the HMI:

.2 Press general fault;

.9 Loop 103 – Influent Channel 2 Bar Screen

.1 Process Variable (PV): measured differential water level from LE/LIT-103A and LE/LIT-103B.

.2 Control Variable (CV): Control command to screening motor

.3 Hand switch at the local control panel allows a user to run the bar screen in either Hand or Auto.

.1 Bar screen operation in Hand mode;

.1 The bar screen can be run either in the forward or reverse direction.

.2 Bar screen operation in Auto Mode;

.1 Screen operation is modulated based on fixed timer based operation, where bar screen is incrementally run in the forward position.

.2 Bar screen conveyor and press is modulated based on fixed timer based operation, where conveyor and press is incrementally run in the forward direction.

.3 Bar screen, conveyor and press ON status indicating state mode is displayed at the local control panel and HMI.

.4 Bar screen, conveyor and press running status as FORWARD or REVERSE is displayed at the local control panel.

.5 Bar screen channel PV values are displayed at the HMI

1. On pickup of the following PV setpoints, an alarm is generated at the HMI:
   .1 Differential level High;
   .2 Differential level High/High;
   .3 Differential level Low;
   .4 Differential level Low/Low;
   .5 Fail to start;
   .6 General fault;
   .7 Bar screen E-Stop button enabled.

.6 Conveyor run status is displayed at the local control panel and HMI.

.1 On pickup of the following conveyor faults, an alarm is generated at the HMI:
1. Conveyor general fault;
2. Conveyor E-Stop button enabled.

.7 Press run status is displayed at the local control panel and HMI.

.1 On pickup of the following press faults, an alarm is generated at the HMI:
1. Press general fault.

.10 Loop 400 – Wet Well No, 1 Effluent Pump Station

.1 User configurable setpoint at the HMI allows a user to adjust the water level setpoint for Auto PID level control as measured from bubbler level controller differential pressure transducer LE/LIT-202:

.1 Units: meters of water depth to the nearest hundredth of a meter and percent as measured from Low Setpoint to High/High setpoint;

.2 Sensing range span from bottom of bubbler tube to overflow: 11.525 metres;

.1 Bottom of bubbler tube from well finish floor: 3.55 metres (elevation 147.75 meters);

.3 Minimum allowable operation setpoint from well finish floor: 4.25 metres (elevation 137 metres);

.4 Maximum allowable operation setpoint from well finish floor: 7.35 meters (elevation 140.1 metres);

.1 Initial Run Level Minimum Setpoint (RLMS) from well finish floor: 4.55 metres (elevation 137.3 meters);
.2 Initial Run Level High Setpoint (RLHS) from well finish floor: 7.25 meters (elevation 140 metres).
.3 Initial Run Level High/High Setpoint (RLHHS) from well finish floor: 7.35 metres (elevation 140.1 meters).

.2 Hand switch at the HMI allows the user to designate the wet well as either IN SERVICE or OUT OF SERVICE.
.1 When the well is placed IN SERVICE, then auto PLC controlled pump mode and manual HMI pump operation modes are enabled.
.2 When Wet Well No. 1 is placed OUT OF SERVICE, then auto PLC controlled pump mode operation modes are disabled for the Wet Well No. 1.
.3 If Wet Well No. 2 is placed out of service then Wet Well No. 1 cannot be placed out of service.

.3 Hand switch at the HMI permits the user to select the PLC controlled pump station operation mode as WET WELL AUTO ROTATE mode, TIMED INTERVAL ROTATE mode, or STATIC AUTO SEQUENCE mode:
.1 Wet Well Auto Rotate mode: When selected as the mode of operation Wet Well No. 1 and Wet Well No. 2 preferred pumping designations are automatically alternated when the current LEAD pump has stopped AND Sluice Gates 5 and 6 are OPEN.
.2 Timed Interval Rotate mode: When selected as the mode of operation Wet Well No. 1 and Wet Well No. 2 preferred pumping designations are automatically alternated when the current LEAD pump has stopped after a pre-determined counter value entered at the HMI by an operator has elapsed AND Sluice Gates 5 and 6 are OPEN.
.3 Static Auto Sequence mode: Wet Well No. 1 pumps operate in a fixed mode auto where pumps for the cell operate independent of the adjacent wet well cell operation.
.4 If Sluice Gate 5 OR 6 is closed:
.1 The PLC inhibits the Wet Well Auto Rotate and Timed Interval Rotate modes
.2 The PLC operates in Static Auto Sequence mode.

.4 Hand switch at the HMI allows a user to select the order that the pumps are sequenced (LEAD, LAG, and STANDBY). Hand switch allows user to choose two methods:
.1 HAND: User manually designates pumps as LEAD, LAG, and STANDBY, and starts or stops pumps manually; or

.2 AUTO: PLC automatically designates LEAD, LAG, and STANDBY pumps. PLC automatically alternates LAG and STANDBY pump designation each time the LAG pump is turned off.
   .1 LEAD pump designation is assigned to the VFD when the VFD is available.
   .2 On pickup of pump fail alarm for LEAD pump or pump fail to respond for LEAD pump, the remaining LAG and STANDBY pumps are designated as LEAD and LAG. Where remaining pumps are assigned as LEAD and LAG, the pumps are alternated at each time the LEAD pump is stopped.
   .3 Where only one pump is available it is automatically designated as LEAD pump.

.5 Pump Discharge Pressure Transmitter (PE/PIT)
   .1 Units: 0.0 kPa to 500.0 kPa
   .2 Display pump discharge pressure at transmitter and at HMI.
   .3 User adjustable setpoint at the HMI allows the user to set HIGH PRESSURE and LOW PRESSURE alarm setpoints.
      .1 Upon pickup of high pump discharge pressure after a pump has been called to start, and after a user selectable time delay indicate HIGH DISCHARGE PRESSURE alarm at HMI.
      .2 Upon pickup of low pump discharge pressure after a pump has been called to start, and after a user selectable time delay indicate LOW DISCHARGE PRESSURE alarm at HMI.

.6 Level control loop uses PID control function to automatically sequence pumps and regulate VFD pump speed to maintain the user-specified level setpoint.
   .1 Process Variable (PV): measured water level from LE/LIT-202.
   .2 Control Variable (CV): pump discharge valve control, pump speed signal to VFDs (84 percent – 100 percent), and respective pump run signal to fixed speed pumps.
   .3 Pump sequencing in level-control mode:
      .1 If no pumps are running and PV is greater than RLMS:
         .1 Transmit CV to LEAD pump primary discharge valve.
         .2 Transmit CV to LEAD pump secondary discharge valve.
         .3 When the pump primary discharge valve is open AND the secondary discharge valve is at least 5 percent open; transmit CV to LEAD pump.

.4 Modulate LEAD pump using PID control function.

.2 If CV to LEAD pump is greater than 99 percent and PV is greater than RLMS:

.1 Transmit CV to LAG pump primary discharge valve.

.2 Transmit CV to LAG pump secondary discharge valve.

.3 When the pump primary discharge valve is open AND the secondary discharge valve is at least 5 percent open; transmit CV to LAG pump.

.3 If CV to LEAD pump is greater than 99 percent and PV is equal to or greater than RLHS:

.1 Transmit CV to STANDBY pump primary discharge valve.

.2 Transmit CV to STANDBY pump secondary discharge valve.

.3 When the pump primary discharge valve is open AND the secondary discharge valve is at least 5 percent open; transmit CV to STANDBY pump.

.4 If PV is less than RLHS and greater than RLMS for 1 minute:

.1 Close STANDBY pump secondary discharge valve.

.2 When the secondary discharge valve is less than 5 percent open; Stop STANDBY pump

.3 Close STANDBY pump primary discharge valve.

.5 If PV is less than RLHS and less than RLMS and PV to LEAD pump is less than 99 percent:

.1 Close LAG pump secondary discharge valve.

.2 When the secondary discharge valve is no more than 5 percent open; Stop LAG pump

.3 Close LAG pump primary discharge valve.

.4 Modulate LEAD pump using PID control function.

.6 If CV to LEAD pump is equal to or less than minimum CV value:

.1 Close LEAD pump secondary discharge valve.

.2 When the secondary discharge valve is no more than 5 percent open; Stop LEAD pump

.3 Close LEAD pump primary discharge valve.

.4 PLC automatically stops corresponding pumps for the following conditions:

.1 Pickup of minimum allowable operation setpoint from either LE/LIT-201 or LE/LIT-202.
.2 Pickup of respective pump sluice gate in closed position.

.5 PLC automatically stops pump and indicates alarm condition at the HMI upon the following conditions:
.1 Low pump seal water pressure: PE/PIT-410, PE/PIT-420, PE/PIT-430.
.2 Pickup of respective primary or secondary discharge valve closure, after respective pump run sequence has completed.
.3 Pickup of fault as indicated by the respective motor controller.
.1 Where a specific fault value is available from the motor controller, that value will be indicated at the HMI and an alarm will be generated.
.2 Where a specific fault value is not available from the motor controller a general motor controller fault will be indicated at the HMI and an alarm will be generated.
.3 Loss of network connection with motor controller.

.6 PLC automatically stops pump, indicates alarm condition at HMI and locks corresponding pump out of auto pump control upon the following conditions:
.1 Pump fault as indicated by motor controller.
.2 Pump discharge valve closed while pump running.
.3 Pump discharge valve placed in local control mode.
.4 On pickup of closed gate indication for corresponding pump sluice gate.

.7 Non-PLC redundant operation mode for pump station is provided by the ultrasonic level transducer LE/LIT-201. Operational mode is intended to provide pump station operation in the event automatic PLC operation is not available.
.1 Units: metres of water depth to the nearest hundredth of a meter;
.2 Sensing range span from well finish floor to overflow: 15.00 metres (elevation 147.75 metres);
.3 Minimum allowable setpoint from well finish floor: 4.15 metres (elevation 136.9 metres);
.4 Maximum allowable setpoint from well finish floor: 7.45 metres (elevation 140.2 metres);
.1 Run Level Minimum Setpoint (RLMS) from well finish floor: 4.55 metres (elevation 137.3 metres);

.2 Run Level High Setpoint (RLHS) from well finish floor: 7.45 metres (elevation 140.10 metres);

.8 Redundant level control loop uses PID control function to automatically sequence pumps to maintain the user-specified level setpoint.

.1 Process Variable (PV): measured water level from LE/LIT-201.

.2 Control Variable (CV): pump discharge valve control and respective pump run signal to pumps.

.3 Pump sequencing in level-control mode:

.1 If no pumps are running and PV is greater than RLMS:

.2 Transmit CV to LEAD pump primary discharge valve.

.3 Transmit CV to LEAD pump secondary discharge valve.

.4 When the pump primary discharge valve is open AND the secondary discharge valve is open; transmit CV to LEAD pump.

.2 If CV to LEAD pump is greater than 99 percent and PV is greater than RLMS:

.1 Transmit CV to LAG pump primary discharge valve.

.2 Transmit CV to LAG pump secondary discharge valve.

.3 When the pump primary discharge valve is open AND the secondary discharge valve is open; transmit CV to LAG pump.

.3 If CV to LEAD pump is greater than 99 percent and PV is equal to or greater than RLHS:

.1 Transmit CV to STANDBY pump primary discharge valve.

.2 Transmit CV to STANDBY pump secondary discharge valve.

.3 When the pump primary discharge valve is open AND the secondary discharge valve is; transmit CV to STANDBY pump.

.4 If PV is less than RLHS and greater than RLMS for 1 minute:

.1 Close STANDBY pump secondary discharge valve.

.2 When the secondary discharge valve is no more than 5 percent open; Stop STANDBY pump

.3 Close STANDBY pump primary discharge valve.

.5 If PV is less than RLHS and less than RLMS and PV to LEAD pump is less than 99 percent:

.1 Close LAG pump secondary discharge valve.
.2 Stop LAG pump.
.3 Close LAG pump primary discharge valve.
.6 If CV to LEAD pump is equal to or less than minimum CV value:
.1 Close LEAD pump secondary discharge valve.
.2 Stop LEAD pump.
.3 Close LEAD pump primary discharge valve.
.4 LE/LIT Controller automatically stops corresponding pumps for the following conditions:
.1 Pickup of minimum allowable operation setpoint.
.5 Pump automatically stops upon the following conditions:
.1 Pump fault as indicated by motor controller.
.2 On pickup of closed gate indication for corresponding pump sluice gate.

.9 Manual Pump Control:
.1 User selectable Hand/Off/Auto control at motor controller location:
.1 Hand/Off/Auto switch status is indicated at the HMI.
.2 If user selects pump AUTO, then pump is controlled by automatic process.
.3 If user selects pump OFF, then pump is locked out in PLC control logic and remaining pumps are re-designated by PLC as LEAD and LAG.
.4 If user selects HAND, then pump is locked out in PLC control logic and remaining pumps are re-designated by PLC as LEAD and LAG.
.1 Pump Control Value (CV) is sent to respective pump upon engaging START push button located at the motor controls.
.2 For VFD manual speed control; speed control is provided at the motor controller for manually setting steady state pump speed.
.3 Pump CV is disabled for respective pump upon engaging STOP push button located at the motor controls or upon actuating either emergency E-STOP button located adjacent to pump and motor location.

.10 Manual Discharge Valve Operation:
.1 User selectable Local/Off/Remote control at discharge valve location:
.1 Local/Off/Remote switch status is indicated at the HMI.

.2 If user selects valve REMOTE, then valve is controlled by automatic process.

.3 If user selects pump OFF, then pump is locked out in PLC control logic and remaining pumps are re-designated by PLC as LEAD and LAG.

.4 If user selects LOCAL, then pump is locked out in PLC control logic and remaining pumps are re-designated by PLC as LEAD and LAG.

.5 Valve Control Value (CV) is sent to respective valve upon engaging OPEN or CLOSE switch located at the valve controls.

.11 On pickup of HIGH/HIGH level (LSHH-400) indicate HIGH/HIGH level alarm at HMI and transmit Control Variable (CV) to LEAD, LAG and STANDBY pumps.

.1 After HIGH/HIGH level (LSHH-400) has been inhibited and after a 2 minute delay; stop sending pump run CV to LEAD, LAG and STANDBY pumps.

.2 Interlock CV with pump failure detection.

.3 Interlock CV with low pump seal water pressure detection.

.12 Flow Meter FE/FIT-440

.1 Calculates total effluent flow and displays values at HMI.

.1 Units:

.1 Instantaneous Flow: 0.00 L/s;

.2 Daily Flow: 0.00 Cubic Metres/day;

.3 Total Cumulative Flow: 0.00 Cubic Meters

.11 Loop 500 – Wet Well No. 2 Pumping Station

.1 User configurable setpoint at the HMI allows a user to adjust the water level setpoint for Auto PID level control as measured from bubbler level controller differential pressure transducer LE/LIT-302:

.1 Units: meters of water depth to the nearest hundredth of a meter and percent as measured from Low Setpoint to High/High setpoint;

.2 Sensing range span from bottom of bubbler tube to overflow: 11.525 metres;

.1 Bottom of bubbler tube from well finish floor: 3.55 metres (elevation 147.75 metres);

.3 Minimum allowable operation setpoint from well finish floor: 4.25 meters (elevation 137 metres);

.4 Maximum allowable operation setpoint from well finish floor: 7.35 meters (elevation 140.1 metres);

.1 Initial Run Level Minimum Setpoint (RLMS) from well finish floor: 4.55 metres (elevation 137.3 metres);

.2 Initial Run Level High Setpoint (RLHS) from well finish floor: 7.25 metres (elevation 140 metres).

.3 Initial Run Level High/High Setpoint (RLHHS) from well finish floor: 7.35 metres (elevation 140.1 meters).

.2 Hand switch at the HMI allows the user to designate the wet well as either IN SERVICE or OUT OF SERVICE.

.1 When the well is placed IN SERVICE, then auto PLC controlled pump mode and manual HMI pump operation modes are enabled.

.2 When Wet Well No. 2 is placed OUT OF SERVICE, then auto PLC controlled pump mode operation modes are disabled for the Wet Well No. 2.

.3 If Wet Well No. 1 is placed out of service then Wet Well No. 2 cannot be placed out of service.

.3 Hand switch at the HMI permits the user to select the PLC controlled pump station operation mode as WET WELL AUTO ROTATE mode, TIMED INTERVAL ROTATE mode, or STATIC AUTO SEQUENCE mode:

.1 Wet Well Auto Rotate mode: When selected as the mode of operation Wet Well No. 1 and Wet Well No. 2 preferred pumping designations are automatically alternated when the current LEAD pump has stopped AND Sluice Gates 5 and 6 are OPEN.

.2 Timed Interval Rotate mode: When selected as the mode of operation Wet Well No. 1 and Wet Well No. 2 preferred pumping designations are automatically alternated when the current LEAD pump has stopped after a pre-determined counter value entered at the HMI by an operator has elapsed AND Sluice Gates 5 and 6 are OPEN.

.3 Static Auto Sequence mode: Wet Well No. 2 pumps operate in a fixed mode auto where pumps for the cell operate independent of the adjacent wet well cell operation.

.4 If Sluice Gate 5 OR 6 is closed:

.1 The PLC inhibits the Wet Well Auto Rotate and Timed Interval Rotate modes

.2 The PLC operates in Static Auto Sequence mode.

.4 Hand switch at the HMI allows a user to select the order that the pumps are sequenced (LEAD, LAG, and STANDBY). Hand switch allows user to choose two methods:

.1 HAND: User manually designates pumps as LEAD, LAG, and STANDBY, and starts or stops pumps manually; or

.2 AUTO: PLC automatically designates LEAD, LAG, and STANDBY pumps. PLC automatically alternates LAG and STANDBY pump designation each time the LAG pump is turned off.

.1 LEAD pump designation is assigned to the VFD when the VFD is available.
.2 On pickup of pump fail alarm for LEAD pump or pump fail to respond for LEAD pump, the remaining LAG and STANDBY pumps are designated as LEAD and LAG. Where remaining pumps are assigned as LEAD and LAG, the pumps are alternated at each time the LEAD pump is stopped.
.3 Where only one pump is available it is automatically designated as LEAD pump.

.5 Pump Discharge Pressure Transmitter (PE/PIT):
.1 Units: 0.0 kPa to 500.0 kPa
.2 Display pump discharge pressure at transmitter and at HMI.
.3 User adjustable setpoint at the HMI allows the user to set HIGH PRESSURE and LOW PRESSURE alarm setpoints.
.1 Upon pickup of high pump discharge pressure after a pump has been called to start, and after a user selectable time delay indicate HIGH DISCHARGE PRESSURE alarm at HMI.
.2 Upon pickup of low pump discharge pressure after a pump has been called to start, and after a user selectable time delay indicate LOW DISCHARGE PRESSURE alarm at HMI.

.6 Level control loop uses PID control function to automatically sequence pumps and regulate VFD pump speed to maintain the user-specified level setpoint.
.1 Process Variable (PV): measured water level from LE/LIT-302.
.2 Control Variable (CV): pump discharge valve control, pump speed signal to VFDs (84 percent – 100 percent), and respective pump run signal to fixed speed pumps.
.3 Pump sequencing in level-control mode:
.1 If no pumps are running and PV is greater than RLMS:
.1 Transmit CV to LEAD pump primary discharge valve.
.2 Transmit CV to LEAD pump secondary discharge valve.
.3 When the pump primary discharge valve is open AND the secondary discharge valve is at least 5 percent open; transmit CV to LEAD pump.
.4 Modulate LEAD pump using PID control function.

.2 If CV to LEAD pump is greater than 99 percent and PV is greater than RLMS:
   .1 Transmit CV to LAG pump primary discharge valve.
   .2 Transmit CV to LAG pump secondary discharge valve.
   .3 When the pump primary discharge valve is open AND the secondary discharge valve is at least 5 percent open; transmit CV to LAG pump.
.3 If CV to LEAD pump is greater than 99 percent and PV is equal to or greater than RLHS:
   .1 Transmit CV to STANDBY pump primary discharge valve.
   .2 Transmit CV to STANDBY pump secondary discharge valve.
   .3 When the pump primary discharge valve is open AND the secondary discharge valve is at least 5 percent open; transmit CV to STANDBY pump.
.4 If PV is less than RLHS and greater than RLMS for 1 minute:
   .1 Close STANDBY pump secondary discharge valve.
   .2 When the secondary discharge valve is no more than 5 percent open; Stop STANDBY pump
   .3 Close STANDBY pump primary discharge valve.
.5 If PV is less than RLHS and less than RLMS and PV to LEAD pump is less than 99 percent:
   .1 Close LAG pump secondary discharge valve.
   .2 When the secondary discharge valve is no more than 5 percent open; Stop LAG pump
   .3 Close LAG pump primary discharge valve.
   .4 Modulate LEAD pump using PID control function.
.6 If CV to LEAD pump is equal to or less than minimum CV value:
   .1 Close LEAD pump secondary discharge valve.
   .2 When the secondary discharge valve is no more than 5 percent open; Stop LEAD pump
   .3 Close LEAD pump primary discharge valve.

.4 PLC automatically stops corresponding pumps for the following conditions:

.1 Pickup of minimum allowable operation setpoint from either LE/LIT-301 or LE/LIT-302.

.5 PLC automatically stops pump and indicates alarm condition at the HMI upon the following conditions:

.1 Low pump seal water pressure: PE/PIT-510, PE/PIT-520, PE/PIT-530.

.2 Pickup of respective primary or secondary discharge valve closure, after respective pump run sequence has completed.

.3 Pickup of fault as indicated by the respective motor controller.

.1 Where a specific fault value is available from the motor controller, that value will be indicated at the HMI and an alarm will be generated.

.2 Where a specific fault value is not available from the motor controller a general motor controller fault will be indicated at the HMI and an alarm will be generated.

.3 Loss of network connection with motor controller.

.6 PLC automatically stops pump, indicates alarm condition at HMI and locks corresponding pump out of auto pump control upon the following conditions:

.1 Pump fault as indicated by motor controller.

.2 Pump discharge valve closed while pump running.

.3 Pump discharge valve placed in local control mode.

.4 On pickup of closed gate indication for corresponding pump sluice gate.

.7 Non-PLC redundant operation mode for pump station is provided by the ultrasonic level transducer LE/LIT-301. Operational mode is intended to provide pump station operation in the event automatic PLC operation is not available.

.1 Units: metres of water depth to the nearest hundredth of a metre;

.2 Sensing range span from well finish floor to overflow: 15.00 metres (elevation 147.75 meters);

.3 Minimum allowable setpoint from well finish floor: 4.15 meters (elevation 136.9 meters);

.4 Maximum allowable setpoint from well finish floor: 7.45 metres (elevation 140.2 meters);

.1 Run Level Minimum Setpoint (RLMS) from well finish floor: 4.55 metres (elevation 137.3 metres);

.2 Run Level High Setpoint (RLHS) from well finish floor: 7.45 metres (elevation 140.10 metres);

.8 Redundant level control loop uses PID control function to automatically sequence pumps to maintain the user-specified level setpoint.
- .1 Process Variable (PV): measured water level from LE/LIT-301.
- .2 Control Variable (CV): pump discharge valve control and respective pump run signal to pumps.
- .3 Pump sequencing in level-control mode:
  - .1 If no pumps are running and PV is greater than RLMS:
    - .1 Transmit CV to LEAD pump primary discharge valve.
    - .2 Transmit CV to LEAD pump secondary discharge valve.
    - .3 When the pump primary discharge valve is open AND the secondary discharge valve is open; transmit CV to LEAD pump.
  - .2 If CV to LEAD pump is greater than 99 percent and PV is greater than RLMS:
    - .1 Transmit CV to LAG pump primary discharge valve.
    - .2 Transmit CV to LAG pump secondary discharge valve.
    - .3 When the pump primary discharge valve is open AND the secondary discharge valve is open; transmit CV to LAG pump.
  - .3 If CV to LEAD pump is greater than 99 percent and PV is equal to or greater than RLHS:
    - .1 Transmit CV to STANDBY pump primary discharge valve.
    - .2 Transmit CV to STANDBY pump secondary discharge valve.
    - .3 When the pump primary discharge valve is open AND the secondary discharge valve is; transmit CV to STANDBY pump.
  - .4 If PV is less than RLHS and greater than RLMS for 1 minute:
    - .1 Close STANDBY pump secondary discharge valve.
    - .2 When the secondary discharge valve is no more than 5 percent open; Stop STANDBY pump
    - .3 Close STANDBY pump primary discharge valve.
  - .5 If PV is less than RLHS and less than RLMS and PV to LEAD pump is less than 99 percent:
    - .1 Close LAG pump secondary discharge valve.
    - .2 Stop LAG pump.

.3 Close LAG pump primary discharge valve.

.6 If CV to LEAD pump is equal to or less than minimum CV value:

.1 Close LEAD pump secondary discharge valve.

.2 Stop LEAD pump.

.3 Close LEAD pump primary discharge valve.

.4 LE/LIT Controller automatically stops corresponding pumps for the following conditions:

.1 Pickup of minimum allowable operation setpoint.

.5 Pump automatically stops upon the following conditions:

.1 Pump fault as indicated by motor controller.

.2 On pickup of closed gate indication for corresponding pump sluice gate.

.9 Manual Pump Control:

.1 User selectable Hand/Off/Auto control at motor controller location:

.1 Hand/Off/Auto switch status is indicated at the HMI.

.2 If user selects pump AUTO, then pump is controlled by automatic process.

.3 If user selects pump OFF, then pump is locked out in PLC control logic and remaining pumps are re-designated by PLC as LEAD and LAG.

.4 If user selects HAND, then pump is locked out in PLC control logic and remaining pumps are re-designated by PLC as LEAD and LAG.

.1 Pump Control Value (CV) is sent to respective pump upon engaging START push button located at the motor controls.

.2 For VFD manual speed control; speed control is provided at the motor controller for manually setting steady state pump speed.

.3 Pump CV is disabled for respective pump upon engaging STOP push button located at the motor controls or upon actuating either emergency E-STOP button located adjacent to pump and motor location.

.10 Manual Discharge Valve Operation:

.1 User selectable Local/Off/Remote control at discharge valve location:

.1 Local/Off/Remote switch status is indicated at the HMI.

.2 If user selects valve REMOTE, then valve is controlled by automatic process.

.3 If user selects pump OFF, then pump is locked out in PLC control logic and remaining pumps are re-designated by PLC as LEAD and LAG.

.4 If user selects LOCAL, then pump is locked out in PLC control logic and remaining pumps are re-designated by PLC as LEAD and LAG.

.1 Valve Control Value (CV) is sent to respective valve upon engaging OPEN or CLOSE switch located at the valve controls.

.11 On pickup of HIGH/HIGH level (LSHH-500) indicate HIGH/HIGH level alarm at HMI and transmit Control Variable (CV) to LEAD, LAG and STANDBY pumps.

.1 After HIGH/HIGH level (LSHH-500) has been inhibited and after a 2 minute delay; stop sending pump run CV to LEAD, LAG and STANDBY pumps.

.2 Interlock CV with pump failure detection.

.3 Interlock CV with low pump seal water pressure detection.

.12 Flow Meter FE/FIT-540

.1 Calculates total effluent flow and displays values at HMI.

.1 Units:

.1 Instantaneous Flow: 0.00 L/s;

.2 Daily Flow: 0.00 Cubic Meters/day;

.3 Total Cumulative Flow: 0.00 Cubic Metres

.12 Loop 400 –Force Main Motorized Valve (MV-13, MV-14, MV-15)

.1 Hand switch at the local control panel and HMI allows a user to select Full Open or Full Closed.

.1 When the local control panel Local/Remote switch is placed in LOCAL, local hand operation is permitted.

.2 When the local control panel is Local/Remote switch is placed in REMOTE, HMI hand operation is permitted.

.3 An alarm is generated at the HMI upon pickup of Fail to Open, Fail to Close or Uncommanded Change in State from Open to Closed.

.2 Status of valve is displayed at the HMI.

.13 Loop 920 – Generator Master Control Panel (CP-GMCP)

.1 Generator Breaker Control

.1 Normal breaker operation is controlled by CP-GMCP PAC.

.2 Utility Breaker Control

.1 Utility breakers are not controllable through the HMI.

.1 Each breakers status is displayed as either ‘closed’, ‘open’ or ‘tripped’.

.2 Upon pickup of either breaker ‘open’ or ‘tripped’ an alarm is generated at the HMI.

.3 Breaker load is indicated at the HMI as amps, kW and kWh.

.4 Breaker voltage is indicated at the HMI.

.2 Utility Service distribution breaker multifunction protection relays indicate status and control breaker trip function.

.1 On pickup of over voltage fault, over frequency fault, or thermal overload fault the respective breaker is tripped open and an alarm is generated at the HMI.

.2 Upon being tripped open, an operator is required to manually reset the breaker locally at the switchgear.

.3 Upon pickup of an open utility breaker AND the opposing utility service is available; the respective switchgear tie breakers are aligned to feed the alternate bus and generators are not called to start.

.4 Upon pickup of an open utility breaker AND the opposing utility service is NOT available; the opposing breaker is issued an open command AND the respective generators are called to start.

.5 Upon a utility breaker being issued a close command, AND the respective tie breakers are closed, AND the utility service is available; the respective tie breakers open to isolate the utility services, and the respective utility breaker is issued a close command.

.6 Generator breakers are controllable through the HMI.

.1 If a generator breaker is commanded to close while the respective generator is NOT running, the breaker will be inhibited from being closed onto the bus.

.2 If a generator breaker is commanded to close while the respective generator is running, the breaker will NOT close IF the respective utility source is normal.

.3 If a generator breaker is commanded to close while the respective generator is running, the breaker will close IF the respective utility source is NOT normal AND the bus is synchronized. Upon being issued a close command, the generator is re-assigned as LEAD, LAG 1 or LAG 2 dependent upon the current generator status, where the respective breaker is given priority. Upon synchronizing and being re-assigned, the breaker will onto the bus.

.4 If the generator breaker is commanded to open without a normal utility source available, the generator will open IF at least two generators are available and synchronized.

.3 Indication Of Loss Of Power

.1 Generator Master Control Panel CP-GMCP monitors for loss of power at utility breakers and upon pickup of loss of utility service OR open utility breaker, CP-GMCP PAC sends 'Loss Of Utility Power' signal to CP-4 PAC indicating loss of power to respective pump station. CP-4 PAC initiates a 'Loss Of Utility Time Delay' for a period of 60 seconds which inhibits the 'Fail To Respond' alarm during this delay period for any pump being called to run and not locked-out.

.2 Upon any generator closing on the bus OR the respective tie breaker closing, a signal is sent to CP-4 PAC that cancels the 'Loss Of Utility Delay' inhibit command and each pumps 'Fail To Respond' alarm is re-enabled.

.3 Upon the 'Loss Of Utility Time Delay' timing out, the 'Fail To Respond' alarm is enabled a 'Generator Fail To Start' alarm is initiated at the HMI.

.4 Pump Run On Loss Of Utility

.1 Each pump is given a 'Load Designation' where each VFD driven pump has a 'Load Designation' value of 1200 and each Soft Start driven pump is given a 'Load Designation' value of 750.

.2 Upon being called to run, the total pump 'Load Designation' is indicated at CP-GMCP, where the total 'Load Designation' called to run is a summed value of all pumps being called to run based on the current wet well level and number of motor controllers currently in the 'Hand' position.

.3 Generator Sequencing; Where the generators are called to run either manually OR automatically, the following basis of operation will determine the total number of generators required:

.1 Where the total summed 'Load Designation' value is equal to OR less than 2,000; 1 generator is called to run.

.2 Where the total summed 'Load Designation' value is greater than 2,000 AND less than 4,000; 2 generators are called to run.

.3 Where the total summed 'Load Designation' value is greater than 4,000; 3 generators are called to run.

.5 Return To Utility Function

.1 Upon restoration of the utility source a 'Utility Source Available' timer is initiated for a period of 15 minutes.

.2 Upon the utility being available and stable for the duration of the 'Utility Source Available' timer, the respective generator momentarily synchronizes with the utility for a 'Closed Transition' to utility at which time the generator is taken offline and the respective utility source is providing power to the respective bus;

.1 The LEAD generator enters a 15 minute cool down period, after which the generator shuts down.
.2 The LAG 1 generator enters a 15 minute cool down period, after which the generator shuts down.
.3 The LAG 2 generator enters a 15 minute cool down period, after which the generator shuts down.
.4 After each subsequent shutdown the generator is designated as available and can restart upon failure of the utility.
.5 After all generators successfully complete the cool down mode and are offline, the LEAD, LAG 1 and LAG 2 designations are automatically alternated.

.6 Indication of Generator Status
.1 Each generators status is displayed at the HMI:
.1 LEAD, LAG 1 and LAG 2 are displayed;
.2 Generator day tank fuel status is displayed as percent of full and total liters.
.3 Generator operational status; Run status as either ‘running’ or ‘stopped’, Temperature, battery voltage, faults, oil pressure, fuel consumption, total run time in hours, generator volts, generator amps, generator kW load, generator local status as either ‘normal’, ‘not in auto’ or ‘e-stop initiated’.
.4 Generators may be re-designated at the HMI as either LEAD, LAG 1, LAG 2 or Out Of Service. If designated as Out Of Service the remaining generators are re-designated as LEAD and LAG 1 and the function is inhibited to prevent more than one generator from being taken Out Of Service at any one time.
.2 Indication of individual breaker status:
.1 Each breakers status is displayed as either ‘closed’, ‘open’ or ‘tripped’.
.2 Upon pickup of either breaker ‘open’ or ‘tripped’ an alarm is generated at the HMI.
.3 Breaker load is indicated at the HMI as amps, kW and kWh.
.4 Breaker voltage is indicated at the HMI.

.7 Distribution Breaker Control
.1 Distribution breakers are controllable through the HMI.
.1 Distribution breakers can be opened or closed thorough the HMI.
.2 Each breakers status is displayed as either ‘closed’, ‘open’ or ‘tripped’.

.3 Upon pickup of either breaker ‘open’ or ‘tripped’ an alarm is generated at the HMI.
.4 Breaker load is indicated at the HMI as amps, kW and kWh.
.5 Breaker voltage is indicated at the HMI.

.2 Pump distribution breaker multifunction protection relays indicate the pump and motors status;
.1 Pump and motor thermal status is displayed at the HMI in degrees Celsius. On pickup of thermal overload condition, the respective pump breaker is tripped open and an alarm is generated at the HMI.
.2 On pickup of a motor phase fault, under voltage fault, over voltage fault, or thermal overload fault the respective pump breaker is tripped open and an alarm is generated at the HMI.
.3 Upon being tripped open, an operator is required to manually reset the breaker locally at the switchgear.

.3 Non-pump distribution breaker multifunction protection relays indicate breaker fault status.
.1 On pickup of over voltage fault, over frequency fault, or thermal overload fault the respective breaker is tripped open and an alarm is generated at the HMI.
.2 Upon being tripped open, an operator is required to manually reset the breaker locally at the switchgear.

.4 Breaker Unit Battery Charger
.1 Breaker unit battery charger status is displayed at the HMI as either ‘Normal’ or ‘Fault’. On pickup of a ‘fault’ indication an alarm is generated at the HMI.

END OF SECTION

PART 1. GENERAL

1.1 Summary

.1 This Section includes:
  .1 Human Machine Interface Terminals for control and visualization of facility-wide process equipment, process oriented machinery/instrumentation, process systems and integrated facility metering and control systems.

.2 Provide hardware, software and programming to enable SCADA based Terminal Server Services to provide access of all SCADA screens from each respective Terminal Services Client.

.3 Provide terminal services client access points at the locations indicated within the Contract Documents as being provided with a panel mounted HMI.

.4 Supply network hardware, interconnections, communication hardware and connections, interface components and all necessary programming for a fully functional system.

.5 Coordinate communication protocols to ensure proper data transfer and compatibility between all connected devices, including but not limited to; instrumentation, modems, radios, connected devices and control panels.

.6 Coordinate with the Region's representative for any modifications to existing programming prior to commencing the Work. Allow for adequate time to access and modify existing systems where required. Maintain operation of existing locations and provide for relocation of existing Human Machine Interface Terminals where required for temporary operation by the Region's operators, where needed to accommodate construction activities, and where the existing Human Machine Interface Terminals are required to be temporarily relocated.

1.2 Related Sections

.1 Division 13 – SCADA and Instrumentation

.2 Division 16 – Electrical

1.3 References

.1 National Fire Protection Agency NFPA 70

.2 UL508 - Industrial Control Equipment

.3 International Electrotechnical Commission (IEC) 61131-2 - Programmable controllers. Equipment requirements and tests

.4 IEC 61000-6-2 - Electromagnetic compatibility

.5 ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems

1.4 Definitions

.1 Data Aggregation: Where data is collected and stored locally, then forwarded to centralized data historian server. Where data is collected from multiple sources, the resulting data is a compilation of multiple data sets.

.2 Human Machine Interface (HMI): Used interchangeably with Visualization Node to describe a fixed operator interface node. An HMI may be a workstation or a panel mounted interface where specified in the Contract Documents or shown on the Contract Drawings.

.3 Node: A network connection point. Examples include a PLC, Engineering Station, Visualization Node, etc.

.4 Operator Interface Terminal (OIT): Used interchangeably with Visualization Node to describe a fixed operator interface node. An HMI may be a workstation or a panel mounted interface where specified or shown.

.5 Remote Terminal Unit (RTU): A remotely connected device that collects data then transmits the data to the SCADA communications network using a common communication protocol. The RTU is used to describe a remote transmitter interface (for example: radio, modem, etc.).

.6 SCADA: Supervisory Control and Data Acquisition. A SCADA System is a group of computers and servers running software dedicated for SCADA purposes. This SCADA software can collect and exchange data over industrial networks with PLCs, device level controllers, and other industrial devices. The SCADA software will allow for control, trending, graphic display, alarm tracking, historical logging of values in a database and reporting of data.

.7 SCADA System Supplier and SCADA Integrator: A Subcontractor that integrates commercially available SCADA software package, and then develops a project-specific application. The Contractor shall ensure that this Subcontractor will supply and install the hardware and software to run the project-specific application.

.8 SCADA System Server: Used to describe a combined data acquisition, system reporting, report generation and system access node.

.9 SCADA System Client: Used interchangeably with Work Station Node, Engineering Station Node and Human Machine Interface (HMI) to describe a system access node.

.10 Store and Forward: Refer to Data Aggregation.

.11 Visualization Node: A computer based terminal that runs a commercially available operating system such as Windows with a commercially available SCADA software suite. The visualization node is used interchangeably with Human Machine Interface

(HMI), Operator Interface Terminals (OIT) and may be capable accepting input devices where specified in the Contract Documents or shown on the Contract Drawings, has communication ports, local data storage, provides a display capable of viewing animations and color images, and capable of viewing text documents. The visualization node shall execute software that allows the operator to:

.1 View system status
.2 Interact with system level devices
.3 Modify control system parameters
.4 Communicate with other devices and services on the network.

1.5 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13452 – Human Machine Interface as indicated in Schedule ‘A’ of the Bid Form.

1.6 Submittals

.1 Product Data:
  .1 Include dimensions, mounting arrangements, and weights. Also include manufacturer's technical data on features, performance, electrical ratings, characteristics, terminal connections, and finishes.

1.7 Quality Assurance

.1 Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated within the Contract Documents, that is a member company of the National Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to the Region.

.2 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 General

.1 Comply with the following general requirements as a minimum.
  .1 Certifications: The Human Machine Interface shall have certifications by CE and CSA.
  .2 Real-time Clock: All Operator Interface Terminals shall have a built-in real-time clock with time and date functions.
  .3 Rating: IP65 (Ingress protection rating)
  .4 Environmental Requirements:

1. HMI Terminals shall be capable of withstanding the following criteria as a minimum.
    1. Relative Humidity: Capable of handling a minimum of non-condensation humidity of 0-95 percent.
    2. Degree of Protection: Front panel rating of IP 65 and conform to IEC 60529.
    3. Shock Resistance: Conform to IEC 60068-2-27; Semi-sinusoidal Pulse for 11ms (millisecond), and 15gn (giganewton) on 3 axes.
    4. Vibration: Conform to IEC 60068-2-6. The Terminal shall be capable of 5-9Hz at 3.5 mm, and 9-150Hz at 1g.
    5. Electrostatic Discharge: Conform to IEC61000-4-2, level 3.
    6. Electromagnetic Interference: The Operator Interface Terminal shall conform to IEC 61000-4-3, 10 V/m.
    7. Electrical Interference: Conform to IEC 61000-4-4, level 3.

.5 Enclosure Heating And Cooling:

1. Product shall be based on a fanless design.
2. Where necessary to provide the intended operation, provide enclosure cooling and heating equipment as necessary to maintain environmental variables to within manufacturer listed temperature and humidity limits.

1.9 <u>Delivery, Storage, and Handling</u>

.1 Deliver in packaging designed to prevent damage from static electricity, and physical damage.

.2 Store in accordance with the manufacturers’ requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage. Also, protect from all forms of electrical and magnetic energy that could cause damage.

1.10 <u>Quality Assurance</u>

.1 Provide instrumentation of rugged construction designed for the Site conditions. Provide only new materials throughout, and so marked or labeled, together with manufacturer’s brand or trademark.

.2 Use single source manufacturer for each instrument type. Use the same manufacturer for different instrument types whenever possible. Instruments shall be purchased through the local authorized distributor/representative located in Ontario.

.3 Instruments shall be commissioned by the manufacturer or the manufacturer's local authorized distributor/representative located in Ontario. Authorized distributor representative shall be factory trained by the manufacturer. Supporting documentation shall be provided if requested.

.4 Coordinate instrumentation to ensure proper interface and system integration. Provide signal processing equipment, to include, but not be limited to, process sensing and measurement, transducers, signal converters, conditioners, transmitters, receivers, surge suppressors, and power supplies.

1.11 Delivery, Storage, and Handling

.1 Provide and securely attach the tag number in accordance with the approved control panel shop drawings and instructions for proper field handling and installation to each instrument prior to packaging.

.2 Package instrumentation to provide protection against shipping damage, dust, moisture and atmospheric contaminants.

.3 Include a shipping label which contains the following information:
  .1 Tag number and description in accordance with the approved control panel shop drawings.
  .2 Instructions for unloading, transporting, storing and handling at the Site.

.4 Unload, transport, store and handle instrumentation at the site. Inspect instrumentation for damage in shipment and return damaged instrumentation to the manufacturer.

.5 Do not store instrumentation out-of-doors. Provide dry, clean, and warm storage facilities.

1.12 Warranty

.1 Refer to the Contract Documents including the General Conditions for warranty requirements. Where additional warranty information is provided in Division 13 – SCADA and Instrumentation, the more stringent terms are to be provided.

.2 The Consultant will arrange and conduct, with the Region and the Contractor, a warranty inspection at the Site prior to the expiration of the warranty period. Any deficiencies or outstanding work identified during this inspection shall be remedied by the contractor forthwith at no cost to the Region.

.3 Contractor is to provide Warranty period in accordance with Division 1 – General Requirements.

.4 System Warranty Overview:

.1 The system warranty shall consist of a full scope, in-place warranty, consistent with the Contract Documents. The warranty duration shall be 24 months beyond the date of Total Performance of the Work.

1.13 Product Protection

.1 Control panel designer shall supply independent line fuses or circuit breakers, and size per the manufacturers' recommendation.

.2 Control panel designer shall ensure that communication signals are properly conditioned and protected from all sources of radiated energy or harmonics.

PART 2. PRODUCTS

2.1 Source Limitations

.1 All HMI terminals shall be from a single manufacturer.

2.2 Terminal Services

.1 Terminal Services Server
- .1 The Terminal Services Server shall run in conjunction with the SCADA/HMI:
  1. The Server shall support a minimum of five (5) terminal services clients.
  2. Terminal Services Server access shall communicate over the local network and enable access of all SCADA navigation, control, reporting, alarming and trending HMI interface elements from each of the respective Terminal Services Clients.

2.3 CP-4 and CP-5 Panel Mount HMI

.1 Configuration: Provide a fully configured, installed and programmed HMI functioning as a Terminal Services client, where the SCADA server functions as the Terminal Services server.

.2 381 mm (15 inch) panel door-mounted touch screen Thin Film Transistor **(**TFT) touch screen interface, each with the following minimum configuration:
1. Thermal Management: Fanless passive cooling
2. Operating Temperature: 0 degrees Celsius to 50 degrees Celsius
3. Power: 24 VDC
4. Networking: TCP/IP Ethernet
5. All required cables for system interface an programming
6. Minimum resolution of 1024 x 768.
7. 8-wire analog resistive touch screen interface.
8. Colour Extended Graphics Array (XGA) TFT screen with 65,536 solid colours.

9. Screen backlighting service life of 50,000 hours of continual usage.
10. The screen shall have varying levels of brightness with a contrast ratio of 500:1.

.2 Communication Ports:
1. RJ-45 port, and an integral 9-way male SUB-D connector, dedicated to serial communications. The 9-way SUB-D connector shall support RS232/RS485 Communications. The Registered Jack - 45 (RJ-45) port shall support RS485 communications.
2. Two USB ports for connection of keyboard and mouse input/navigation devices.

.3 Processor: Intel Corporation; Pentium M, 1.4GHz, 2 mega-bytes cache.
.4 Onboard RAM: 1GB
.5 Installed operating system: Microsoft Corporation, XP Professional.
.6 All necessary cables and connections for system interface
.7 Manufacturer: Advatech America, Model TPC-1570H-P2AE, or approved equal

2.4 <u>CP-GMCP Panel Mount HMI</u>

.1 Configuration: Provide a fully configured, installed and programmed HMI functioning as a Store and Forward node, where HMI screens are stored and managed locally, local data is collected then transmitted to the SCADA server.

.2 381 mm (15 inch) panel door-mounted touch screen TFT (transparent film transistor) touch screen interface, each with the following minimum configuration:
1. Thermal Management: Fan based cooling
2. Operating Temperature: 0 degrees Celsius to 50 degrees Celsius
3. Power: 24VDC
4. Networking: TCP/IP (transmission control protocol/Internet protocol)Ethernet
5. All required cables for system interface an programming
6. Minimum resolution of 1024x768.
7. 8-wire analog resistive touch screen interface.
8. Colour XGA (extended graphics array) TFT screen with 65,536 solid colors.
9. Screen backlighting service life of 50,000 hours of continual usage.
10. The screen shall have varying levels of brightness with a contrast ratio of 500:1.

.2 Communication Ports:
1. RJ-45 port, and an integral 9-way male SUB-D connector, dedicated to serial communications. The

9-way SUB-D connector shall support RS232/RS485 Communications. The RJ-45 port shall support RS485 communications.

2. One USB port for connection of keyboard and mouse input/navigation devices.

.3 Network Configuration: Ethernet TCP/IP
.4 Peripheral Component Interconnect (PCI) Expansion Slot Kit #6189V2PCI15
.5 Processor: ARM, 266 MHz
.6 Onboard RAM: 2GB
.7 40GB Hard Drive
.8 DVD and CD RW Drive
.9 Installed and Configured Operating System: Microsoft XP Professional, with latest service packs
.10 All necessary cables and connections for system interface
.11 Manufacturer: Rockwell Automation Inc., Allen Bradley 6181P-15-TPXPHSS, or approved equal.

PART 3. EXECUTION

3.1 Installation

.1 Where installed on or within an enclosure, fasten as recommended by the manufacturer.

.2 Provide spacing as required by the manufacturer to ensure adequate cooling. Insure that the air surrounding and penetrating the rear and sides has been conditioned to maintain the required temperature and humidity range.

.3 Wiring and cable entering and exiting shall be sized to comply with the manufacturers requirements.

.4 During installation, upper ventilation slots shall be covered to prevent accidental debris entry. However, during normal operation ventilation slots shall not be blocked, or obstructed by any means.

3.2 Identification

.1 Identify components, and wiring according to all applicable codes, standards and as specified with the contract documents.

3.3 Field Quality Control

.1 Field Service: The Contractor shall ensure that the SCADA Integrator will provide a qualified service representative to perform the following:

.1 Inspect HMI Terminal, wiring, components, connections, and equipment installation.
.2 Test and adjust HMI Terminals, components, equipment and software.
.3 Provide in field testing and debugging of equipment including pre-testing of software interface and its

associated application programs as necessary to provide a fully functional system.

.4 Report results in writing.

END SECTION

PART 1. GENERAL

1.1 Summary

.1 This Section includes SCADA software and hardware for control and interface of process and measurement equipment for a fully functional system including, but not limited to:

- .1 Supply control panels, related ancillary components and metering systems.
  1. Coordinate instrumentation requirements in order to ensure proper data transfer and compatibility between all instrumentation, operator interface terminals, Programmable Logic Controllers, control panels and software.
- .2 Integration of all process controls and metering components.
- .3 Supply network hardware, network mounting hardware, network interface hardware, communication interconnections, communication hardware and interface components.
  1. Coordinate communication protocols in order to ensure proper data transfer and compatibility between all connected devices, including but not limited to; instrumentation, operator interface terminals, Programmable Logic Controllers, modems, radios and control panels.
- .4 Supply computer hardware, computer mounting hardware, computer configuration and computer programming.
- .5 Supply all necessary software, software programming, related software communication protocol interface components and graphical design elements.

.2 Testing and commissioning covered under this section includes all connected systems including but not limited to:

- .1 SCADA hardware and software
- .2 Associated communications systems
- .3 Programmable Logic Controllers
- .4 Controllers
- .5 Instrumentation
- .6 Control panel assemblies
- .7 Packaged component systems specified elsewhere in the Contract Documents

1.2 Related Sections

.1 York Region 13420 - HMI Programming Manual (included as an appendix)

.2 York Region 13960 - SCADA Tagging Standard (included as an appendix)

.3 Section 13105 – General Instrumentation Requirements

.4 Section 13390 – Package Control Systems

.5 Section 13400 – Programmable Automation Controllers

.6 Section 13452 – Human Machine Interface

.7 Section 13930 – Instrument And Equipment Testing

.8 Section 13961 – Electrical Controls And Devices

.9 Division 16

1.3 References

.1 ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems

.2 ANSI Y14.1, Y14.2, Y14.3 – Drawing Standards

.3 EN61131-2 - Programmable controllers. Equipment requirements and tests

.4 IEC 61000-6-2 - Electromagnetic Compatibility

.5 IEEE PC37.1/D1.9 – Standard for SCADA and Automation Systems

.6 NFPA 70 (NEC)

.7 National Institute of Standards and Technology (NIST) Pub 800-53 – Recommended Security Controls for Federal Information Systems and Organizations

.8 NIST Pub 800-63-1 – Electronic Authentication Guideline

.9 NIST Pub 800-82 – Guide to Industrial Control System Security

.10 National Institute of Standards and Technology Interagency Report (NISTIR) – Guidelines for Smart Grid Cyber Security

.11 UL508 - Industrial Control Equipment

1.4 Definitions

.1 Application Server: Communicates with external devices to poll and retrieve data from devices. The application server functions as the data source for retrieving and archiving of device data. The application server provides application processing services and communicates with the configuration database and with the historian database.

.2 Automated Voice Alarm Notification: Communications used by the hosting SCADA alarm software to notify personnel via speech, of system alarms using server based modem to client phone communications.

.3 Configuration Database: Database that manages the device configuration data. The configuration database communicates with all nodes to keep them updated on global changes such as security settings, device settings, etc. The configuration database is accessed when the objects within the database are viewed, created, modified, deleted, deployed or uploaded.

.4 Controller: A primary element that functions to provide loop control. Controllers have provisions for a process variable input signal, a control output signal, setpoint adjustment, tuning of the PID control parameters and provide for an interface of the values within the process variables and the setpoints. They are panel mounted programmable logic controllers, which are microprocessor-based systems having provisions for multiple inputs and outputs for both discrete and analog control capability, with the ability for advanced Human Machine Interface.

.5 CPU: Central Processing Unit

.6 Customized: A quantity and variable as determined by the Region or the Consultant.

.7 Data Aggregation: Where data is being retrieved from a remote source, aggregate data is collected and stored at the remote source, then forwarded to a centralized data historian server. Where data is collected from multiple sources, the resulting data set is a compilation of multiple data sets.

.8 Database: Relational database used to store and retrieve data supporting Open Database Connectivity (ODBC) and Structured Query language (SQL).

.9 Dead-time Compensation: A time based offset algorithm derived value used to predicatively control systems that have a delayed feedback process variable.

.10 Domain Controller: A server that is configured to respond to security authentication requests and includes logging, checking permissions and address lookup for the purposes of granting network access based on configured user credentials.

.11 Engineering Station Node: An Engineering Station will execute SCADA configuration software and will allow the operator to interact with SCADA server, view system status, interact with system level devices, modify control system parameters, modify system settings and view system status. The engineering station node may also function as a visualization node.

.12 Ethernet: Communication protocol based on the IEEE 802.3 and 802.1 standards.

.13 Firewall: A hardware appliance which runs embedded software for controlling Ethernet based wide-area network in-bound and out-bound communications, where the appliance functions as a packet filter to control, analyze and block network communications at the packet level, and serves as an application gateway to restrict and allocate network traffic based on configured permissions. The firewall also hosts network antivirus and malware software for the detection and management of malicious software.

.14 Historian Database: Database that stores device data for later retrieval. The historian database receives data from the application server. The historian database is accessed when HMI screens, reports, trending and alarms are viewed, created or modified.

.15 Human Machine Interface (HMI): Used interchangeably with Visualization Node to describe a fixed operator interface node. An HMI may be a workstation or a panel mounted interface where specified or shown.

.16 I/O: Input and/or Output

.17 Integrator: A Subcontractor specializing in the practice of instrumentation and automation system installation and service. The Contractor shall ensure that the SCADA Integrator is responsible for interfacing of control systems, control systems coordination and system integration for all control systems, instrumentation and related components used throughout the Contract.

.18 Internet: System of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to access connected devices for the purpose of accessing and interacting with documents and systems hosted on remote computers.

.19 KVM (Keyboard, Video and Mouse) Switch: A hardware device that allows a user to control multiple computers from a single keyboard, video monitor and mouse and that acts to digitally switch between the attached computers. Although multiple computers are connected to the KVM, only one attached computer is controlled at any given time.

.20 LAN: Local Area Network

.21 Node: A network connection point. Examples include a PLC, Engineering Station, Visualization Node, etc.

.22 ODBC: Open Database Connectivity

.23 Operator Interface Terminal (OIT): Used interchangeably with Visualization Node to describe a fixed operator interface node. An HMI may be a workstation or a panel mounted interface where specified in the Contract Documents or shown on the Contract Drawings.

.24 PID: Control action, Proportional-Integral-Derivative. Control feed-back or feed-forward algorithm used as a mechanism to tune a system for intended operation.

.1 Proportional determines the reaction to the error.

.2 Integral determines the reaction based on the sum of the errors.

.3 Derivative determines the reaction to the rate at which the rate has been changing.

.25 P&ID: Process and Instrumentation Diagram. Used to describe process and control action.

.26 PLC: Programmable Logic Controller.

.27 Rack Unit (U): Unit of measure (for example 1U, 2U, etc) used to describe the height of equipment intended to be mounted in a rack enclosure. 1U represents 1.75 inches in height.

.28 Redundancy: Redundant configurations of systems and equipment are referred to using mathematical formulas based on the parameter “N”, such as; “N + 1” or “2N”. In this convention, N is the number of systems or pieces of equipment which must be operational to accomplish normal operation of the system.

.1 N + X redundancy refers to a system configuration in which the total number of units provided is equal to the number needed to meet the load, N, plus some number of operationally redundant units, X. For example, if a system requires 1 PLC to normally function and another for hot standby, the system would be described as N + 1, where N = 1.

.2 XN redundancy refers to a system configuration in which the total number of units provided is some multiple, X, of the number required to meet the load. For example, if a system requires 1 PLC to normally function and another is provided for hot standby, it would be described as 2N, where N = 1.

.29 Remote Terminal Unit (RTU): A remotely connected device that collects data then transmits the data to the SCADA communications network using a common communication protocol. RTU is used to describe a remote transmitter interface (for example radio, modem, etc.).

.30 SCADA: Supervisory Control and Data Acquisition. A SCADA System is a group of computers and servers running software dedicated for SCADA purposes. This SCADA software collects and exchanges data over industrial networks with PLCs, device level controllers, and all other connected or networked devices. The SCADA software will allow for control, trending, graphic display, alarming, alarm tracking, historical logging of values in a database and reporting of collected data.

.31 SCADA System Server: Used to describe a combined data acquisition, system reporting, report generation and system access node.

.32 SCADA System Client: Used interchangeably with Work Station Node, Engineering Station Node and Human Machine Interface (HMI) to describe a system access node.

.33 SCADA System Supplier and SCADA Integrator: A company that integrates commercially available SCADA software package, and then develops a project-specific application. This company will supply and install the hardware and software to run the project-specific application.

.34 Short Messaging Service (SMS): A communications protocol that facilitates the transmission of short messages between the Application Server and cellular telephones.

.35 SMTP: Simple Mail Transfer Protocol for electronic mail transmission across internet protocol networks, as defined by the Internet Engineering Task Force (IETF).

.36 SQL: Structured Query Language.

.37 Store and Forward: Refer to Data Aggregation.

.38 Tag: Device and/or data block representations.

.39 Visualization Node: A computer based terminal that runs a commercially available operating system such as Microsoft Windows with a commercially available SCADA software suite for retrieving system values, setting system setpoint values and capable of storing data locally. The visualization node is used interchangeably with Human Machine Interface (HMI), Operator Interface Terminals (OIT) and may be capable accepting input devices where specified in the Contract Documents or shown on the Contract Drawings, has communication ports, local data storage, provides a display capable of viewing animations and colour images, and capable of viewing text documents. The visualization node shall execute software and allow the operator to:

  .1 View system status
  .2 View and modify system alarms
  .3 View reports
  .4 Interact with system level devices
  .5 Control system level devices
  .6 Modify control system parameters
  .7 Communicate with other devices and services on the network.
  .8 Access equipment data sheets

.40 WAN: Wide Area Network

.41 Web: See Internet.

.42 Workstation Node: Used interchangeably with Visualization Node to describe a fixed operator interface node for retrieving, setting and viewing connected devices and their associated settings, and to view reports and system objects. A Workstation Node is usually a user workstation.

1.5 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13453 – SCADA Software and Hardware as indicated in Schedule 'A' of the Bid Form.

.2 The work outlined in sections 1.7.2.1, 1.8.5 and 1.8.6 in relation to modification of the existing SCADA system programming nomenclature shall be included in the unit price for Section 13453 – Provide additional tagging of SCADA I/O points as indicated in Part B of Schedule 'A of the Bid Form.

1.6 Submittals

.1 General Requirements
- .1 The Contractor shall be responsible for the accuracy and completeness of all aspects of the SCADA submittal, including but not limited to SCADA software and applicable hardware. Provide all documents in Adobe Acrobat format on compact disc and loaded at SCADA server for centralized access from HMI locations.
- .2 The Contractor shall not begin construction of SCADA related components or systems until all SCADA submittals are approved by the Region.
- .3 Within thirty (30) Days of the notice to commence, submit SCADA Integrator qualifications.
- .4 Within ninety (90) Days of the notice to commence, submit:
  1. Hardware Product Information Submittal
  2. UPS Load Calculation Submittal
  3. Software Product Information Submittal
  4. Interconnection Diagrams
  5. Functional Network Documentation Submittal
  6. Functional Software Design Submittal
  7. System Documentation Submittal
- .5 All associated diagrams and drawings shall be provided in a standard 11"x17" format at a scale that is readily legible and prepared in accordance with ANSI standards.

.2 Hardware Product Information Submittal:
- .1 The Contractor shall submit for review Product information for all equipment, software and material specified in this section, including all ancillary components not provided elsewhere and intended to support specified systems.

.3 Power Distribution Submittal: Prepare a summary of all SCADA hardware power requirements and provide load calculations that will be used for determining Uninterruptible Power Supply (UPS) load run times.

.4 Software Product Information Submittal:
- .1 The software documentation shall provide a comprehensive description of all software, necessary for

the operation and maintenance of the system. Software documentation shall be furnished for each item of software and program in the system, and shall indicate release version and all features provided.

.2 Warranty information shall be supplied for each software or program in the System.

.3 Manufacturer support information, including duration and outline of support being provided.

.4 Software License information shall be submitted for each software or program in the system, indicating the number of licenses provided for each type of program or software and any annual fees due to maintain licenses.

.5 Information as needed to verify that submitted software meets the design intent and to document all features related to software.

1. Submit tabulated reference data indicating all software functions.

.5 System Layout Drawings:

.1 Provide Site plans and floor plans indicating location of all control panels, RTU's, antennas and major pieces of equipment related to the SCADA system.

.6 Interconnection Diagrams:

.1 Interconnection diagrams shall show the external wiring between terminals of associated equipment, control panels, connected equipment, terminal boxes and any other device, panel, or enclosure. Interconnection diagrams shall clearly depict all cable tags. Cable tagging shall conform to the standards specified in the Contract Documents.

.2 Show interconnection diagrams as standard riser diagram / topology format and include communication protocols used, wiring and conduit callouts, equipment designations and related information to describe all system interconnections.

.7 Functional Network Design Document:

.1 Provide a functional network design document indicating the following:

1. A complete network system diagram showing the interconnections between hardware subsystems. This shall include network cabling, wireless nodes and all network devices
2. Tabulated list of all major system components. This includes existing panels and panels not supplied by the SCADA system supplier.
3. Assign each component a unique device identifier. Include protocol addresses.
4. Label of all components on block diagrams.

5. Clearly indicate physical locations for all major system components on a scaled floor and site plan, where not indicated on contract drawings.

.8 Functional Software Design Document (FSDD):

.1 The FSDD shall show the top-level design of the proposed software in a concise manner. The complete description of support, interface, diagnostic, and general I/O software shall also be included. An inventory of major software packages, including third party, provided shall be included. The FSDD shall include a description of the historical data collection subsystem, including table usage and data storage rates. The document shall include, but not be limited to:

1. Polling Process, including anticipated scan rates.
2. Hard Drive Storage space required to log every tag value, indicating anticipated capacity in months of operation in the format indicated in table 1A. Provide totalized values for review and verification of storage space.

Table 1A – Sample Hard Drive Capacity Calculation Format

Data Point Description	Data Row Length (bytes)	Samples Per Second	Samples Per Hour	Samples Per Month	Data Retention (Months)	Disk Space Needed (GB)
Equipment xx.x	32	0	60	43200	84	0.108

.9 Operation and Maintenance (O&M) Manuals:

.1 Supply O&M manuals for all equipment and software provided.

.2 The manuals shall be developed for a system operator audience.

.3 The manuals shall detail preventive and restorative procedures required to keep the equipment in good operating condition and provide step-by-step procedures for data backup and re-imaging.

.4 Manuals for OEM equipment shall contain original printed materials, not copies, and shall be in the manufacturer's original format.

.5 Complete O&M manual shall be provided on compact disc and in Adobe Acrobat (.pdf) format with tabbed data.

.10 Instruction Manual:

.1 The manual shall contain a detailed analysis of each major component so that maintenance personnel can effectively service, troubleshoot, and repair the equipment. Each manual shall include a Table of Contents, and shall be divided into the following sections:

1. Introduction: The purpose of the manual, special tools and equipment, and safety precautions.
2. General Information and Specifications: A general description of each equipment item, and its specifications.
3. Listings: Include contact information for each product provider, recommended maintenance provider, and local source for replacement parts.
4. Theory of Operation: Explain the relationship of all equipment to each other, and its purpose in the overall SCADA network.
5. Software: Listing and explanatory text for any software or firmware.
6. Operation Procedures: The locations and functional descriptions of all controller indicators, or displays.
7. Troubleshooting: A tabular list of all symptoms, probable causes of malfunction or improper operation, and potential remedies to each specific malfunction, down to field replaceable components.
8. Preventive Maintenance Instructions:
    1. These instructions shall include all applicable visual examinations, hardware testing, diagnostic hardware/software routines and data backup and retrieval instructions. Instructions on how to load and use any test and diagnostic programs and any special or standard test equipment shall be an integral part of these procedures.
9. Complete instruction manual shall be provided on compact disc and in Adobe Acrobat (.pdf) format.

.11 System Operator’s Manuals:

.1 The System Operator's Manuals shall describe the configuration and all functions for the systems and equipment provided.

.2 Functional descriptions shall include algorithms necessary to fully understand the functions.

.3 The manuals shall be organized for quick access to each detailed description of the operator's procedure.

.4 The manuals shall be limited only to description of procedures for functions that are performed by the operator.

.5 The System Operator's Manuals shall serve as a complete instruction to the system and equipment and shall describe in detail the operator interfaces and operator procedures. In addition to the Operator interaction sequences, the following shall be provided in a matrix format:

1. Summary description of all major functions
2. Description of data on displays.

3. Description of how the system and equipment react to situations such as heavy alarming, loss of communication links, heavy operator interaction, and loss of power and restoration of power.
4. Description of all programmed messages and alarms that the system is programmed to output, with an explanation of what the message indicates and what action the system operator should take. Provide descriptions in tabulated format.

.12 System Administrator Guide:

.1 The System Administrator Guide shall be a user's manual for all the corresponding systems programs. It shall include information on system restoration from file backups, starting and bootstrapping the system, editing and expansion techniques (including display/report compiler, database, and applications edit), batch mode operation of software utilities, and troubleshooting to be used in conjunction with the system dumps, error and abort messages.

.2 Security settings for all installed systems, components, including all related network access settings. Identify specific network accessed software and hardware ports used, blocked or disabled along with the ports identification, purpose and setting for all used ports.

.3 Instructions with all administrative passwords shall be provided for each of the peripherals and for all Software provided.

.13 Software Support Materials

1. Program Media:
   1. Furnish complete sets of program media documentation. These documents shall include source of all programs written specifically for the proposed system, including RTU and PLC programs, HMI scripting related applications and programmed objects of all programs necessary for the operation and maintenance of the systems programs.
   2. If any changes are made to programs during system testing and acceptance, provide within 10 Days, corrected copies of source, object and system media.
   3. Provide all documentation in digital format.
2. Programmer Manual:
   1. The purpose of this manual will be to enable systems and applications programmers, to maintain, modify, and expand the capacity and functionality of the system. This manual

shall comprise the standard manuals furnished by the computer system manufacturer covering the Operating System, Utilities, and Diagnostics, and High Level Language(s) supplied, together with furnished manuals that are specific to the system. The manual shall include descriptions of the procedures to be used for:

.1 Default system level access logins and passwords.

.2 Modifying and expanding the system databases and testing revised versions.

.3 Defining, linking to the database, and testing revised and new displays, logs, reports, data acquisition, process control, and data processing procedures including the addition of communication links, RTUs, PLCs, and input/output points.

.4 System operational troubleshooting including error descriptions.

.5 Instructions for configuring and rebuilding servers and workstations as if starting a new system, as well as rebuilding from backups (this will apply to peripherals applicable to the system as a whole, including network items).

.6 Provide effective procedures/techniques for creating, expanding, and editing SCADA and PLC applications. Include useful backup procedures required for system recovery.

3. System Configuration Inventory List:

1. An inventory list shall be furnished for all Contract material, software, software serial numbers, documentation, spare parts, and test equipment. Hardware identification of each unique module by serial number and each unique software module shall be included on the list. The inventory list shall

include, but not be limited to, the following information:

.1 Manufacturer's name, part number, and serial number.

.2 Quantity of units supplied with the deliverable System/subsystem.

.3 Software modules supplied.

.4 Operating system software provided for all CPUs/microprocessors.

.5 Operating systems enhancements and upgrades applied and provided during the installation.

.6 System documentation supplied.

2. The inventory list shall be subdivided by hardware, software, test equipment, spares, documentation, and training courses. Each of these major divisions shall be further subdivided to the individual deliverable item level. Each item must be defined in sufficient detail to permit identification in shipping documents and inventory checks. The organization of the inventory list shall include provision for annotating each item with forecast and actual dates for:

.1 Review (Documentation)

.2 Shipping and Delivery (All items Except Documentation)

.3 System Testing (Hardware and Software)

.4 Site Demonstration Tests (Hardware and Software)

.5 Final Acceptance (Spares, Documentation, etc.)

.6 Delivery (Training Courses)

.14 Binders and Electronic Copies:

.1 Each manual shall be bound in 8 1/2" x 11 inch 3-ring side binders with commercial quality hardback, cleanable plastic covers. Final versions of the manuals shall also be provided as separate Adobe Acrobat pdf files on CD-ROM. The manuals shall be subdivided with permanent page dividers with tab titling clearly printed under reinforced laminated plastic tabs. Each volume shall have a Table of

Contents, with each product or system description identified.

.15 Testing Documentation Submittals:

.1 Thirty (30) Days prior to testing, submit Site Acceptance Test (SAT) plan. Prepare and submit for review a SAT plan that includes contact information, planned dates, step-by-step functional testing procedures and special considerations. The plan shall comprehensively identify all systems being tested and list each testing procedure in detail with the expected outcome.

1. Format of plan shall be tabulated and at a minimum include the following information:
    1. Title, including commissioning description and date.
    2. Test number in ascending order.
    3. Completion check off box.
    4. Description of test.
    5. Completion notes indicating what is being checked and expected result.
    6. Space for field notes.
    7. Space for signature indicating testing has been completed.

.2 Test Reports: Upon completion of commissioning tests, prepare and submit for review a complete test report indicating results of system commissioning, deficiencies, corrective measures and recommendations.

.16 Training Submittals:

.1 Proposed Training Outline; outline proposed subjects and any special requirements for training (for example: facilities, hardware, etc.). Include proposed dates and times of training.

1.7 System Description

.1 System Topology

.1 Client-Server Network consisting of:

1. Application Server
2. Configuration Database
3. Historian Database
4. Engineering Station Node
5. Visualization Node (HMI’s, OIT’s, etc.)
6. Connected system devices (PLC’s, instrumentation, RTU’s, etc.)
7. Automated Alarm Notification

.2 SCADA System Server

.1 The SCADA Server hardware and software is existing and shall have the software programming modified and augmented to incorporate new systems, remove references to systems being removed and modify all system references, such that the programming nomenclature ‘tags’ that are used are consistent with York Region 13960 - SCADA Tagging Standard included as an appendix..

.2 General Requirements: The SCADA System Server shall interface to all connected and remotely accessed devices, PLC’s, RTU’s and HMI’s as outlined within the Contract Documents. SCADA Server access includes off Site interface from various York Region facilities, where data is polled and aggregated off Site.

.3 All data points residing on PLC’s, RTU’s and connected devices shall be made available to the SCADA Server and archived on the server where values change. Provisions shall be made to adjust the sampling frequency and sampling type based on individual data points. Point monitoring requirements shall be coordinated by the Contractor during the submittal phase.

.4 SCADA System Server Software Requirements:

1. The server shall have all related software loaded and configured for a complete and functional system.
2. All work associated with SCADA Server programming shall be coordinated to mitigate any unplanned operation disruptions to the pumping station.

.3 SCADA System Client

.1 General Requirements: The SCADA System Client shall interface via radio and networked connections directly or indirectly to networked devices, RTU’s, PLC’s as outlined within the Contract Documents. The SCADA System Client shall gather and display available SCADA data and reports, and enable modification of data points. All data points including setpoints and control points shall reside at the respective PLC or specified controller.

.2 SCADA System Client Software Requirements:

1. The SCADA System Client shall have all required software loaded and configured for a complete and functional system.

.3 The following software components shall be available on the SCADA System Client:

1. Graphic Displays (Engineering Station Node and Visualization Node)
2. Alarm Displays (Engineering Station Node and Visualization Node)
3. Trend Displays (Engineering Station Node and Visualization Node)

4. Development Environment (Engineering Station Node)
5. Graphic Builder (Engineering Station Node)
6. Equipment and system documentation, including O&M manuals (Engineering Station Node and Visualization Node)

.4 Store And Forward Client

.1 A Store and Forward Client shall reside at the Generator Master Control Panel CP-GMCP, where CP-GMCP shall interface with the local PLC's and devices for the purpose collecting data and forwarding the aggregated data when polled by the SCADA server.

1. Local storage for the CP-GMCP location shall be accomplished using a local historian database.
2. The client shall be able to store a minimum of one-hundred-sixty-eight (168) hours of local pump station data, where the maximum available site data throughput is used to calculate required data retention capacity.

.2 All local client navigation screens, runtime configurations, security configurations, setpoints, tags, tag values, etc. shall reside on the client and shall be fully accessible from the SCADA system server for reading and writing values.

.3 Client shall be configured to function in a stand-alone capacity, where functionality is not limited or hindered in any way if the store and forward client is disconnected from the SCADA network.

.4 Indication shall be provided at Visualization Nodes indicating the status of the Store and Forward Client, including SCADA server status and Store and Forward Client aggregated data as a percent of capacity.

1.8 <u>SCADA Software</u>

.1 General

.1 Description: The SCADA software package shall be part of a complete SCADA system. This system shall include all required programming, required design effort, network configuration and interconnection hardware.

.2 Make all necessary adjustments to the proposed design as directed by the Region to provide a fully functional system.

.3 Where instructed by the Region; replace installed software, replace hardware and revise navigation design to meet design intent.

.4 Core SCADA Functionality: All core SCADA functionality offered, such as communications drivers, graphics capabilities, reporting, historical storage, trend and alarm displays and the development environment shall be provided as a single integrated software package or suite of packages designed and listed by the manufacturer as compatible with each installed software component. The software shall be designed with the ability to make changes to the system while the system is running. Shutting down the system for required system modifications shall not be acceptable.

.5 The following software and associated programming shall be supplied to augment, or replace functionality of the software package:

1. Additional tag insertions and modifications to existing SCADA software.
2. Additional Operator and HMI Pages including; Graphics, I/O representation and report generation.
3. Modify existing software for alarm annunciation of connected devices and for correcting existing programming nomenclature.

.6 Where re-using the existing SCADA software, the following software and associated programming shall be supplied to augment, or replace functionality of the software package:

1. Where required, reconfigure page layout and design to be compliant with these Specifications.
2. Additional tag insertions and tag modifications to existing SCADA software.
3. Additional Operator and HMI Pages including; Graphics, I/O representation and report generation.
4. Modify existing software for alarm annunciation of connected devices.
5. Communication software for remote and off Site notification of alarms.
6. Database storage type and capacity to meet requirements specified in the Contract Documents.

.7 Configured Graphics Pages: Provide customized graphic pages to be used at the SCADA System Server and SCADA System clients to access devices. Graphic pages shall be developed that mimic the actual system, including all devices, displays and status of controlled components and system.

1. Graphic pages providing setpoint interface and user control functions shall be provided for control and configuration of all devices, configuration inputs and associated functional control, and shall be provided in addition to the customized graphic pages specified in the Contract Documents.
2. The Contractor shall provide adequate allowance to provide fully customized graphic based navigation screens as specified in the Contract Documents and as needed to meet the design intent.

3. Where instructed by the Region, the Contractor shall make all necessary corrections and adjustments to the provided graphic pages.

.8 Alarms: Provided with device level alarming for each tag and derived variable and customized general alarm pages to be used at the SCADA System Server and SCADA System clients to access devices.

.9 Trends: The Region shall be provided with customizable trends tables indicating trends by selectable device and tag. Values shall be scaled per device and quantity measured, with date and time range selection.

.10 Configure system to log all tags and derived values for alarming, trending and historical archiving.

.11 Historical Reporting: The Region shall be provided with custom historical reports. The reports shall at a minimum provide:

1. User selectable device
2. User selectable device value
3. Device specific identification
4. Min/max values
5. Totals
6. Automatic report generation with user selectable reporting frequency (weekly, monthly, daily, specific dates, etc.)
7. Output to Microsoft Excel spreadsheet

.12 HMI and Report Development

1. The Contractor shall coordinate with the Region for specific HMI design requirements prior to commencing work.
2. The Contractor shall provide a fifty (50) percent, seventy-five (75) percent and one-hundred (100) percent design meetings to review initial HMI design, report design, Region requirements for HMI, operational requirements and general HMI screen design elements required.
    1. Initial fifty (50) percent design meeting shall occur after successful submission of submittals and within ninety (90) Days of notice to commence.
    2. Intermediate seventy-five (75) percent design meeting shall occur within sixty (90) Days of the initial fifty (50) percent deign meeting.
    3. Final one-hundred (100) percent design meeting shall occur within sixty (90) days of the intermediate seventy-five (75) percent design meeting.
3. The Contractor shall submit copies of developed Graphic Pages, Alarm Pages, Reports and

Trending Pages for approval after completing the final design, and prior to commencing Site Acceptance Test (SAT).

.2 Connectivity

.1 Description: The SCADA software shall employ an I/O client to manage the reading and writing all data from PLCs, RTUs, and system components. The I/O client shall provide the data on request to the data historian and any SCADA System Client in the network.

.2 Requirements: The Contractor shall modify the existing systems as necessary to interface with new and relocated systems for proper function.

.3 Microsoft Windows Terminal Server Support

1. In addition to the client/server networking, the system shall support the user of Microsoft Terminal Server. The user shall be able to have multiple configurations (view-only or view and configure) without the need to purchase or install separate configurations. A configuration management tool shall be provided to map remote users with appropriate SCADA/HMI applications to launch.

.4 Terminal Services Server

1. The Terminal Services Server shall be available in two forms, running in conjunction with the SCADA/HMI or running as a separate component from the SCADA/HMI:
    1. Where used in conjunction with the SCADA/HMI software to enable HMI functions, the Server shall support a minimum of ten (10) remote clients.
    2. Where operating separate from the SCADA/HMI software to access various computer systems located throughout the SCADA system, the server shall be capable of up to twenty-five (25) remote clients.
2. Terminal Services Server access shall employ secure password protection. The Contractor shall coordinate all off Site access with the Region prior to remotely accessing systems.

.3 Database

.1 All data including, but not limited to device configuration, setpoints, device values, device measurements, alarms, logging info, etc. shall be managed and accessed by system interfaces and reports using a common system database.

.2 A time stamp shall be included with every alarm, login, action, message and tag value change recorded. This time stamp shall indicate the time and date that the alarm, message, login, action or tag was generated. Time stamping shall be provided by the database computer time.

.3 The database builder program shall also be able to export the current tag listing for modification by the external program.

.4 The development of the database tags shall be completely independent of the creation of graphics displays.

.5 The software package shall also allow for database configuration verification. This task will allow for verification of configuration errors on a local database or a database on another node. Errors shall be reported in a dialog box and a user must be able to make the corrections from this dialog box.

.4 Tag Attributes shall be developed using the York Region SCADA Tagging Standard - Section 13960 included as an appendix.

.5 SCADA Communications

.1 Description: The SCADA software shall be configured to communicate with all PLCs, HMI's, remote I/O devices and other devices within the network.

.2 Communication failure at any node shall not render that node or any attached nodes inoperable. Each node shall function independently using a locally stored program.

.3 General communication capabilities: The system shall be configured with the following communications capabilities:

1. Diagnostic alarms shall be provided with the system that will automatically notify the operator of the failure of any communications path both locally and remotely.
2. A package of communication software drivers shall include the following as a minimum:
   1. Ethernet/IP Driver
   2. Modbus Driver

.4 Communication re-establishment

1. Upon re-establishment of communications after a failure all historical alarm, event and trend data archived by the remote field device shall be automatically backfilled into the SCADA System Server and Client alarm files.

.5 Communication Diagnostics

1. The system will provide a diagnostic screen that operates online within the HMI that monitors message rates from the communication program to the connected field devices, with an interface 'button' to initiate a request for communications (device "ping") to manually initiate communications link testing.

2. The diagnostic screen will display the number of new messages, retries, time-outs, and any occurrences of error.
3. Where the device communication fails after an adjustable time-out period, a communications loss alarm shall be logged and alarmed.

.6 Security

.1 Description: Security features shall be fully integrated and configured to permit and restrict users based on configured security level access to hardware and software residing on programmable or network configurable system devices including, but not limited to:
1. SCADA Server
2. SCADA Engineering Workstation and HMI’s
3. PLC’s
4. Radio Transceivers

.2 Where devices bridge or connect to a secured system, a configurable secure bridge or acceptable configurable bridge protocol shall be used to pass user credentials to the primary system (for example domain controller on primary system interfacing with bridged or connected system).

.3 At a minimum, the SCADA software shall have the following security capabilities:
1. Encrypted passwords that are verified at each node, interface and at the server.
    1. Encrypted passwords shall be stored within the application server settings database.
2. Passwords shall be hidden in both the configuration and runtime environments to ensure that personnel cannot access another account without authorization.

.4 Operator Action Tracking: Monitoring and logging of each Operator action shall be enabled.
1. Action Tracking shall include all operator control actions where inputs or outputs are forced, modifications are made to the system, alarm acknowledgements, system log-in/ log-out activities and when the system is stopped or started.
2. The sequence of actions shall be viewable within a date range or selected device and made available through an external open file format (for example txt, csv, xls, etc) for analysis.

.5 Log-Out Function: Automatically log out a user after an adjustable time period. Logging out a user will only cause the system to revert to a view only security status. Logging out will not shutdown any node or interface.

.6 A minimum of five (5) privilege levels shall be available for administering user access privileges. The software shall verify that a user has access to all tasks for his privilege level prior to performing any function. If the user does not have the correct privilege for a task a message will indicate insufficient privilege and log the attempt at the SCADA System Server. Preliminary security access privilege levels shall include:

1. Administrator (Full configuration and system access)
2. Manager (User account admin, system account admin, System User Level 1 – Full Operational Control)
3. Operator 1 (System User Level 1 – Full Operational Control)
4. Operator 2 (System User Level 2 – Irrigation System Control Only)
5. Public (System User Level 3 – View Only Mode)

.7 Provide graphical objects for each programmatically accessible item and each plant area with the ready means available to define the privilege level, define whether operator input is enabled or disabled, and if the object will be visible or not based on the operator's current privilege levels within the plant area.

1. Provide a mechanism to restrict access to different areas of the plant based individual user or defined user groups.

.7 Graphical Displays shall be developed using the guidelines found in the Section 13420 - HMI Programming Manual included as an appendix.

1.9 Quality Assurance

.1 Electrical Components, Devices, and Accessories

.1 Listed and labeled by a recognized testing agency and listed by the manufacturer for intended use.

.2 SCADA System Availability Requirements

.1 A fundamental objective of the SCADA System Supplier's proposed system design shall be to ensure that no single equipment failure or temporary error condition can disable the systems overall operation or generate any spurious control commands to the system equipment. This requirement is not intended to specify a hot backup installation, but to provide a modular system that when a site is in error or has failed; will not disrupt the whole of the SCADA system or prevent another site or terminal at another site within the SCADA system from functioning as designed.

.3 Single Point of Failure

.1 The SCADA equipment configuration shall prevent any single hardware or software failure from causing loss of any system function or from causing overall system malfunction. Single hardware failures may cause loss of specific communication channels temporarily until failed equipment is replaced. This requirement is not intended to specify a hot backup installation, but to provide a modular system so that when a component is in error or has failed, it will not disrupt the whole of the SCADA system or prevent the site from functioning as designed in manual mode.

.4 Programmatic Operational Checks

.1 The SCADA System Supplier's proposed system shall continually poll each component in the system for operation, alarm I/O, and report the malfunction. Upon detecting a malfunction, the failed operation shall be attempted a number of times (programmable) in order to determine whether the malfunction is temporary or permanent. Permanent malfunctions shall be alarmed and logged. Temporary malfunctions shall be logged for maintenance purposes. Communication delays shall not be logged as a device specific alarm.

.5 System Availability

.1 During the System Availability Demonstration, the SCADA system shall achieve an average availability rate for all functions of at least 99.95 percent. This is equivalent to a total downtime of approximately 4 hours per year for the system.

1.10 <u>Delivery, Storage, and Handling</u>

.1 Store SCADA software in a secured location and in binders. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. Protect SCADA software from theft, loss, exposure to dirt, fumes, water, corrosive substances and physical damage. The Contractor shall deliver all documents and hardware to the Region as part of the Contract close-out procedures.

1.11 <u>Warranty</u>

.1 System Warranty Overview

.1 The system warranty shall consist of a full scope, in-place warranty, consistent with the provisions of the Terms and Conditions in the Contract Documents. The warranty duration shall be twenty-four (24) months from the date of Total Performance of the Work.

.2 All hardware components and system programming that is a part of the completed system shall be covered by the warranty.

.3 The Contractor shall not provide third party warranties.

PART 2. GENERAL

2.1 SCADA Software

.1 SCADA software manufacturer: Subject to compliance with requirements and shall include all necessary software packages, software components and software patches for a fully functional system.

.2 SCADA software version shall be of the latest version offered by the manufacturer at time of installation.
- .1 Where a revised version has been made available after submitted software has been approved, The Contractor shall provide the most recent version available.

.3 The core SCADA software components shall reside on SCADA System Server.

.4 Source Limitations
- .1 All SCADA software shall be based on the GE Fanuc iFix software platform.

.5 SCADA Component Software shall include, but not be limited to:
- .1 GE Fanuc iFix
  1. Existing at SCADA Server
  2. Add at CP-GMCP HMI
- .2 GE Fanuc Proficy Historian
  1. Existing at SCADA Server
  2. Add at CP-GMCP HMI

.6 Database Software:
- .1 Database size and functionality shall not be restricted.
- .2 Database shall not be restricted by number of connections and shall not be subject to significant degraded performance due to quantity of simultaneous connections as a result of the database architecture or design.
- .3 Software selected shall be listed for server hardware being provided.
- .4 Manufacturer: Microsoft SQL Standard Edition, or Approved Equal.

.7 PLC Programming Software
- .1 PLC software and PLC hardware shall be from the same manufacturer.
- .2 Provide 1 Licensed program for use with Microsoft Windows XP/Vista operating system and related cables required to connect to PLC. Coordinate with Region for system installation and configuration requirements.

1. Manufacturer
    1. Allen Bradley, Rockwell Automation Inc., RSLogix 5000 or approved equivalent.

PART 3. EXECUTION

3.1 Examination

.1 Examine areas, surfaces, and substrates to receive SCADA System and associated control panels for compliance with requirements, installation tolerances and other conditions affecting performance.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Software Applications

.1 Load and configure all operating system software.

.2 Load and configure all SCADA software.

3.3 Installation

.1 Fasten control panels, and other devices.

.2 Ventilation slots shall not be blocked, or obstructed by any means.

3.4 Identification

.1 Identify components, and wiring according to all applicable codes, and standards, including those listed in subsection 1.3 above, and the requirements of the Contract Documents.

3.5 Field Testing and Commission

.1 Installation and Start-Up
    .1 Inspect wiring, components, connections and equipment installation for conformance with manufacturer recommended practices and as indicated in the Contract Documents.
    .2 Test, validate and verify equipment interconnections and displayed values.
    .3 Provide software programming, software loading and software debugging.
    .4 Install and test SCADA applications.
    .5 Test and validate operation of all related system components, including those systems and components listed elsewhere.
    .6 Perform tests as specified in the Contract Documents and report results in writing and provide as part of O&M documentation.

.7 The Consultant reserves the right to retest functions as needed to demonstrate that system performs as intended.

.8 The Consultant's decision shall be final regarding completeness of testing and final acceptance.

.9 Develop a specific plan for the startup and commissioning of the SCADA system and for any required cutover. No startup or cutover activities shall be performed until the plan has been successfully approved by the Region and the Consultant.

.10 Procedures, Forms, and Checklists:

1. Conduct all testing in accordance with, and documented on, Consultant accepted procedures, forms, and checklists developed by the Contractor.
2. Describe each test item to be performed.
3. Have space after each test item description for sign off by appropriate party after satisfactory completion.

.2 System Installation Test (SIT)

.1 The SIT shall include a comprehensive loop check and shall include, but not be limited to:

1. Verifying all the equipment installations.
2. Demonstrating that each functional requirement identified within the Contract Documents. Demonstrating that all equipment control functions, including the operation of automatic control strategies. Actuation of field devices shall be closely coordinated with facility operations.
3. Verifying system performance parameters and system responses under field operational conditions.
4. Verifying system setpoints using approved methods.
5. Verifying all values displayed within the software using approved methods.
6. Verifying accuracy of documentation, especially operator's manuals, software documentation, and general system operating instructions.

.3 Site Acceptance Test (SAT)

.1 A SAT that verifies each of the installed functions, software, and system performance shall be conducted after all system elements have been installed and the SIT has been completed. The SAT will be a part of the commissioning and acceptance testing process.

1. The SAT defined under this Section shall include, but not be limited to the installed SCADA system, attached control systems and instrumentation installed as a part of this project.

.2 The SAT tests shall be performed to verify complete operation of the associated systems, requiring that all equipment be installed at its permanent location and shall include testing as required by the Consultant to verify field installed equipment function.

.3 Provide a comprehensive plan detailing each component and each system being tested thirty (30) Days prior to the proposed SAT for approval.

.4 Provide the appropriate technical representatives for the execution of the Site Demonstration Test. Test support personnel shall be qualified to resolve and correct problems encountered with the system during the tests. In addition to test support personnel, provide all test instruments and equipment necessary to troubleshoot any of the proposed system problems encountered. The Region reserves the right to increase the requirements for test support personnel or require substitution of support personnel if support is deemed inadequate by the Region.

.5 If lengthy delays are encountered during the SAT due to failure of systems to perform as intended, the SAT test shall be re-scheduled, and the Contractor responsible for incurred costs associated with re-scheduling the required SAT retesting, until such time tests are accepted in writing as complete.

.4 Site Availability Demonstration (SAD)

.1 Test Requirements:

1. At the completion of the SAT, the Contractor shall conduct a SAD test utilizing all equipment, software, and services supplied under this Contract. During the test, the system shall meet the availability criteria defined below and shall meet the performance requirements stated in the Contract Documents. The Region's personnel may elect to participate in any and all parts of this demonstration at the discretion of the Region.

.2 Scope of Test:

1. All equipment and software provided shall be subject to the availability measurements, including but not limited to all installed instrumentation and controls.

.3 Test Equipment:

1. The Site Availability Demonstration shall be performed under field operating conditions. All functional and performance requirements specified in this Section shall be met during the SAD.

.4 Length of Test:

1. The system shall be subjected to SAD evaluation for a period of a minimum of 60 Days (1440 hours).

If at the end of the 60 Days, the system availability is determined to be less than that required, the test shall continue on a day-by-day basis, dropping off the previous day's test results. This sliding window concept shall continue until the system passes the test or until 120 Days has passed.

.5 Preventive Maintenance:

1. During the Site Availability Demonstration period, perform preventive maintenance of the type and the frequency of service defined in the SCADA maintenance manuals. Supply a recommended maintenance plan prior to start of the test.

.6 Test Prerequisites:

1. Final copies of O&M manuals provided
2. Final copies of System Operator's manuals provided
3. Final copies of System Administrator manuals provided
4. Final Record Documents provided
5. Completion of SIT and SAT tests

.7 Progress Reports:

1. Maintain the official record of operating time, recorded incidents and disposition, maintenance action, and calculated availability. At the completion of system availability demonstration, prepare a separately bound test report for the Consultant to evaluate and approve.

.8 Contract extensions shall not be granted to The Contractor where the SAT or SAD has either failed or The Contractor has not completed the necessary tasks within the project timeline.

.9 Letter of System Acceptance:

1. Upon completion and approval of SAD, the Region shall provide a letter of System Acceptance, which will be signed by all parties and serve as designation of the beginning of the warranty period.

3.6 Demonstration and Training

.1 Provide a qualified service representative to train Region personnel in the adjustment, operation and regular maintenance of the SCADA system.

.2 Provide a minimum of forty (40) hours of training in eight (8) hour intervals.

.3 Training Overview:

.1 Provide A comprehensive training program covering the operation and maintenance of all elements of the proposed system.

.2 For training sessions conducted on-Site, the Region will provide the necessary workstations.

.3 All training classes shall be completed prior to the start of the Site Acceptance Test.

.4 Training shall not be combined with other activities such as system configuration, testing or commissioning.

.4 Required Training Sessions:

.1 Sufficient sessions shall be presented to satisfy session size restrictions and conflicts in facility personnel scheduling. If the standard training curriculum includes applicable information in addition to those discussed below, the Contractor shall also provide these courses. The categories of training to be provided shall be:

1. Operator Training:

    1. Training sessions shall be provided in order to instruct the system operators in the efficient operation of all aspects of the SCADA system components. The course material shall include the general operation of the SCADA system, and the operation of the specific system features incorporated in the SCADA system. In particular, the operator training shall include instruction on the use of all operational functionality.

2. Software Maintenance Training:

    1. Training sessions shall be provided that will enable facilities staff to develop and maintain all aspects of the system software. Separate sessions shall be presented that deal with the following topics:

        .1 SCADA server operation, functionality and system maintenance.

        .2 Process database replication, backup and restoration

        .3 Process display development and modification

        .4 Supervisory Control strategy development and modification

        .5 Report development and modification

        .6 General software maintenance, including system backup, restoration and archiving.

.7 Calculation additions, alarm and event logging additions, Graphic display, report and trend additions

.8 Network training for adding additional equipment (printers, workstations, etc) or additional PLCs / RTUs and I/O from the SCADA Network

.9 Adding, editing, transporting and testing of data sent to historical database system

.10 Any Third party tools for accessing data from any database.

.5 Training sessions shall address the procedures for the standard SCADA system software, plus material explaining the specific conventions and procedures used by the Contractor in developing the SCADA applications. The sessions shall also provide instruction in techniques for developing and maintaining current, comprehensive SCADA documentation.

.6 Dates and times of training sessions shall be coordinated by the Contractor with the Region, and shall be based on the Region's requested schedule.

END OF SECTION

PART 1. GENERAL

1.1 General

.1 This Section includes requirements for the implementation of SCADA system and overview of the SCADA System Integrator (SI) scope of Work.

1.2 References

.1 York Region SCADA and Instrumentation and Control Guidelines and Specifications.
  .1 York Region Section 13420 - HMI Programming Manual (included as an appendix)
  .2 York Region Section13960 - SCADA Tagging Standard (included as an appendix).

.2 Section 13930 - Instrument and Equipment Testing.

.3 Section 13933 – Software Site Acceptance Testing Specification.

1.3 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13480 – SCADA Integrator as indicated in Schedule ‘A’ of the Bid Form.

1.4 System Description

.1 The Contractor shall ensure that the SCADA System Integrator Subcontractor (the “SCADA System Integrator”) will be responsible for providing and coordinating all Work indicated in Division 13 Specifications related to the process controls and the integration of systems into the SCADA system.

.2 The Contractor shall ensure that the SCADA System Integrator shall be responsible for all SCADA related programming and system SCADA programming updates indicated within this Specification and listed elsewhere within the Division 13 - SCADA and Instrumentation specifications.

.3 The SCADA system shall perform control, monitoring, alarming, start ups, shut downs, interlocking, etc. of the equipment and processes provided under this Contract for the system allowing fully automatic, unsupervised operation.

.4 The existing software located on the existing SCADA Server contains software tagging that does not meet York Region Section13960 - SCADA Tagging Standard the Region’s published Software Tagging Standard. The Contractor shall update all existing software located on the existing SCADA Server to meet York Region Section13960 - SCADA Tagging Standard.

.5 The existing software located on the existing Programmable logic Controllers located in the existing Control Panel CP-1, Control

Panel CP-2 and Control Panel CP-3 shall be updated to remove references to system components and processes that are to be removed or no longer exist, and update all programmatic device reference tagging to meet the Region's most current programming nomenclature at the time of construction. Where the existing Programmable Logic Controllers contain software tag references that do not meet the Region's published Software Tagging Standard, the Contractor shall update the software programming so that the Programmable Logic Controllers tag references meet York Region Section 13960 - SCADA Tagging Standard.

.6 The Contractor shall ensure that the SCADA System Integrator will prepare a complete Process Control Narrative that provides a comprehensive overview of the facility operation. The prepared Process Control Narrative shall be developed using the published York Region Standards for Process Control Narrative development in Sections 13021, 13021A and 13021C included as appendices.

.7 Refer to Division 13 – SCADA and Instrumentation and Division 16 – Electrical Specifications for details on operation, control system requirements, Factory Acceptance Testing (FAT), commissioning, Software Acceptance Testing (SAT), training, and other services to be provided under the Contract.

.8 The Region reserves the right to request additional SCADA System Integrator personnel or request replacement the Integrator personnel at any time during the Contract, if it is determined by the Region, at its sole discretion, that the personnel performing the role of the SCADA Integrator are not qualified to perform the Work as specified in the Contract Documents. Where requested to augment SCADA System Integrator personnel by the Region, the Contractor shall provide additional SCADA System Integrator personnel. Where requested to replace SCADA System Integrator personnel by the Region, the Contractor shall provide replacement SCADA System Integrator personnel. Where such requests are made by the Region, any requests for extensions of Contract Time or increases in Contract Price shall be the responsibility of the Contractor.

1.5 Progress Submittals

.1 Submit documents in printed, electronic (pdf) and electronic editable format.

.2 Process Control Narratives including all related systems.

.3 Prepare and submit Software FAT Plan, SCADA Startup and Commissioning Plan, and SAT plan for review in accordance with York Region SCADA standards. Include:

- .1 Proposed timeline schedule and description of each task
- .2 Purpose of tasks, outline of tests to be performed, procedures.
- .3 Evaluation of results, check lists and sign off sheets.

.4 Copies of completed products or work in progress (documents, software, programs, code, etc) shall be provided with each payment request or payment certificate.

.5 Software FAT/SAT checkout/verification forms. Submit all copies on CD ROMs.

1.6 Closeout Submittals

.1 Submit documents in printed, electronic (pdf) and electronic editable format to record future changes.

.2 In addition to requirements specified elsewhere in the Contract Documents, the manuals shall include documentation specific to the SCADA integration, PAC and SCADA programming Works.

.3 Process Control Narratives including Region's packaged systems. Coordinate, organize, review, request modifications and confirm the development of the Region's system technical documentation related to controls and instrumentation for O&M manuals. Electronic editable copy of the Process Control Narrative to be submitted in Microsoft Word format.

.4 Program Code: Editable and compiled, electronic versions of program code (PAC, Operator Interface Terminal, SCADA and any other applicable code) on CD ROM for Region backup purposes.

.5 Programming and Configuration Records:
 .1 Programming, integration and configuration records
 .2 Short "Executive Summary" guide on how to operate the control system

.6 Documentation of programming Work under this Contract upon completion of the Work as specified in the Contract Documents.

.7 Information on used data structures, data organization, control system details, final I/O list including network points, data mapping, naming/tagging conventions, development and configuration, etc.

.8 Printouts of Operator Interface screen graphics layouts, colour conventions, graphics and symbols, interpretation, screen navigation, functional overview. Editable copy of source code is to be provided.

.9 Event recording (alarms, warnings, status), storage, retrieval, and organization.

.10 Trending and data logging, storage, retrieval and organization.

.11 System security.

.12 System start up and shutdown.

1.7 .Qualifications

.1 The Contractor shall ensure that the SCADA System Integrator will function as an expert in the field of SCADA control and architecture, associated hardware and software, Programmable Logic Controllers, programming industrial networks and communication systems, and various process equipment and treatment systems.

.2 The Contractor shall ensure that the SCADA System Integrator will have expertise in managing large SCADA projects in municipal/industrial water and wastewater systems including control system standard development, and shall demonstrate expertise in implementation of SCADA as it relates to the operation of such facilities.

.3 The Contractor shall ensure that the SCADA System Integrator (company) will have a minimum of 10 years of experience and at least five (5) projects of similar nature and magnitude. Proof of projects and references shall be required for approval by the Consultant or the Region.

.4 The SCADA System Integrator (company) shall be one of the following list of Region approved York SCADA System Integrators:
 .1 Eramosa Engineering Inc.
 .2 Hatch Mott MacDonald Group Inc.
 .3 Summa Engineering Ltd.

.5 The SCADA System Integrator Subcontractor should be named in the Bid Form in Schedule ‘B’ List of Subcontractors.

1.8 Sequencing and Scheduling

.1 Coordinate tests with Work listed under other Divisions.

.2 Schedule time required for commissioning requirements into the project construction schedule. Scheduled commission activities shall include time for completion of functional testing, startup and functional commissioning of Region systems (as outlined under other Divisions).

.3 In accordance with the Contract Documents provide sufficient time in the construction schedule for regular Site meetings and visits during construction. Administer and provide meeting notes related specifically to SCADA System Integrator’s scope of Work.

1.9 System Start Up and Commissioning

.1 Refer to the requirements of Section 13930 – Instrument and Equipment Testing.

.2 Refer to the requirements of Section 13933 – Software Site Acceptance Testing (SAT).

.3 The Work shall be divided into multiple stages and include all of the Region's systems.

.4 System verification is intended to demonstrate the complete operation of the SCADA system under normal and failure operating conditions. Ensure that safety measures and fail safe interlocks are in place, and operate as designed and intended.

.5 SCADA System Integrator shall proceed to the next stage of testing after the Consultant's approval of satisfactory system performance at the current stage. Rectify deficiencies, conduct troubleshooting and otherwise take corrective action with respect to the installed systems.

.6 Control and instrumentation Work shall require completion and operational readiness of selected segments of Work prior to the beginning of the SCADA system testing.

PART 2. PRODUCTS

2.1 PLC Programming Practices

.1 The following paragraphs outline general rules for programming of logic controllers. The intention of these paragraphs is to provide the SCADA System Integrator with information on the project minimum requirements in regards to PAC programming practices.

.2 The York Region PAC Base Load and York Region PAC Programming Manual shall be used. Modifications of the standard PAC modules are not to be made without approval from York Region PCS. The York Region PAC Base Load and York Region PAC Manual will be provided to the Contractor after award of the Contract.

.3 All tagging is to conform to York Region Section 13960 – SCADA Tagging Standard.

.4 The program control logic and data files shall be documented in the program code:

- .1 The level of documentation shall be sufficient to allow understanding of the program code by a third party.
- .2 All program and data files shall have a name and a brief description.
- .3 All spare, future, or reserved memory locations shall be properly described.

.5 All points interfacing SCADA operator interface shall have a symbol that exactly matches the SCADA operator interface database tag in addition to the standard address comment.

.6 When a rung or memory address is removed from the code, all relevant comments shall be removed from the database.

2.2 SCADA Programming Practices

.1 The following paragraphs outline general rules for programming of the SCADA operator interface. The intention of these paragraphs is to provide the SCADA system integrator with information on the project minimum requirements in regards to SCADA programming practices.

.2 The York Region iFix Shell Application and York Region HMI Programming Manual shall be used. Modifications of the standard SCADA modules are not to be made without approval from York Region PCS.

.3 The SCADA tag names shall be developed using the Region of York Region Section13960 - SCADA Tagging Standard.

2.3 Integration Work

.1 The Contractor shall ensure that the SCADA System Integrator (SI) shall lead, supervise, and support the overall SCADA system implementation, requirements and control aspects of the Contract, including the integration and requirements related to manufacturer supplied packaged systems.

.2 The overall programming of the control systems shall be the responsibility of the Contractor and its package suppliers; however, the SCADA System Integrator shall provide details on the Region's standards related to the SCADA system. The Work in general includes:

.1 Publication and delivery of the SCADA Standards to the suppliers in regards to the presentation of information, tagging, controls and monitoring, alarms and events.

.2 Review of shop drawings and submittals for completeness and compliance with the Region’s SCADA Standards as indicated herein within subsection 2.1 to ensure compatibility of control systems with the Work provided by other suppliers and Subcontractors (example: screw press) and under these Sections (example: sludge feed pumps and polymer systems).

.3 Coordination of programming efforts, data exchange, implementation and interface with ancillary systems, reviews and comments, and provision of supplier assistance.

.4 Interface of the control system to the SCADA system for monitoring, control and data acquisition.

.3 The SCADA System Integrator is fully responsible for the integration of the Contract SCADA system, in its entirety including but not limited to the following:

.1 Finalize the detailed design of the control system including the Process Control Narratives to meet the Region's SCADA Standards.

.2 Ensuring that proper interfacing is provided between the system, the application software and protocol layers.

.3 Support all aspects of project automation including instrumentation, process equipment, control systems, wiring, panels, etc.

.4 Support all installation aspects of the Work including process, mechanical, instrumentation and control, electrical, environmental, health and safety systems and related services.

.5 Implementation of Region-specific equipment/process control requirements.

.6 Review of project documentation, shop drawings and submittals for all systems provided under the Contract for completeness and compliance with the Region's SCADA Standards.
.7 Coordinate programming efforts, data exchange, interface with ancillary systems, reviews, and comments.
.8 Ensure that relevant information is available to all parties in a timely manner.

2.4 Process Control Narratives

.1 Process Control Narrative development shall be completed by the Contractor.

.2 The Process Control Narrative outlines the systems operation in detail, lists of programming of logic controller(s) functions and system references. The intention of the Process Control Narrative is to provide detailed information on the control and monitoring of the process equipment and other facility systems that are directly or indirectly associated with the plant. It shall be used as an aid in developing the control strategy and integration of the plant operation.

.3 The Process Control Narrative shall be treated as a "work in progress", where all future mark ups and modifications including "as constructed" documentation Works shall be completed by the SCADA System Integrator based on actual implementation.

.4 Upon award of the Contract, the Contractor shall request a copy of the base Process Control Narrative. The Contractor shall ensure that the SCADA System Integrator will be responsible for updating and creating additions to the Process Control Narrative from the initial Process Control Narrative received from the Region after award of the Contract.

.5 The Contractor shall ensure that the SCADA System Integrator will incorporate all control details provided by the equipment packaged systems vendors and other suppliers, which are related to equipment/process control requirements in the Process Control Narratives. Written description to include the detailed instrumentation and control system including the list of functions monitored, controlled, and alarmed. The SI shall provide documents in an editable file format for incorporation into the plant manual.

.6 Prepare and submit pre-programming Process Control Narratives for the entire system in accordance with the requirements of the Contract. Allow for review meetings with the Region and Consultant.

.7 The updated Process Control Narratives shall be reviewed and approved by the Consultant and the Region before commencement of the SCADA programming Work.

.8 The Consultant and the Region reserve the right to review and modify the control concepts. The SCADA System Integrator shall allow for such modifications including custom configurations and revised hardware configurations to meet the Region's (plant) control practices.

.9 The SCADA System Integrator shall maintain and keep updated Process Control Narratives during development and construction.

.10 Make updated documents available upon the request by the Consultant or the Region. Documents shall be available in editable electronic and/or printed format when requested.

.11 Update, prepare and submit the final Process Control Narrative documents for the entire control system in accordance with the Contract requirements after successful completion of the software FAT, completion of the SAT, completion of the commissioning period and completion of the warranty period. Process Control Narratives are to be updated for any operational changes, setpoint value changes, control setpoint changes or alarm setpoint changes.

.12 The SCADA System Integrator is responsible for integrating all pre-packaged equipment supplier (“vendor Process Control Narratives into the overall facility Process Control Narrative.

.13 Provide administration services associated with the Process Control Narratives Works including organization and coordination (including packaged supplier's narratives) and documents revisions, tracking, etc.

.14 The Contractor shall ensure that the SCADA System Integrator will be responsible for providing and maintaining all temporary operational controls and systems as needed for any construction activities throughout the construction process.

2.5 PLC Programs

.1 Provide programs with control and monitoring functions as outlined under the Process Control Narratives and meeting Contract requirements.

.2 The SCADA System Integrator shall request or make minor modifications to the programs provided by the suppliers and required for SCADA interface, control and monitoring data exchange, etc.

.3 The Contractor shall allow for modifications to new or existing equipment programming and systems throughout the Contract to allow for the sequencing and cutover of equipment, and systems.

2.6 SCADA Programs

.1 Provide SCADA programs for the facility processes with control and monitoring functions as outlined under the Process Control Narratives and meeting the requirements of the facility and the Contract.

.2 The Contractor shall provide modifications to existing SCADA software and systems throughout the Contract to allow for the sequencing and cutover of equipment, and systems.

2.7 Other Programming and Configuration

.1 SCADA Configuration: The Contractor shall ensure that the SCADA System Integrator will ensure the proper configuration, setup and calibration of all computers (including SCADA server) and control equipment including but not necessarily limited to all field instrumentation, programmable automation controllers, communications equipment, control devices, process equipment, etc. to ensure functional system.

.2 The Contractor shall provide all ancillary programming and system, hardware, equipment configurations and modifications for a fully functional system.

2.8 Software and Accessories

.1 The Contractor shall ensure that the SCADA System Integrator will have its own licensed copies of all programming software including SCADA, PAC, OIT, I/O drivers and data servers. Use of Region licenses is not permitted.

.2 Communication cables, wireless hubs, wiring accessories, etc. shall meet the Contract requirements.

.3 Data Backup Means: Hardware, software, and storage media.

PART 3. EXECUTION

3.1 Demonstration

.1 Provide trained qualified "hands on" technical personnel to perform services herein specified including, but not necessarily limited to, troubleshooting of other overall SCADA related facility systems (instrumentation, controls, etc.) and programming. Allow for services of mechanical, electrical, instrumentation, and other Subcontractors to support start up and commissioning.

.2 Perform Software Factory Acceptance Test (FAT).

.3 Prior to the commencement of commissioning, review mechanical and electrical Works to ensure that the equipment is correctly installed, supported, connected and wired. Immediately advise the Consultant in writing of any deficiencies or deviations from the installation instructions.

.4 The Consultant and facility operators shall provide support services during start up and commissioning, and shall observe events, but they shall not be an active participant or responsible for the operation during startup and commissioning.

.5 Perform Site Acceptance Test (SAT). Inspect, operate, test, and adjust the equipment.

.6 Make any necessary changes and adjustments to the SCADA system.

.7 Allow for sufficient time dedicated exclusively to the integration of vendors' packaged systems as indicated under individual Specification Sections. A manufacturer's representative for the equipment specified in the Contract Documents shall be present at the Site for pre-startup assistance, inspection and certification of the installation, and equipment commissioning testing.

.8 The Estimated Contract Price shall include all disbursements including travel expenses, (accommodation, meals, transportation, etc.) to provide the services as listed.

.9 PAC or SCADA programs or any other Work under SCADA integration without proper documentation (even if fully operational and tested) will be considered Work not completed.

3.2 Training

.1 Provide training services for the Region's staff on the proper operating and maintenance procedures after satisfactory startup and commissioning.

.2 The operation and maintenance training shall include:
  - .1 Class training with overview of SCADA operation, technology and principles. Provide study and training materials and manuals.
  - .2 Hands on training. Provide presentation by the instructor with Region's staff following and physically performing control operations for the following (as minimum):
    1. System overview.
    2. How to navigate the system(s).
    3. Operation and operator interface.
    4. System security.
    5. How to monitor system.
    6. How to control system.
    7. Event management (alarms, warnings, statuses).
    8. Trending.
    9. Maintenance and SCADA checks.
    10. Troubleshooting; simulate alarms and explain causes and procedures.

3.3 Protection of Finished Work

.1 Back-up all existing software, programs, configuration files, etc. on external back-up media before proceeding with any modifications Work on the existing systems. Maintain a separate back-up copy off Site.

.2 Back-up programs, software, and codes on a daily basis during the commissioning and startup period. Daily copies of all software programs are to be submitted to the Region's PCS group

END OF SECTION

GENERAL

1.1 General

.1 All requirements of the Contract apply to the Work of this Section, which is provisional Work which shall be undertaken by the Contractor only at the request of the Region.

.2 The Contractor shall provide all the devices and components necessary to meet the intent of this Specification and to ensure a fully functional wide area network that meets the performance requirements specified in the Contract.

.3 Telecommunications companies may have wireless equipment installed and functioning at Region facilities. The Contractor shall ensure that existing facilities remain functional at all times. Any damage or failures to existing facilities caused by the Contractor will be rectified by the Contractorat no cost to the Region.

.4 Provide all related radio components including but not limited to; radios, radio towers, radio structures, integration related programming, and radio configuration.

.5 The Leslie Street Sewage Pumping Station SCADA system shall be configured to be a Hub Site that communicates to the Core Sites and associated Remote Facilities via radio telemetry using the Regions standard 5.8 GHz radio network components. The primary link will be located at the Milliken potable water tank located in the Town of Markham at 4347 14th Avenue in the vicinity of 14th Avenue and Kennedy Road.

.6 The Region shall provide and install the antenna and related appurtenances at the Milliken tank site.

1.1 Special Requirements

.1 Radio system installer: The Contractor shall ensure that the radio system installer will coordinate the radio system requirements and provide all associated coordination required for testing and commissioning of the radio system. Coordination with the SCADA Sytem Integrator Subcontractor will also be required to verify signals and for interfacing the radio system with the SCADA system.

.2 The following radio system installers are approved:
  .1 CBA Consulting Group
  .2 Bright Pulse Networks

.3 The radio system installer shall be named in Schedule B – List of Subcontractors in the Bid Form.

1.2 Technical Definitions

.1 Core Sites: The Core Sites are Newmarket Administration Centre and Bayview Operations Centre which are linked with a high bandwidth landline.

.2 Hub Site: Are the geographical operations hubs and PCS network centres in the Region and each Hub Site is linked to the Core Sites via redundant backhaul communications links. There are seven (7) Hub Sites in York Region.

.3 Radio Hub Site/Radio Hub: Is the extension point of the Hub PCS network to a Remote Facility and is linked to the Hub Sites or Core Sites via redundant backhaul communications links.

.4 Remote Facility: A Remote Facility can communicate with another Remote Facility, and a Hub Site or Radio Hub site.

1.3 Scope of Work Definitions

.1 The following terms are used in this specification to describe the scope of Work associated with various devices. The terms shall have the following definitions in this context:

- .1 Abandon: Abandon and make safe all process and electrical connections, make related process and electrical systems work safely after disconnection of abandoned item(s).
- .2 Free-issue: Equipment or services supplied by the Region for incorporation into the Contract by the Contractor.
- .3 Reasonably to Scale (RTS): Dimensions shown are approximate only. The Contractor shall field verify the dimensions prior to starting the Work.
- .4 Provide: Supply the named device or equipment and all necessary appurtenances, install, test and commission. Unless otherwise noted in the Contract Documents, the device or equipment supplied and all appurtenances shall be new.
- .5 Remove: Abandon and make safe all process and electrical connections, remove the item and mend the void space and process to its intended function.
- .6 Replace: Verify that replacement material fits the replaced item and provide adapters as required, abandon and make safe all process and electrical connections, remove the item, supply and install new item with required adapters, make related process and electrical systems work safely after replacing item(s)..
- .7 Region: Refers to the designated Regional Staff or Regional Representative.

1.4 References

.1 Comply with the latest edition of the following statutes codes and standards and all amendments thereto.

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
.2 CSA S37-01 Antennas, Towers and Antenna-Supporting Structures for Tower Manufacture and Installation
.3 TIA/EIA-195C, Electrical and Mechanical Characteristics for Terrestrial Microwave Relay System Antennas and Passive Reflectors
.4 Ontario Provincial Standard Specification, Construction Specification for Pole Erection (OPSS 615), .
.5 Ontario Electrical Safety Authority, Section 75-242 “Setting of Poles” and Specifications 6, 7, and 8
.6 Industry Canada regulation RSS-210 “Low Power License-Exempt Radio communication Devices” that pertain to the outdoor application of the following unlicensed frequency ranges: 5725 to 5875 MHz
.7 Conform to the IEEE 803 standard for all 5.8 GHz intra-radio links
.8 Conform to Health Canada’s Radiofrequency Exposure Guideline - Safety Code 6.
.9 Where copper or fibre optic Ethernet cabling is installed:
  1. TIA/EIA-568-B, Telecommunications Cabling Standard. All standards referenced within the TIA/EIA-568-B standard, where applicable, constitute standard provisions of this specification
  2. Ontario Electrical Safety Code, Section 56 – Optical Fibre Cables
  3. Ontario Electrical Safety Code, Section 60 – Communication
  4. TIA/EIA-606: Administrative Standard for Telecommunications
.10 Ontario Electrical Safety Code.

1.5 Scope of Work

.1 The Work to be performed under this Section, if required by the Region includes, but is not limited to, the supply of materials, labour, equipment, permits, etc. necessary for the complete construction of the Works shown on the Contract Drawings and as specified herein. The following is a general, but not necessarily complete, description of the work to be done:
  .1 Provide and install a 5.8 GHz wireless Ethernet Bridge, with integrated antenna, lightning protection, cabling, utility pole, mast, managed network switch, radio tower and appurtenances at all Remote Facilities, Hubs, and Radio Hubs included in this Contract.

1.6 Radio Link Performance Requirements

.1 The radio links provided by the Contractor shall meet the following minimum radio link performance requirements:

.1 Provide a signal fade margin for each radio link that ensures one way annual availability of 99.995 percent or greater. At the Region's discretion, lower link availability may be accepted. Under no circumstances will a one way annual availability or worst month availability be accepted that is less than 99.95 percent.

.2 The Effective Isotropic Radiated Power (EIRP) of all links shall will comply with Industry Canada, Radio Standard Specification RSS-210, for Low Power License Exempt Radio Communication Devices and all amendments.

.3 The minimum data rate for 5.8 GHz point-to-point links will be 50 Mbps at a Bit Error Rate (BER) of 10^{-6}.

.4 For some radio links it may not be feasible to meet the performance requirements specified in the Contract Documents due to environmental constraints. The Region places a higher priority on the reliability of the link than the data rate. Compliance with Industry Canada regulations is mandatory. The determination of feasibility with respect to meeting the performance requirements will be at the sole discretion of the Region.

.5 The 5.8 GHz wireless network will comply with the IEEE 802.3 standard, unless otherwise noted in the Contract Documents.

.6 These standards utilize frequency bands that are regulated but not licensed by Industry Canada. It is understood by the Region that at anytime during construction or after Contract completion that interference from another radiation source, operating in the same frequencies, may affect the operation or performance of any wireless link in the network. If it was reasonable for the Contractor to have identified the interfering source during the pre-construction or construction phase of the Contract, the Contractor will be required to take the necessary steps to eliminate or mitigate the interference.

1.7 Measurement and Payment

.1 The Work of this Section, if required by the Region, will be paid for at the lump sum price for Section 13520B as indicated in Item No. P.02 in Part 'B' of the Bid Form.

1.8 Submittals

.1 Comply with the requirements of Section 01300 – Submittals. In the event of a conflict, between the requirements of this Section and the requirements of Division 1 Section 01300 – Submittalsm the requirements of this Section shall take precedence.

.2 All Shop and Record drawings submitted by the Contractor will comply with the Region's CAD standards and shall be generated with the latest version of AutoCAD. All drawings will be formatted for and submitted on 594 mm x 841 mm ISO A1 paper.

.3 Prior to starting construction submit radio link calculations and path profiles (Pre-Construction Link Verification) using components approved by the Region and dimensions determined by the Contractor. The radio link calculations are in addition to the requirements of this Division. Radio link calculations shall be performed utilizing the *Telecommunication Union, ITU Radiocommunication Assembly, Rec. ITU-R P.530* model.

.4 Prior to starting construction at any site submit the Site Antenna Installation drawing.

.5 Submit proposed tag labels for cables, equipment and enclosures in accordance with the specifications to the Region for approval before proceeding with this Work.

.6 Submit the following documentation a minimum of 28 Days prior to Site Acceptance Testing: test plan, test sheets, working drawings, as-built drawings.

.7 Submit the Network Operations and Maintenance Manual, within 14 Days following the completed Site Acceptance Test.

.8 Submit a description of any proposed network testing tools (software or hardware) required to meet the intent of the Link Acceptance Test (LAT), Network Acceptance Testing (NAT), a minimum of 28 Days prior to LAT. Following LAT, submit original signed copy of the Region’s LAT test sheet.

.9 Submit a description of any proposed network testing tools (software or hardware) required to meet the intent of the Network Acceptance Test (NAT), a minimum of 28 Days prior to Network Acceptance Testing. Following NAT, submit original signed copy of the Region’s NAT test sheet.

.10 Submit a description of any proposed network testing tools (software or hardware) required to meet the intent of the Transmission Cable Test (TCT), a minimum of 28 Days prior to Transmission Cable Testing and Link Acceptance Testing. Following TCT, submit original signed copy of the Region’s TCT test sheet.

.11 Submit configurations for all managed network equipment installed and configured by the Contractor for review and acceptance by the Region a minimum of 14 Days in advance of the Network Acceptance Test. Final configurations shall be included in the Operations and Maintenance Manual.

.12 Submit photographs of the Work performed as sites are completed. Photographs shall include as a minimum the site, the control panel, the underground conduit, the top of the pole (taken from eye level), grounding rod installations/configuration. All obstructions, if any, must be photographed and identified.

  .1 For Radio Hub Sites, submit photographs taken from the top of each antenna for the entire beamwidth of the antenna. If identifiable, take photographs of the receiving radio hub site(s).

.13 Submit WAN construction schedule within seven (7) Days following the contract kick-off meeting.

.14 Supply the Region with six (6) hardcopies and electronic versions on CD of each submittal. CAD files will be in the latest version of AutoCAD format and configuration files will be in plain text. All other electronic versions will be in PDF format.

PART 2. PRODUCTS

2.1 Antenna Masts

.1 Radio Tower Based Mast:
- .1 The tower shall be constructed to Canadian Standard Association (CSA) standards CSA-S37/01 for self supporting towers.
- .2 Design height: 61 metres
- .3 CSA Design Criteria: CSA Class 1
- .4 Accessories:
  1. Ladder with round rungs and angle rails
  2. Tower grounding kit
  3. Lightning rod, 1.5 metres connected to grounding system using #4 AWG bare copper
  4. Antenna face mount
  5. Cable safety climb kit
  6. Cable safety slider and listed karabiner
  7. Full body safety harness, one Medium, one Large and one Extra-Large as listed by the manufacturer
- .5 Antenna Tower Manufacturer:
  1. Trylon TSF Incorporated, Super Titan series
  2. Or approved equal

.2 Grounding System
- .1 Provide an outdoor Ethernet network and wireless Ethernet bridge grounding system in compliance with the 13520B SCADA 5.8 GHz Wireless Details drawing and this Specification.
- .2 Lightning protection to be provided for network cabling located within 2 metres of wireless bridge.
- .3 External lightning protection to be provided for network cabling at point of entry into facility leading to the network.
- .4 Comply with Sections 10 and 54 of Ontario Electrical Safety Code.
- .5 Bond network cabling system ground to existing building ground as close as possible to the building point of entry. As a minimum, bond network cabling system ground to existing grounds with a No. 6 AWG copper wire that is as straight and short as possible.
- .6 Bond network cable system ground to a solid copper ground bar within the PAC panel.

.7 Bond the wireless Ethernet radio at the pole top. The ampacity of the ground conductor shall be equal to or greater than the ampacity of the lightning protection unit. Installed grounding kits are to be watertight.

.8 Bond wireless Ethernet radio mounting pipe and lightning protection units to antenna tower grounding rod utilizing a No. 6 AWG ground conductor. Ground wire is to be clamped to the mounting pipe securely with a minimum of two (2) pipe clamps.

.9 At the time of installation, the site resistance relative to ground must be less than or equal to 5 ohms in accordance with IEC61024.

.10 Grounding kit by Andrew, A CommScope Company to be installed on all copper Ethernet cabling where it enters into a valve chamber and/or the room hosing the PAC panel and network panel.

.3 5.8 GHz Wireless Ethernet Bridge

.1 Provide a 5.8 GHz Wireless Ethernet bridge as specified in the Contract Documents.

.2 The mounting plate and mast shall be installed on the antenna tower. The mounting plate shall be manufactured from aluminum with the following minimum dimensions: 370 mm (14.5”) Length x 370 mm (14.5”) Width x 6.35 mm (0.25”) Depth.

.3 Provide testing and commissioning of the Wireless Ethernet bridge. Coordinate activities with Region staff.

.4 All wiring is to be neatly dressed and run within cable managers.

.5 Fit a drip loop on the PIDU Plus to Wireless Ethernet Bridge cable to ensure that moisture does not run in to the Powered Indoor Unit (PIDU) Plus.

.4 Antenna Alignment

.1 Each Remote Facility antenna shall be aligned with a Hub, Radio Hub, or another Remote Facility antenna. The Contractor is to record signal strength and quality at both sites for submission to the Consultant.

.2 Digital Voltmeter (DVM) to be used to verify antenna alignment proportional to receive signal strength for coarse adjustment of antenna position.

.3 For fine adjustment, align the antenna with measured azimuth, elevations and a GPS coordinates utilizing the Wireless Ethernet Bridge audible tones until highest pitch tone is received. Adjust by making small incremental movements in angular alignment. Adjust for each of the states as defined in the manufacturers installation and commissioning literature.

.4 Copies of wireless link graphical views from Manufacturer Web Interface Tool are to be provided from installation showing alignment process and final alignment.

.5 Patch Cords
.1 Provide three (3) CAT6 patch cords as a minimum, or as required certified by the manufacturer.
.2 Patch cords will be sized to suit + 30 cm (maximum) in length.

.6 As-Built Drawings
.1 The Contractor will create and submit red-lined as-built drawings for each Radio Hub Site upon completion of the Contract. At a minimum, the Contractor shall annotate the drawings with the following details: all final dimensions, equipment location, approved design, material changes, final elevations and azimuths.
.2 Provide completed Resistance Values Table and Link Identification Table from Manufacturer Deployment Guide.

2.2 Antenna Mast Clamps

.1 Pipe to Pipe Mount:
.1 Antenna Mast Clamps shall be by Andrew Corporation, AB-S50-SSHm, or approved equal.
.2 Provide all u-bolts, screws, bolts, nuts, washers and necessary appurtenances to mount the antenna mast as functionally detailed in the Contract Drawings and according to manufacturer installation recommendations.

2.3 Surge Protectors

.1 5.8 GHz Lightning Surge Protector:
.1 The lighting surge protector shall be PTP-LPU by Motorola Incorporated, part number WB2978AA. A quantity of 2 lighting surge protectors required per link.

2.4 Outdoor Ethernet Cable

.1 Outdoor Ethernet Cable:
.1 Outdoor Ethernet cable shall be Superior Essex Inc. Operations Service Provider (OSP) Broadband Category 5e cable, part number 04-601-55, or approved equal.

.2 Outdoor Ethernet Cable Connectors:
.1 RJ45 Shielded liner plug, Category 5e connector as per wireless bridge manufactures recommendations.

2.5 Wireless Bridges

.1 5.8 GHz Ethernet Wireless Bridge:
.1 The 5.8 GHz Wireless Ethernet Bridge shall be Motorola PTP58500 radio with integrated antenna, part. MCP-WB2859AA.
.2 PIDU Plus (Power Indoor Unit Plus) by Motorola to be supplied with radio installation.

PART 3. EXECUTION

3.1 General

.1 The Regional Municipality of York, Water and Wastewater Facilities, SCADA Wide Area Network (WAN) is a mission-critical network requiring a high-degree of reliability and robustness. The Contractor is responsible for constructing a wireless network that meets the performance criteria specified within this Specification Section.

.2 This Specification is a functional specification. Therefore, during the performance of the Work, it is the responsibility of the Contractor to bring to the attention of the Region any design, equipment or installations issues, which the Contractor believes may prevent the network from meeting any of the minimum performance requirements or comply with this Specification. The Contractor will recommend solution(s), in writing to the Region, including impact to scope, Contract Time and Contract Price. The Region will, in its sole discretion, make a determination if the identified issue(s) will or will not negatively impact network performance. Complete all network enclosure installations in accordance with Division 13 – SCADA and Instrumentation.

3.2 Sequence of Construction

.1 Complete all work associated with Hubs, and Radio Hubs.

.2 Complete all work associated with Remote Facilities.

.3 Prior to performing site acceptance test of WAN components and complete Site Acceptance Testing of Remote Facilities, Hubs, and Radio Hubs.

3.3 Mandatory WAN Meetings

.1 The Contractor's WAN representative (the person responsible for the construction of the WAN) and the Contractor's Project Manager shall attend these mandatory meetings. These meetings are in addition to routine construction meetings.

.2 A WAN kick-off meeting will be held at the pre construction meeting to review this specification and Wide Area Network (WAN) Contract Drawings in detail. Major WAN milestones will be identified with the Contractor to incorporate into the overall project schedule.

.3 Two (2) additional meetings will be called at the discretion of the Consultant to review issues relating to construction of the WAN. The Contractor will be provided with a minimum 14 Days' notice of a meeting.

3.4 Pre-Construction <u>Link Verification</u>

.1 The Contractor’s WAN representative (the person or Subcontractor responsible for the construction of the WAN) and the Contractor’s Project Manager shall attend these mandatory meetings. These meetings are in addition to routine construction meetings. The Contractor’s WAN representative is to be named in the Schedule B – List of Subcontractors in the Bid Form and will not be the Contractor’s project manager.

.2 Measure and record the site coordinates (latitude and longitude) utilizing a GPS. Compare to Region supplied coordinates and report any discrepancies, otherwise use the Region values.

.3 Determine the azimuth and inclination for the line-of-site path for the link.

.4 Measure or determine the site altitude above mean sea level to an accuracy of plus or minus three (3) metres. Indicate the method of measurement.

.5 For all 5.8 GHz link calculations use a BER of 10^{-6}.

.6 Submit Radio Link Report using approved radio link modelling software and submit to the Region for review.

.7 Accepted Radio Link Calculations will form the performance criteria for the Link Acceptance Test (LAT).

3.5 Cable Acceptance <u>Testing - General</u>

.1 This Section specifies the inspection, test, and acceptance requirements for the transmission cabling of the Wide Area network.

.2 Provide all of the test equipment required to conduct acceptance tests.

.3 All of the installed cabling shall be tested and successfully pass all test criteria.

.4 Visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are to be returned to the supplier and replaced at no additional cost to the Region.

.5 The Region reserves the right to conduct, using the Contractor’s equipment and labour, a random re-test of up to twenty (20) percent of the outdoor Ethernet cables to confirm documented results. Any failed cabling shall be re-tested and restored to a passing condition. In the event that more than five (5) percent of the cable fails during re-test, the entire cabling shall be re-tested and restored to a passing condition at no additional cost to the Region.

.6 Acceptance shall be subject to completion of all Work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation as specified in the Contract Documents.

.7 The maximum allowable distance for Ethernet copper cable runs is 90 m including all patch cables. The Region may agree to allow certain cable runs to exceed acceptable standardised performance criteria. If required these cable runs will be exempt from meeting the specified standards. However, the Contractor shall still be required to test these cable runs to validate component and installation performance.

.8 Outdoor Ethernet Cable Test Equipment. Test equipment shall meet the following minimum criteria:

- .1 All test equipment of a given type shall be from the same manufacturer, and have compatible electronic results output. Acceptable test equipment manufacturers are Fluke Corporation, Hewlett-Packard Company (HP), or MicroTest S.R.L.
- .2 Test adapters must be approved by the manufacturer of the test equipment. Adapters from other sources are not acceptable.
- .3 Baseline accuracy of the test equipment must exceed TIA Level III, as indicated by independent laboratory testing.
- .4 Test equipment must be capable of certifying Category 6 UTP to TIA/EIA-568-B.2 standards.
- .5 Test equipment must have a dynamic range of at least 200 dB to minimize measurement uncertainty.
- .6 Test equipment must be capable of storing full frequency sweep data for all tests.
- .7 Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
- .8 Test equipment must be capable of running individual NEXT, return loss, etc., measurements in addition to autotests. Individual tests increase productivity when diagnosing faults.
- .9 Test equipment must make swept frequency measurements in compliance with TIA/EIA-568-B standards.
- .10 The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

.9 Cable Test Results Manual:

- .1 Submit test reports in both a hardcopy and electronic format. Hand-written test reports are not acceptable. Submit electronic files on a CD format disk in a PDF format. If test results cannot be converted to a PDF format then provide any necessary proprietary software to view the results at no cost to the Region.

.2 Submit five (5) copies of the Cable Test Results manual. The manual consists of hardcopy test result reports placed into lockable 'D' ring binders with a cover and spine that clearly indicates the title of the manual. Put a CD with the electronic copies of test reports in a pocket in the Cable Test Results manual.

.3 Both the Contractor and the Consultant must sign hardcopy reports.

.4 design, material changes**,** final elevations and azimuths**.**

3.6 Testing

.1 Failed test results shall be submitted to the Region with suggested corrective action. After corrective action is implemented, the test shall be repeated. In all tests, a 100% successful pass rating is required for acceptance of completion of the Work.

.2 The Contractor is required to provide all testing equipment including laptops and manufacturer testing software and LINKPlanner Radio report.

.3 Site Acceptance Test (SAT) – All Radio Hub Sites

.1 All Radio Hub sites will undergo a witnessed Site Acceptance Test (SAT), where the Region's representative and the Contractor shall witness the performance of the SAT.

.2 Site Acceptance Tests will evaluate the workmanship and verify installation against this specification, As-Built and shop drawings.

.3 Prepare a checklist or test sheet using Microsoft Excel.

.4 The Contractor shall conduct the test when directed by the Region.

.5 The SAT will be completed when all items in the checklist have been witnessed and initialled by the Region as being in conformance with the design as specified in the Contract Documents.

.4 Link Acceptance Test (LAT)

.1 All sites shall undergo a witnessed Link Acceptance Test (LAT). Perform all link acceptance tests where supported by the manufacturer's radio and/or manufacturer supplied diagnostic tools to confirm link status. Complete the LAT test sheet provided by Region and submit an original signed copy.

.2 Perform all radio link tests at both ends of the radio link.

.3 Copies of wireless link graphical views and System Statistics from Manufacturer Web Interface Tool are to be provided for the final installation.

.4 Measure and record Histogram Data using Manufacturer Web Interface Tool for four (4), one (1) hour intervals.

Exported Comma Separated Values (csv) Histogram Data files for all diagnostics are to be provided to the Consultant and Region for acceptance of LAT.

.5 Measure and record Histogram Data using Manufacturer Web Interface Tool for first 24 hr period. Exported csv Histogram Data files for all diagnostics are to be provided to the Consultant and Region for acceptance of LAT.

.5 Network Acceptance Test (NAT)

.1 The Network Acceptance Test (NAT) will be witnessesed by the Region's representative and the Contractor, where the NAT will consist of testing Ethernet performance of overall network by the Contractor, including the Wireless and their connections to the core and Radio Hub local area networks. Complete NAT test sheet provided by Region and submit original signed copy.

.2 Using laptops connected to the network at both ends of the link and suitable TCP/IP test software perform a "Ping" test. The latency of the ping test shall be less than 2 milliseconds (msec). Packet losses shall not exceed 0.001 percent. Repeat the test ten (10) times and record the minimum, maximum and average latency.

.6 Outdoor Ethernet Cable test

.1 Measure and record actual length and maximum allowable length. Any individual test that fails the link length criteria shall be marked as FAIL.

.2 Record tester manufacturer, model, serial number, software version, last calibration date, lab details, link criteria, pass/fail indication, and date/time of test.

END OF SECTION

PART 1. GENERAL

1.1 General

.1 This document outlines the minimum equipment and performance standards for a completely interoperable Building Automation System (BAS).

.2 The Work shall include design, supply, installation, and commissioning a complete microprocessor based automatic control system to achieve the performance specified in the following Sections.

.3 The BAS shall be capable of total integration of facility infrastructure systems with user access to all system data, either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.

.4 The entire BAS shall be peer-to-peer networked, stand-alone, distributed control in accordance with American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers (ANSI/ASHRAE) Standard 135-2004, BACnet – A Data Communication Protocol for Building Automation and Control Networks.

.5 All labour, material, equipment and software not specifically referred to herein or on the plans, but that is required to meet the functional intent of the Contract, shall be provided without additional cost to the Region.

.6 The Contractor shall ensure that the BAS Subcontractor will be a manufacturer or licensed factory representative and installer of the manufacturer, specified for the service region in which the Site is located.

.7 The Contractor shall ensure that the BAS Subcontractor will provide the necessary engineering, installation, supervision, commissioning and programming for a complete and fully operational system. The BAS Contractor will provide as many trips to the Site for installation, supervision, and commissioning as are necessary to complete the Contract to the satisfaction of the Consultant and the Region.

.8 The Contractor shall ensure that the Controls Subcontractor will specifically read all mechanical and electrical Drawings, specifications, and addenda and determine the controls Work provided by the Mechanical Subcontractor, its subcontractors, and the Electrical Subcontractor. The Contractor shall ensure that the Controls Subcontractor is expected to have the expertise to coordinate the Work of other Subcontractors and to make a completely coordinated Building Automation Control System (BAS) for the mechanical systems.

.9 The BAS shall be compatible with future control Products for 10 years or more. Any equipment or control systems that are scheduled or suspected to become outdated or obsolete or shall not be used on this Contract.

.10 Ensure compliance with the Ontario Electrical Safety Code and Ontario Building Code along with any other codes deemed applicable by the local building inspector.

.11 The system shall be installed by trade certified electricians regularly employed by the Controls Subcontractor. The system shall be tested and calibrated by factory certified technicians qualified for this type of work and in the regular employment of the BAS manufacturer or its exclusive factory authorized installing contracting field office representative. The installing office shall have a minimum of five years of installation experience with the manufacturer. Supervision, calibration and commissioning of the system shall be by the employees of the factory authorized BAS branch or representative.

.12 For existing sites, visit the premises prior to tender to become familiar with field conditions and existing equipment. The BAS system shall be capable of operation of existing and new equipment as specified in this section and the Sequence of Operations specified in Section 15985 – HVAC Controls and Sequence of Operation.

1.2 Related Sections

.1 Section 01501 – Construction Sequencing

.2 Section 13400 – Programmable Automation Controllers

.3 Section 13961 – Electrical Controls and Devices

.4 Division 16 - Electrical

.5 Section 13960 – SCADA Tagging Standard (included as an appendix)

1.3 References

.1 Instrumentation, Systems, and Automation Society (ISA):
  - .1 S5.1, Instrumentation Symbols and Identification.
  - .2 PR12.6, Installation of Intrinsically Safe Systems for Hazardous Locations
  - .3 S5.4, Standard Instrument Loop Diagrams.
  - .4 S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
  - .5 S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.2 National Electrical Manufacturers Association (NEMA):

.1 ICS 1, Industrial Control and Systems: General Requirements.
.2 ICS 2, Industrial Control Devices, Controllers and Assemblies.
.3 ICS 3, Industrial Control and Systems: Factory Built Assemblies.
.4 ICS 4, Industrial Control and Systems: Terminal Blocks.
.5 ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
.6 ICS 6, Industrial Control and Systems: Enclosures.
.7 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
.8 IA 2.2, Programmable Controllers - Equipment Requirements and Tests.
.9 IA 2.3, Programmable Controllers - Programming Languages.

1.4 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13700 – Building Automation System as indicated in Schedule ‘A’ of the Bid Form.

1.5 Submittals

.1 Refer to Section 1300 – Submittals.

.2 Drawings and Submissions:
.1 Submit four (4) copies of following information to the Consultant for review and approval:
1. Control Schematics.
2. Detailed sequence of operation for each control schematic or controlled system.
3. System Architecture indicating the proposed interconnection and location of all BAS panels, network connections and key peripheral devices (workstations, modems, printers, repeaters, etc.)
4. BAS Points List indicating the panel ID, panel location, hardware address, point acronym, point description, field device type, point type (that is, AO/DO/AI/DI), end device fail position, end device manufacture and model number, and wire tag ID). Terminal identification for all control wiring shall be shown on the shop drawings.
5. Wiring diagrams including complete power system, interlocks, control and data communications.
6. Hard copy graphical depiction of the application control programs.
7. Manufacturers’ data / specification sheets for all material supplied.

PART 2. PRODUCTS

2.1 Building Automation System

.1 Building Automation System shall be one of the following systems:
  .1 Automated Logic
  .2 Delta
  .3 Reliable Controls

2.2 Scope

.1 This project scope shall include, but not be limited to, the following Work:
  .1 Preparation of control shop drawings for review and approval. Refer to Subsection 1.5.2 Drawings and Submissions of this Section.
  .2 Supply and install a network of Building Automation Control System (BAS) panels and field devices. Refer to Subsection Part 2.3- Materials, 2.9 - Enclosure and 2.8 - Field Devices of this Section.
  .3 Supply and install customized graphics software as specified in this Section. Refer to Subsection 2.4 Operator's Workstation of this Section
  .4 Install, wire and label all BAS control system components. Refer to Part 3 - Installation of this Section
  .5 Calibrate and commission the installed control system. Refer to Subsection 3.4 Commissioning of this Section.
  .6 Provide maintenance manuals and as-built drawings. Refer to Subsection 3.7 As-Built Documentation of this Section.
  .7 Provide customized training for operations, maintenance and technical staff. Refer to Subsection 3.5 Training of this Section.

2.3 Materials

.1 All devices shall be network accessible using the BACnet protocol, where each device is monitored and controlled over the network interface.

.2 Devices shall be field reconfigurable using the local human machine interface. Device settings and configurations shall not be hard coded into the BAS interface programs.

.3 All controllers shall be loaded to a maximum of 80 percent. 20 percent of each of the inputs, outputs and variables shall remain unused to allow for future growth and expandability.

.4 The system shall consist of a central operator interface, microprocessor-based controllers, sensors, wells, automatic control valves, control dampers, transducers, relays,, and damper actuators.

.5 All equipment and software programming, etc. shall use the Regions standard – Refer to 13960 – SCADA Tagging Standard included as an appendix. .

.6 Software shall be field programmable, capable of all control and mathematical functions and shall use Proportional Integral Derivative (PID) formulas for controlling the connected systems.

.7 All temperature units for BAS and controlled equipment shall be in degrees Celsius (^{o}C).

.8 Operator Activity Tracking - An audit trail report to track system changes, accounting for operator initiated actions, changes made by a particular person or changes made to a specific piece of equipment designated time frame, shall be printable and archived for future use. The operator activity tracking shall be in a tamper-proof buffer file.

.9 Operator workstation interface software shall optimize operator understanding through the use of English language prompting, English language point identification and industry standard PC application software. The software shall provide, as a minimum, the following functionality:

- .1 Real-time graphical viewing and control of environment
- .2 Scheduling and override of building operations
- .3 Collection and analysis of historical data and dynamic data (trend plot)
- .4 Definition and construction of dynamic color graphic displays
- .5 Editing, programming, storage and downloading of global controller databases
- .6 Alarm reporting, routing, messaging, and acknowledgment

.10 Provide a graphical user interface, which shall minimize the use of the keyboard through the use of a mouse or a similar pointing device and a “point and click” approach to menu selection.

.11 Battery backup: Automatic restart after power failure: Upon restoration of power after an outage, the BAS shall automatically, and without human intervention, update all monitored functions, resume operation based on current synchronized time and status and implement special start-up strategies as required.

.12 Refresh rate – The maximum permissible refresh rate is ONE (1) second. The refresh rate is defined as the time it takes the controller central processing unit (CPU) to sample all inputs, calculate all variables, update all timers and proportional integral derivative (PID) controllers, check all schedules, update all trend logs an runtime logs, execute all programs and assign values to all outputs.

.13 The HVAC equipment shall be supplied as "Thermostat-Ready". The building automation system shall have direct control of dampers, heating and cooling stages without the requirement of BACnet, Lonworks or any other type of communication interface. Factory installed interlocks, safeties and anti-cycle timers shall be provided as required.

.14 Reports shall be generated on demand or via a pre-defined schedule and directed to video displays, printers or hard drive. At a minimum, the system shall allow the user to easily obtain the following types of reports:

.1 A general listing of all or selected points in the network
.2 List of all points currently in alarm
.3 List of all points currently in override status
.4 List of all disabled points
.5 List of all points currently locked out
.6 List of user accounts and access levels
.7 List all weekly schedules
.8 List of limits and dead-bands
.9 Excel reports
.10 System diagnostic reports including a list of BAS panels on line and communicating, and the status of all BAS terminal unit device points
.11 List of programs

.15 Provide a means for the operator to view the communication status of all controllers connected to the system. The status should show whether the controller is communicating or not.

.16 Provide a means for the operator to reset the error count for all controllers to zero.

.17 Provide a means for the operator to display and change the system configuration. This shall include, but not be limited to, system time, day of the week, date of day light savings set forward and set back, printer type and port addresses, modem port and speed, etc. Items shall be modified utilizing easy to understand terminology using simple mouse/cursor key movements.

.18 Provide a security system that prevents unauthorized use unless the operator is logged on. Access shall be limited to the operator's terminal functions unless the user is logged on.

.19 Where possible, utilize Optimized Start features on equipment to reduce hydro demand charges.

.20 During the initial design the Region shall supply the controls contractor a range of BACnet addresses the BAS will run on. The BAS network will run either BACnet over IP or BACnet over Multiple Spanning Tree Protocol (MSTP). All BAS points will be network visible so that other BACnet systems can auto discover them. The Contractor shall consult with the Region's Project Manager during the development of addresses.

2.4 Operator's Workstation

.1 Supply and install all operating software and dynamic system graphics on the Operator's Workstation. Workstation to be supplied by BAS Subcontractor unless stated otherwise by the Region Project Manager.

.2 Supply licenses for all software required to monitor, configure system, edit graphics, trend storage, (data exchange including Open Database Connectivity (ODBC) (if applicable)) without limitations to points.

.3 Reliable Controls ("RC") shall include licensing for the following: RC Studio, RC Webview, RC Archive.

.4 Delta Controls shall include software licensing for the following: ORCA web-Large (Open Real-time Control Architecture Web-Large), Illustrator, ORCAweb (Open Real-time Control Architecture web), OWS (Operator Workstation), ODBC (Open Database Connectivity), DDE (Dynamic Data Exchange) , Historian Large.

.5 Automated Logic shall include licensing for the following: WEB CTRL, Advanced reports.

.6 The operator workstation interface software shall be designed to operate on the Windows 7 Professional platform.

2.5 WAN Access

.1 Provide necessary interface and cabling to connect the BAS to the York Region WAN. Obtain the particular WAN system details from the Consultant or Project Supervisor.

.2 The Region shall supply the WAN IP address, Gateway and Subnet mask for the BACnet Broadcast Management Device (BBMD) router in the network. The controls contractor will facilitate integration into the Region's existing BAS BACNET network.

.3 On the network a BACnet IP device that is capable of BBMD will route information from other sites and the operator work station. In addition there shall be a CAT5 wire that is run to the Region's IT switch with a 4' pigtail and connector.

2.6 Trend Data

.1 Provide trend logs for every hardware input and output.

.2 All trends should be accessible via the graphical interface.

.3 Trends should contain all related variables of a control loop (that is, setpoint, measured variable and control output) and have the ability to be plotted simultaneously on the same graph. Field Devices Individual trends should provide an appropriate "snapshot" of the variable. Trends should contain a minimum of 5 days worth of trend data.

.4 Provide trending capabilities at 5 minute intervals that allow the user to easily monitor and preserve records of system activity over a one year period. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard drive for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.

.5 Trending shall be accessible from the graphics screens for each point. Each point shall have its associated trend capability accessible from the graphic via an icon located beside the point name on the graphic page.

.6 Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual point or predefined groups of a minimum of six points. Provide sufficient capacity to allow for trending a minimum of 100 points at 2000 samples each. Reports shall be easily transferable on-line to Microsoft Excel. The Contractor shall provide custom designed spreadsheet reports for use by the Region to track energy usage and cost, equipment run-times, equipment efficiency, and/or building environmental conditions.

.7 The operator shall be able to change trend log setup information. This includes information to be trend logged as well as the interval at which the information is to be logged. All points in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics where the point is displayed.

.8 Trending shall include the ability to track energy management aspects including, but not limited to, the following:
- .1 Daily use
- .2 Monthly use
- .3 Daily Hi and Low
- .4 Monthly Hi and Low
- .5 Demand Limiting and Load Shedding Program
- .6 Run time accumulation for any specified equipment
- .7 After hour use log

.9 The primary input sensor for all control loops must connect to the same panel containing the control loop output.

.10 Trend data storage must be in the same panel as the hardware or logical points being trended.

2.7 Alarms

.1 The BAS will be configured to provide for remote alarm capabilities.

.2 Alarms shall be capable of being routed to the Region's IT server so that they can be sent to Operator's email addresses.

.3 The operator workstation shall provide audible, visual and printed means of alarm indication. The Alarm Dialog box shall always become the Top Dialog box regardless of the application(s) being run at the time (such as a word processor). A printout of all alarms shall be sent to the assigned terminal and port.

.4 Provide a log of alarm messages. The alarm log shall be archived to the hard drive of the operator workstation. Each entry shall include a point descriptor and address, time and date of alarm occurrence, point value at the time of alarm, time and date of point return to normal condition and time and date of alarm acknowledge.

.5 The Controls Contractor shall work with the Region to determine required alarms in addition to those specified in the Contract Documents.

.6 Alarm messages shall be in plain English and shall be user definable on site or via remote communication.

2.8 Field Devices

.1 Automatic Control Valves
  .1 Valves used for throttling applications shall have a linear percentage-to-flow characteristic.
  .2 Ball valves are the preferred valve type for zone and HVAC control valves. Globe and butterfly valves shall be used where required to provide the desired pressure drop and control valves (CV).
  .3 Automatic Control valves shall be manufactured by Belimo Aircontrols Incorporated.

.2 Control Valve Actuators
  .1 Size control valve actuators to provide a tight close off against system head pressures and pressure differentials.
  .2 Valve actuators shall accept a 0-10 VDC control voltage for all proportional applications.
  .3 Floating point control of valves is not acceptable under any circumstances.
  .4 Heating valves shall spring-return fail open and cooling valves shall spring-return fail closed. Non-spring-return control valves may be used for terminal reheat coils and large HVAC control valves requiring a higher close off pressure.

.3 Damper Actuators
  .1 Actuators shall be direct coupled for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. Provide 0-10 VDC control voltage for all proportional applications and either

line or low voltage actuators for all two position applications.

.2 Actuators located in outside air intake ducts, mixing boxes or plenums or which could be exposed to outside air temperatures shall be suitable for operating in ambient temperatures as cold as -30 degrees Celsius and shall be provided as NEMA 3 weatherproof or NEMA 4X weatherproof.

.3 Actuators located in NEMA classified hazardous areas shall be explosion-proof - NEMA 7 rated for NEC Class I, Division 1, Group D or a standard unit with a separate NEMA 7 enclosure. Where unit is also required to be corrosion resistant, actuator shall be oil submerged type and the NEMA 7 rating shall prevail; however, an exterior, factory-applied corrosion-resistant finish suitable for the particular corrosive environment (such as heresite or baked phenolic coating) will be required if unit casing is not inherently corrosion resistant for the specific application.

.4 Damper actuators are to be manufactured by Belimo or approved equivalent.

.4 Automatic Control Dampers

.1 All automatic control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor (except for variable air volume (VAV) Boxes which shall be supplied by the Mechanical Subcontractor). All dampers in a mixing application shall be opposed blade. Parallel blade shall be permitted in other applications. Dampers shall be a tight closing, low leakage type with replaceable extruded vinyl seals on all outdoor and exhaust applications.

.5 Room Sensors/Thermostats

.1 Office: Temp Display, Set point Display, Set point Adjust, Schedule Override, High and Low Limit on set points.

.2 All areas except offices: Set point Adjust, Schedule Override, High and Low Limit on set points.

.3 Mount sensors at a height of 1.5 m (5 ft) to 1.8 m (6 ft) unless otherwise indicated on the Drawings.

.4 Mount thermostats and space sensors as noted on the Drawings. Do not mount on outside walls without permission of consultant.

.6 Current Switches (Digital)

.1 Provide BAS status for fan and pump motors using a mosfet type digital switch. Acceptable manufactures are Automation Components Incorporated (ACI), Enercorp Instruments Limited, Greystone Energy Systems Incorporated, Veris Industries and Elkor Technologies Incorporated.

.7 Pressure Transmitters

.1 Technical Performance - Solid State design, operating on capacitance principle, with non-interactive fine resolution, zero and span adjustments. End-to-end accuracy +/- 2 percent of full scale pressure range, including temperature compensation. 4-20mA or 0-5 VDC output.

.2 Standard of Acceptance – Automation Components Incorporated (ACI), Enercorp Instruments Limited, Greystone Energy Systems Incorporated, Modus Instruments Incorporated.

.8 Duct Temperature Sensor

.1 Probe - Technical Performance – 10 k ohm thermistor sensor encapsulated in a 200mm long, 6mm OD copper or stainless steel probe. Operating range 0 to 60 degrees Celsius. End-to-end accuracy +/- 0.3 degrees Celsius. Assembly complete with wiring housing and mounting flange.

.2 Averaging - Technical Performance - 10 k ohm thermistor constructed of FT6 plenum rated cable or soft copper tubing, incorporating numerous temperature sensors encapsulated at equal distances along the length of the element. The assembly acts as a single sensor reporting the average temperature form all individual sensors. End-to-end accuracy +/- 0.3 degrees Celsius. Assembly complete with wiring housing and mounting flange. Mount in a zig-zag manner to provide continuous coverage of the entire duct cross-sectional area.

.9 Outdoor Air Temperature Sensor

.1 Two outdoor air temperature sensors shall be installed and shall be programmed to check each other for accuracy. In the event of sensor failure the sensor deemed to be accurate shall be used to control the systems. The outdoor air sensors shall be located on a north wall if possible and a minimum of 0.9 m (3 ft) from any opening in the building envelope which could affect the sensor readings. The back face of the sensor enclosure shall be insulated to prevent temperature pick up from the building wall.

.2 Technical Performance, 10 k ohm thermistor -50 degrees Celsius to 50 degrees Celsius in a weatherproof enclosure mounted on north exposure. End accuracy of +/- 0.3 degrees Celsius over the entire operating range.

.10 Pipe Temperature Sensor

.1 Well - Technical Performance – 10 k ohm thermistor sensor encapsulated in a 6 mm OD, 50 mm long probe, with screw fitting for insertion into a standard thermowell. Operating range -10 to +100 degrees Celsius. End-to-end accuracy +/- 0.3 degrees Celsius over the entire operating range. Complete with brass thermowell. Use heat transfer paste when mounting the sensor in thermowell. No surface mount strap on temperature sensors shall be used to monitor fluid temperature unless approved by the Consultant.

.11 $C0_2$ Detector
- .1 Technical Performance – Infrared CO2 monitor c/w 4-20 mA or 0-5 VDC output, accuracy of +/- 40 ppm +3 percent reading.
- .2 Standard of Acceptance – Automation Components Incorporated ACI-CO2-D or Telaire Systems Incorporated duct mount.

2.9 Enclosure

.1 The BAS control and power supply cabinets shall conform with the following:
- .1 Panel enclosures shall be a locking type, metal cabinet, with common keying.
- .2 CSA certified 150359 and UL listed E109310.
- .3 16 or 14 gauge steel.
- .4 Slip hinges enabling door removal for easier access and mounting. Door shall be lockable.
- .5 1/4 turn keyed latch standardized to G549 keyset.
- .6 14 or 12 gauge galvanized steel panel on collar studs natural finish.
- .7 Grounding stud on inner cover surface.
- .8 Grounding hole on mounting panel with grounding screw.
- .9 ANSI/ASA61 grey polyester - epoxy textured powder coating inside out.
- .10 3" deep wire duct shall be installed to neatly conceal controller wiring.
- .11 Power supply cabinets shall be provided with a ESA Field Evaluation approval.
- .12 2-100 VA 120/24 Transformers Class II UL5085-3.
- .13 Over Current Protection by Circuit Breaker.
- .14 Outlet Receptacle for Service Laptop Power.
- .15 Any panels in a cooling tower or chemically treated areas shall be stainless steel (fiberglass enclosures rated for outside applications are acceptable).

2.10 BAS Database Naming Conventions & Programs

.1 All BAS programs shall be created in each panel in logical order as determined by the equipment being controlled by each panel on the network. Naming conventions shall be submitted for review by the Region. Names may be changed to comply with the Region’s naming conventions.

.2 All programs and program code is to follow proper coding practices including internal comments to describe the function of the statements and also ensure the source code is formatted in a consistent and logical manner. Programming coding should be kept as simple as possible.

.3 System Schedules shall be submitted for approval and will include global and local scheduling.

.4 The Outdoor Air Temperature Program shall be in its own program named OAT PG.

.5 Network Status Panel Naming Conventions shall indicate the building, panel location and panel number. The building name can be abbreviated as necessary to fit in the space, as approved by the Consultant and the Region.

2.11 <u>Graphic Display Screens</u>

.1 All Graphic Display Screens shall have the following common elements and functions regardless of system manufacturer. Every site shall have a graphic display screen for Site Graphic, System Architecture, each air handler, boilers, emergency generator, lighting, exhaust fans, heat reclaim, and for each room controlled by the BAS system.

.2 All operator accessible points shall be yellow text and all information points shall be blue.

.3 Trending shall be accessible from the graphics screens for each point. Each point shall have its associated trend capability accessible from the graphic via an icon located beside the point name on the graphic page.

.4 Appendix A at the end of this document shows examples of typical graphic screens. These are examples only. Graphics shall comply with the following specific screen content. Not all equipment and systems are listed below but the format will be the same for other equipment:

.5 Graphic Screens General All Screens
- .1 Navigation buttons to each major system in the building which indicate current screen display by a change in button colour
- .2 Background colour shall be black
- .3 Outdoor air temperature shall be displayed on every graphic screen

.6 Site Graphic
- .1 The York Region Logo on the site or opening graphic screen
- .2 Artist concept or scanned in picture of the front of the building
- .3 Access links to all global schedules or specific screens affecting entire building operation
- .4 Access buttons links to Set Time, Holiday Schedule, Schedule, Alarms, Points on Manual

.7 System Architecture
- .1 Control panel layout and network architecture
- .2 Indicating BAS panels and panel type(model)
- .3 Panel locations room number text on screen
- .4 Systems controlled by each panel
- .5 Links to points list accessible from each panel

.8 Architecture Panel Layout (Locations on Floor Plans)
- .1 Locations of each panel on each floor plan level
- .2 Panel types indicated by different icon
- .3 Controls transformers locations
- .4 Main network wiring and sub-network wiring layout

.9 Floor Plans graphics
- .1 Room numbers accurate in accordance with room signage
- .2 Mechanical rooms locations & signage tags
- .3 Space temperatures for every temperature on each floor in appropriate room
- .4 Space focus pick area for individual room control where applicable shall be yellow text
- .5 Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour
- .6 Status of Air Handler by colour change Red for off status, or text indication
- .7 Supply air temperature for each air handler

.10 Air Handler (AHU) graphic
- .1 Accurate representation of the AHU design
- .2 All associated control points to be displayed
- .3 All points to be monitored for automatic mode and shall be displayed when in Manual mode
- .4 A calculated percentage of fresh air shall be indicated on the AHU graphic
- .5 Operator offset adjustment of the supply air setpoint, adjustable directly form the graphic
- .6 AHU physical location shall be indicated on the graphic
- .7 Weekly occupied time of day schedule for the associated AHU shall be accessible directly from the graphic by selecting an icon
- .8 Weekly student time of day schedule for the associated AHU shall be accessible directly from the graphic by selecting an icon
- .9 Trend logs shall be accessible directly form the graphic by selecting an icon

.11 Boiler graphic
- .1 Boiler graphic piping layout shall be accurate in accordance with the piping layout
- .2 All associated control points for the boiler system to be displayed

.3 Operator offset adjustment of the scheduled water setpoint, adjustable directly form the graphic
.4 Lead boiler and boiler stages shall be indicated in the BAS graphical interface.
.5 Lead pump shall be indicated in the BAS graphical interface.
.6 Boiler status shall be indicated graphically
.7 Pump status shall be indicated graphically
.8 Calculated scheduled water setpoints to be displayed
.9 Operator offset editable directly from the graphic screen
.10 Weekly time of day schedule for the building occupied schedule shall be accessible directly from the graphic by selecting an icon
.11 Trend logs shall be accessible directly from the graphic by selecting an icon

.12 Exhaust fans graphic
.1 Exhaust fans control shall be editable directly from the graphic.
.2 Exhaust fan status shall be indicated in text and a change in the exhaust fan icon.
.3 Exhaust fan physical location shall be indicated on the graphic.
.4 Area of the building being exhausted shall be indicated on the graphic.

PART 3. INSTALLATION

.1 All wiring line and low voltage shall be installed in EMT conduit unless specifically specified otherwise on the Contract Drawings.

.2 All wiring shall be in accordance with the Ontario Electrical Safety Code and any applicable local codes. All BAS wiring shall be installed in conduit unless otherwise allowed by the Ontario Electrical Safety Code or applicable local codes. Where BAS plenum-rated cable wiring is allowed, it shall be run parallel to, or at right angles to, the structure, properly supported and installed in a neat and workmanlike manner. BAS wiring that runs in exposed ceiling spaces (including garages, mechanical rooms) shall be installed in conduit.

.3 In accessible ceilings, wiring from BAS controllers to sensors and actuators, control system network and low voltage wiring only may be installed with yellow jacket LVT cable. Where the ceiling is used as a return air plenum install plenum rated yellow jacket cable instead of LVT.

.4 BX or flex conduit may only be used for the final (approximately one meter) run to controls devices, where the controls equipment is mounted on vibrating machinery.

.5 Install EMT and cable at right angles to building lines, securely fastened, and in accordance with the standards set out in Division 16 - Electrical.

.6 No wire smaller than 18 gauge is to be used on the Contract except for: wiring between terminal computer devices, wire in standard communication cables, such as printers and short haul modems, wire used in communication networks, i.e. any cable transferring digital data, using twisted shielded pairs.

.7 All field wiring including sensor wiring and wiring from panels to devices shall be continuous. The use of wire connectors, wire nuts or splicing is not allowed.

.8 Provide wells for all specified temperature sensors in hydronic piping system. Strap-on sensors may be only be used where a well installation is not possible. Obtain approval of the Consultant for the use of strap-on sensors.

.9 Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently be switched off.

.10 Mount transformers and other peripheral equipment in panels located in serviceable areas. Provide line side breakers/fuses for all transformers.

.11 All 120 VAC power for any controls equipment shall be from dedicated circuits. Provide a breaker lock for each breaker used to supply the control system. Update the panel circuit directory.

.12 The controller may be powered from the equipment that it is directly controlling (i.e. heat pump, roof-top unit) only if the controller controls no other equipment and the power supply to the controller remains energized independently of unit operation or status.

.13 All BAS control wiring shall be yellow jacket for identification purpose.

.14 The breaker or power isolation location shall be clearly marked on the inside door of each BAS panel enclosure.

.15 Wiring in ceiling spaces to be installed clear of ceiling tiles and lights to allow access and removal of tiles and lights.

.16 Contractor shall prepare a wiring mock-up of a typical system/device/main panel to demonstrate quality and workmanship for approval by the Region. This approved mock-up quality shall be maintained throughout the entire installation. System requiring mock-up to be discussed with the Region.

.17 All wiring shall be routed orthogonally and drops shall have additional wiring coiled in ceilings to facilitate future sensor relocation.

.18 Wiring in ceiling spaces to be secured/tied every 120 cm (48 in) minimum.

.19 Surge suppression shall comply, as a minimum, with the manufacturer's requirements.

.20 All equipment including controllers shall be grounded.

.21 All end-of-wire connectors shall be certified.

.22 All components shall be labelled and detailed in manuals.

.23 All wiring systems shall be colour coded to simplify maintenance.

.24 All equipment shall be located for ease of service access.

.25 The Contractor shall maintain a list of deficiencies when close to completion, and shall update this list on a regular basis for review by the Region's representative.

.26 If the project is a retrofit of an existing system:

.27 The Contractor shall remove all old redundant wiring following system verification

.28 Re-use of existing wiring is not allowed. Run continuous new wiring

.29 Re-use of components (for example enclosures, transformers) is not allowed unless approved by the Region.

3.2 Equipment Location

.1 All distributed equipment such as VAV boxes, Roof top units, unit ventilators, fan coil units, etc. that utilize dedicated BAS controllers, shall have locally mounted controllers, in accessible locations within the building envelope. All locally mounted controllers shall be installed in enclosures suitable for that location. BAS controllers for mechanical equipment other than those listed above in Subsection 2.3 shall be mounted in mechanical rooms as noted below, unless specifically approved by the Consultant for this project.

.2 All other BAS controllers, and interface devices that require regular inspection or that serve multiple HVAC systems shall be located in mechanical rooms, or in pre-approved storage rooms, or janitor closets.

.3 All equipment located in mechanical rooms, storage rooms or janitor closets shall be installed in metal cabinets with hinged, lockable covers.

.4 Transformers or power supplies shall not be located in ceiling spaces unless approved by the Consultant for terminal control valves, actuators or zone controllers. When transformers are installed above ceilings, transformers shall be installed in metal enclosures, and the location shall be clearly labeled on the t-bar ceiling to indicate power transformer location.

.5 A 120 VAC duplex receptacle for laptop power shall be provided if the cabinet is located further than 1.5 m (5 ft) laterally from the nearest outlet.

3.3 Identification and Labelling Equipment

.1 All panels must have a lamacoid tag (minimum of 3”x1”) affixed to the front face indicating panel designation and function (that is, “BAS Panel 1” or “Relay Panel 3”).

.2 All field sensors or devices must have a lamacoid tag (minimum of 3”x1”) attached with tie-wrap or adhesive indicating the point software name and hardware address (that is, AHU1_MAT, 2.IP4).

.3 Room sensors and other sensors in finished areas will require a device tag.

.4 All devices within a field enclosure will be identified via a label or tag.

.5 All BAS panel power sources must be identified by an adhesive label indicating the source power panel designation and circuit number on the outside of the enclosure door (that is, “120 VAC fed from LP-2A, Space #1).

.6 All field equipment panels fed from more than one power source must have a warning label on the front cover.

.7 All wires will be identified with self-adhesive wire labels or clip-on plastic wire markers at both ends.

.8 All rotating equipment controlled by the BAS will have a tag or label affixed indicating that the equipment may start without warning.

.9 All BAS panels will have a points list sheet (within a plastic sleeve) attached to the inside door. The points list will identify the following for each point: Panel number, panel location, hardware address, software name, point description, field device type, point type (that is. AI or DO), device fail position, device manufacturer and model number or reference and wire tag reference.

.10 Where required, field panels will have wiring diagrams attached to the inside door.

.11 Provide new or modify existing equipment wiring diagrams (for boilers, chillers, etc.) wherever the BAS interfaces to other equipment.

3.4 Commissioning

.1 Perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning.

.2 Upon completion of the performance tests, repeat these tests, point-by-point in the presence of the Region's representative, as required. Properly schedule these tests so that testing is completed by the time directed by the Region's representative.

.3 Confirm and demonstrate to the Consultant and the Region that all systems are programmed and operating correctly. As the project nears substantial performance, and in accordance with Section 01501- Construction Sequencing, the Contractor shall allow sufficient programming time in order to customize the sequences to meet operational needs, fine tuning of the system and other duties as required. The Region will determine the schedule.

.4 Submit four (4) copies of the system commissioning report to the Consultant for review and approval.

.5 Each analogue input (for example temperatures, pressure, etc.) shall be verified with a calibration device approved by the Region. All actual temperature readings should be with +/- 1 degrees Celsius of the readings observed at the workstation.

.6 Each analogue output shall be verified by manually commanding the output channel from the operator workstation to two or more positions within the 0-100 percent range and verifying the actual position of the actuator or device. All devices shall operate over their entire 0-100 percent range from a minimum control range of 10 percent to 90 percent.

.7 Digital outputs shall be verified by witnessing the actual start/stop operation of the equipment under control.

.8 Digital inputs shall be verified by observing the status of the input point as the equipment is manually cycled on and off.

.9 Record all out-of-season or unverified points in the commissioning report as “uncommissioned”.

.10 The BAS field panel power source shall be toggled on and off to ensure reboot functionality and power down memory retention of all parameters. During the power down test, all connected system components should go to their fail-safe state.

.11 All trends should be reviewed to ensure that setpoints are being maintained and excessive cycling of equipment is not occurring.

.12 Control loop tuning parameters can be verified by applying a change to the current setpoint and observing the resulting trend log. Setpoint should be reached in a “reasonable” period of time without excessive cycling or hunting of the controlled device.

3.5 Training

.1 Once 5 consecutive Days of alarm-free operation are complete and documented, operator training may begin.

.2 Provide 1 Day of instruction to the Region's designated personnel on the operation of the BAS and describe its intended use with respect to the programmed functions. Operator orientation of the BAS shall include, but not be limited to, the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the system's operation.

3.6 Warranty

.1 Provide a warranty on all components supplied under this Contract for a period of two years from the date of Total Performance of the Work. Replace all controls equipment that fails during this period without cost to the Region.

.2 All controllers shall have a 5 year manufacturer's warranty commencing on the date of Total Performance of the Work.

3.7 As-Built Documentation

.1 Within 14 after the date of Substantial Performance of the Work, update the original submittal documents to reflect the "As Built" conditions of the Contract and submit four copies as required by the Consultant and/or the Region.

.2 Provide a separate laminated copy of the control drawings for mounting in the mechanical room or in the controls panels.

.3 Provide final point lists, shop drawings and all installed equipment data and operations sheets.

.4 Submit diskettes/CD's (including back-up diskettes/CD's) containing up to date copies of the programs in each controller. Provide original program disks and documentation confirming registration for all software programs provided as a part of this Contract including: the BAS operator interface software, and the BAS graphics (bitmap files). Provide one set of original disks for every computer supplied under this contract or that the software has been loaded onto.

.5 Submit (4) printed copies of the final programs that include all point definitions, weekly and annual schedule setting, controller setpoints and tuning parameters, and documented programmed sequences of operation.

3.8 Control Points and Points List

.1 A typical points list for system control and monitoring is attached as a Supplement to this Section: 13700-01 – Schedule for System Control and Monitoring and shall be used as a guide for the minimum requirement for the system design.

.2 This points list is not intended to be complete. It is intended to be a typical list to capture all foreseeable equipment types. Project specific points list must be created on a project-by-project basis by the BAS contractor and shall be reviewed by York Region.

.3 York Region staff shall be consulted to develop the sequence of operations in addition to Section 15985 – HVAC Controls and

Sequence of Operations. York Region will provide the BACnet address range for each building.

.4 All control points shall have built in time delays to prevent short cycling.

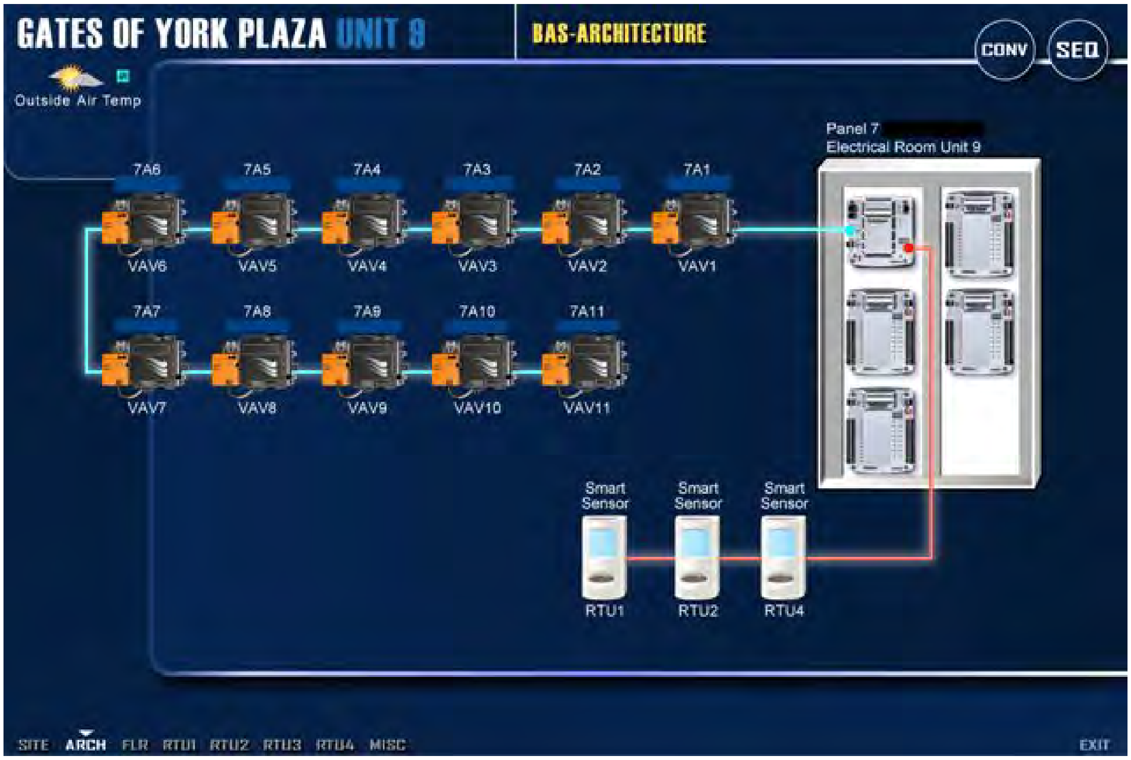
.5 Point Naming conventions shall be submitted for review by the Region. Names may be changed to comply with the Region's naming conventions.

3.9 <u>Supplements</u>

.1 The supplements listed below, following the "END OF SECTION", are part of this Specification.

.1 Section 13700-01 – Schedule for System Control and Monitoring

Appendix A – Typical Graphic Screens


GATES OF YORK PLAZA UNIT 9
BAS-ARCHITECTURE
CONV
SEQ
Outside Air Temp
Panel 7 [redacted]
Electrical Room Unit 9
7A6
7A5
7A4
7A3
7A2
7A1
VAV6
VAV5
VAV4
VAV3
VAV2
VAV1
7A7
7A8
7A9
7A10
7A11
VAV7
VAV8
VAV9
VAV10
VAV11
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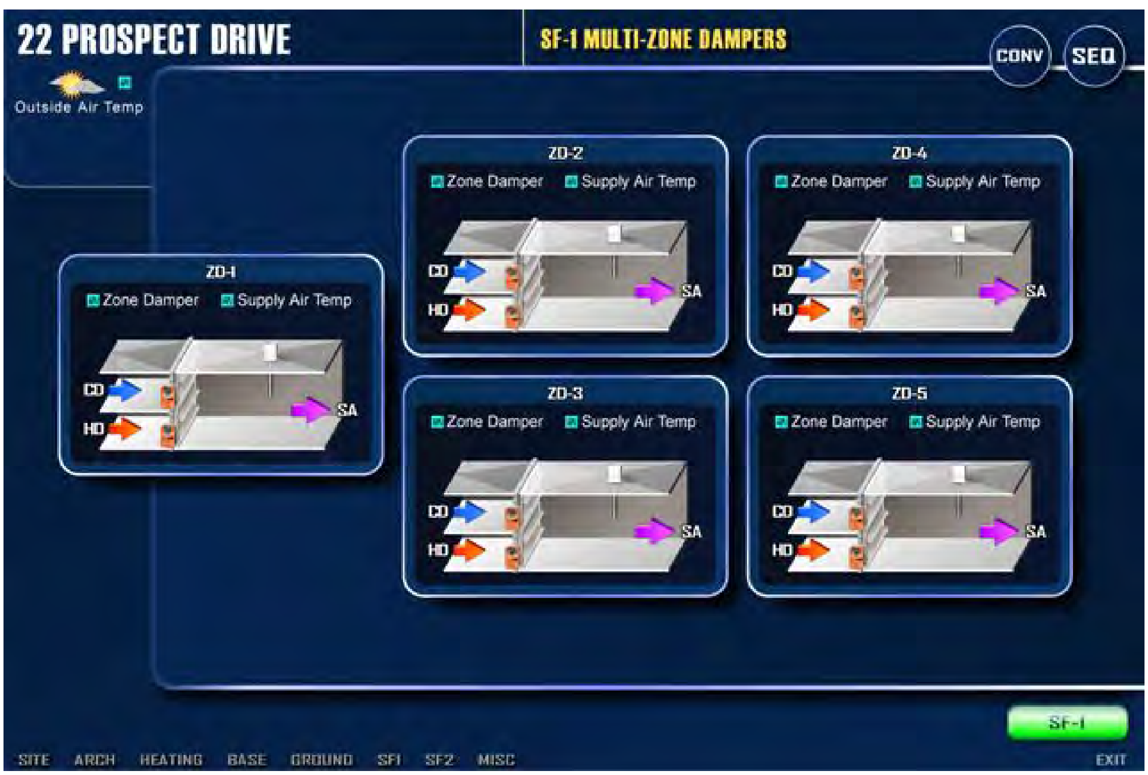
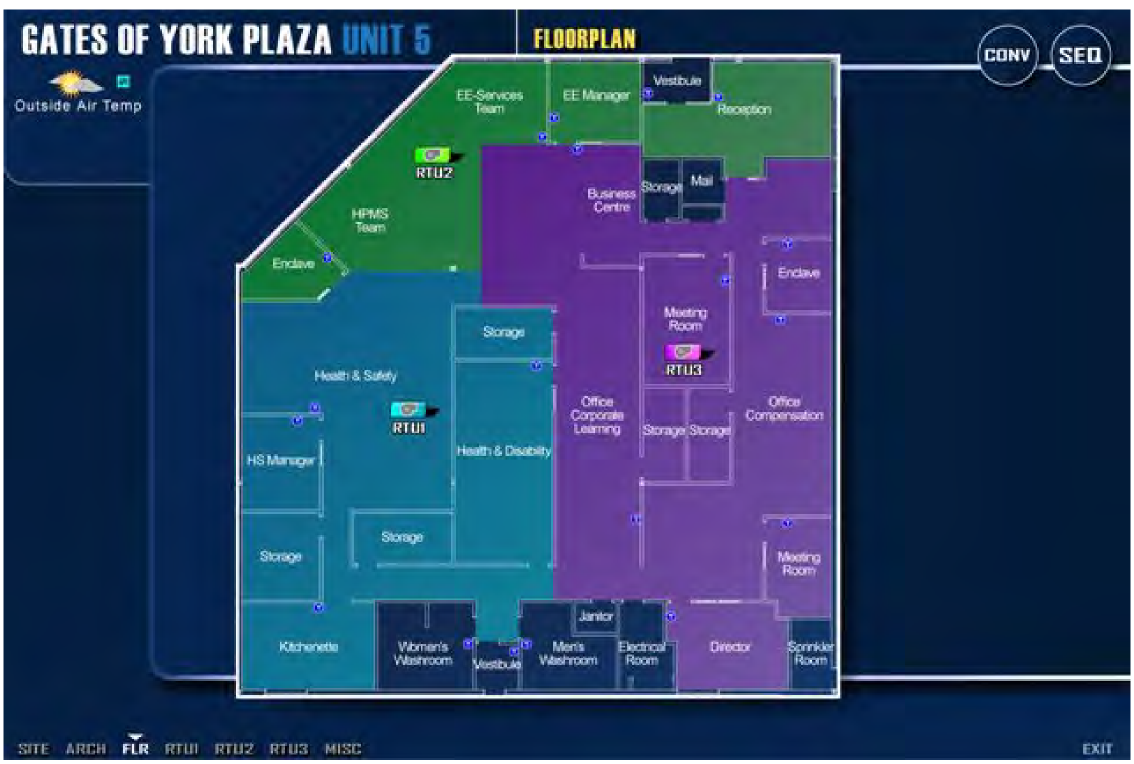
RTU2
RTU4
SITE ARCH FLR RTU1 RTU2 RTU3 RTU4 MISC
EXIT


22 PROSPECT DRIVE
SF-1 MULTI-ZONE DAMPERS
CONV
SEQ
Outside Air Temp
ZD-1
Zone Damper
Supply Air Temp
CD
HD
SA
ZD-2
Zone Damper
Supply Air Temp
CD
HD
SA
ZD-3
Zone Damper
Supply Air Temp
CD
HD
SA
ZD-4
Zone Damper
Supply Air Temp
CD
HD
SA
ZD-5
Zone Damper
Supply Air Temp
CD
HD
SA
SF-1
SITE ARCH HEATING BASE GROUND SF1 SF2 MISC
EXIT


GATES OF YORK PLAZA UNIT 5
NORTH VESTIBULE
CONV
SEQ
Outside Air Temp
Force Flow
Vestibule
Reception
Storage
Mail
ZONE SENSOR
Zone Temp
Occupied Setpoint
Unoccupied Setpoint
SCHEDULE
Weekly
Annual
FLOORPLAN
EXIT


GATES OF YORK PLAZA UNIT 5
FLOORPLAN
CONV
SEQ
Outside Air Temp
EE-Services Team
EE Manager
Vestibule
Reception
RTU2
Business Centre
Storage
Mail
HPMS Team
Enclave
Enclave
Meeting Room
Storage
RTU3
Health & Safety
RTU1
Office Corporate Learning
Storage
Storage
Office Compensation
HS Manager
Health & Disability
Storage
Storage
Meeting Room
Janitor
Kitchenette
Women's Washroom
Vestibule
Men's Washroom
Electrical Room
Director
Sprinkler Room
SITE
ARCH
FLR
RTU1
RTU2
RTU3
MISC
EXIT


22 PROSPECT DRIVE
MISCELLANEOUS
CONV
SEQ
Outside Air Temp
DHW PUMP
Stat
Ctrl
SANITARY EF2
Stat
Ctrl
SANITARY EF3
Stat
Ctrl
SITE ARCH HEATING BASE GROUND SF1 SF2 MISC
EXIT


GATES OF YORK PLAZA UNIT 8
RTU1
CONV
SEQ
Outside Air Temp
Min. Position Damper Control
Mixed Temp
OA
Return Temp
Supply Temp
DX COOLING
Stage 1
Stage 2
SUPPLY FAN
Status
Control
GAS HEATING
Stage 1
Stage 2
RA
SA
ZONE TEMP
OCCUPIED SP
SCHEDULES
Fan
High Occ
Annual
Override Timer
Unoccupied Setpoint
SITE ARCH FLR RTU1 RTU2 RTU3 RTU4 MISC
EXIT

END OF SECTION

		Analog Points															Digital points						Misc.				
		Input												Output			Input			Output							
	Point name EQ Type	Temperature	CO2/CO/NO2	Velocity	Diff. Press.	Pressure	Low Limit	Flow	Timer	Position	Speed	Humidity	Lux	Electric	Damper	H / C Valve	Status	Position	Switch	Start/Stop	On/Off	Damper	Alarm	Weekly Sch.	BACNET Object Exchange	Graphic	Notes
Outdoor	**OAT**																						X				Sensor fail alarm
Temperature		X																					X				2 Sensors with temp avg
Photo Cell													X										X				
Humidity												X											X				2 sensors
AHU Systems (AHU-2, AHU-3, AHU-4)	**AH**																						X	X		X	The HVAC equipment shall be supplied as “Thermostat-Ready”. The building automation system shall have direct control of dampers, heating and cooling stages without the requirement of BACnet, Lonworks or any other type of communication interface. Factory installed interlocks, safeties and anti-cycle timers shall be provided as required.
Fan						X					X						X			X			X				
Heating										X						X							X				
Economizer														X									X				Full BAS Control 0 - 100%. Remove OEM actuator
Cooling																X				X			X				
Power Exhaust						X											X			X			X				Provide pressure based fan control for VAV exhaust
Bypass damper														X									X				
Supply Air		X	X									X											X				
Return Air		X	X									X			X								X				
Mixed Air		X													X								X				
Heat Wheel											X			X						X			X			X	VFD's, Alarm and sequence for defrost/freeze protection
Space Temp - Display/Adjust/Override		X																					X				
Static Pressure						X																	X				
Freeze Stat							X																X				
Supply air flow rate at VAV boxes								X															X				
Supply air flow rate at main duct (and each floor if applicable)								X															X				
Filter differential Pressure					X																		X				

		Analog Points															Digital points						Misc.				
		Input												Output			Input			Output							
	Point name EQ Type	Temperature	CO2/CO/NO2	Velocity	Diff. Press.	Pressure	Low Limit	Flow	Timer	Position	Speed	Humidity	Lux	Electric	Damper	H / C Valve	Status	Position	Switch	Start/Stop	On/Off	Damper	Alarm	Weekly Sch.	BACNET Object Exchange	Graphic	**Notes**
MUA Systems (AHU-1)	**MUA**																						X	X		X	The HVAC equipment shall be supplied as “Thermostat-Ready”. The building automation system shall have direct control of dampers, heating and cooling stages without the requirement of BACnet, Lonworks or any other type of communication interface. Factory installed interlocks, safeties and anti-cycle timers shall be provided as required.
Fan								X			X			X			X			X			X				
Heating		X														X							X				Space and Discharge Air Temperature Inputs
Economizer															X		X						X				Full BAS Control 0 - 100%
Bypass damper															X		X						X				
Supply Air		X																					X				
Mixed Air		X																					X				
Occ Sensor (Dry Well)																	X						X				Provide occupied/unoccupied ventilation rates based on room occupancy and OAT
Space Temp - Display		X																					X				
Freeze Stat							X																X				
Supply air flow rate								X															X				
Filter differential Pressure					X																		X				
Split AC Systems	**AC**																						X	X		X	Incorporate existing split AC system into BAS
Fan																				X			X				
Space Temp		X																					X				
DX																				X			X				If unit is wired accordingly. If not Standalone operation of DX is acceptable as long as the BAS can disable it through a weekly
Condensing Units	**CU**																						X	X		X	
Fans																				X			X				
Compressor										X			X							X			X				Speed input outout required for modulating compressors

		Analog Points															Digital points						Misc.				Notes
		Input												Output			Input			Output							
	Point name EQ Type	Temperature	CO2/CO/NO2	Velocity	Diff. Press.	Pressure	Low Limit	Flow	Timer	Position	Speed	Humidity	Lux	Electric	Damper	H / C Valve	Status	Position	Switch	Start/Stop	On/Off	Damper	Alarm	Weekly Sch.	BACNET Object Exchange	Graphic	
DX		X			X									X									X				(Differential pressure for suction and return required for modulating compressors

		Analog Points															Digital points						Misc.				
		Input												Output			Input			Output							
	Point name EQ Type	Temperature	CO2/CO/NO2	Velocity	Diff. Press.	Pressure	Low Limit	Flow	Timer	Position	Speed	Humidity	Lux	Electric	Damper	H / C Valve	Status	Position	Switch	Start/Stop	On/Off	Damper	Alarm	Weekly Sch.	BACNET Object Exchange	Graphic	Notes
CO2	**CO2**																						X			X	
Zone Levels			X																				X	X			BACNET Monitoring of the Gas detection system is acceptable
Fan Start																	X			X							2 Stage system. 1st stage fan starts. 2nd stage Fan and horn start.
Audible Alarm																				X			X				
Strobe Alarm																				X			X				
EF Timed Override Pushbutton																	X						X				Pushbutton is used to start fan to ventilate space for a predetermined time when fans are otherwise off. 1 Pushbutton per zone.
EF Systems	**EF**																						X	X		X	Incluing AHU if exhaust fan is present
Fan																	X			X			X				
Occ Sensor (Bathrooms)																			X				X				Bathrooms: Local EF control
Occ Sensor (Screen Room, Wet Well, Dry Well)																	X		X				X				Provide occupied/unoccupied ventilation rates based on room occupancy and OAT
Space Temp - Display/Adjust/Override		X																					X				Space Temp for areas where fan is used for waste heat ventialtion
SF Systems	**SF**																						X	X		X	
Fan								X			X						X			X			X				
Occ Sensor (Screen Room, Wet Well, Dry Well)																	X		X				X				Provide occupied/unoccupied ventilation rates based on room occupancy and OAT
Space Temp - Display/Adjust/Override		X																					X				
Unit heaters	**UH/FC**																						X	X		X	
Start Stop																				X			X				
Heating valve														X									X				All heating valves will be fully modulating 0-10V
Space Temp - Display/Adjust/Override		X																					X				

		Analog Points															Digital points						Misc.				
		Input												Output			Input			Output							
	Point name EQ Type	Temperature	CO2/CO/NO2	Velocity	Diff. Press.	Pressure	Low Limit	Flow	Timer	Position	Speed	Humidity	Lux	Electric	Damper	H / C Valve	Status	Position	Switch	Start/Stop	On/Off	Damper	Alarm	Weekly Sch.	BACNET Object Exchange	Graphic	Notes
Boiler Plant	**Blr**																						X	X		X	
Start Stop																	X			X			X				
Modulation														X									X				
Supply Water (Building Loop)		X																					X				
Return Water (Building Loop)		X																					X				
Supply Water Temp (Tempered Loop)		X																					X				
Return Water Temp (Tempered Loop)		X																					X				
Note: OAT Reset		X																					X				
Supply Pressure (Building loop)						X																	X				
Return Pressure (Building Loop)						X																	X				
Differential pressure bypass						X								X									X				
Pumps	**P**																X						X			X	
Start Stop									X								X			X			X				For coil pumps, provide start/stop control based on OAT and respective heating coil operation. Operating time recorded
Speed					X	X					X			X									X				Speed required for variable speed pumps
Lights - Screen Room / Work Shops	**SR/WS**																						X	X		X	
Lights																				X							Only if no Lighting Automation System exists
Occupancy Sensor																			X								A sufficient number of sensors shall be installed to capture motion in all areas even with installed equipment and vehicles parked. Consult the Regions project team to review locations.
Push Button override																			X								Lights will be manual on. Off will be based on occupancy with time delay

		Analog Points															Digital points						Misc.				Notes
		Input												Output			Input			Output							
	Point name EQ Type	Temperature	CO2/CO/NO2	Velocity	Diff. Press.	Pressure	Low Limit	Flow	Timer	Position	Speed	Humidity	Lux	Electric	Damper	H / C Valve	Status	Position	Switch	Start/Stop	On/Off	Damper	Alarm	Weekly Sch.	BACNET Object Exchange	Graphic	
Gas Meter (pulse)	**Gas Meter**																									X	Gas meter shall be pulse output thermal mass flow meter. Accuracy of +/- 1% at full range of meter.
Consumption								X																			Monitor and record gas consumption
Boilers								X																			Gas meter installed on gas supply line to each boiler to monitor and record boiler gas consumption
Water Heater								X																			Gas meter installed on gas supply line to water heater to monitor and record gas consumption
Water Meter	**WM**																						X				
Boiler make-up water								X																			
Locker Room/ Washroom Control	**LR/WR**																						X	X		X	
Lights																					X		X				
Motion Sensor																		X					X				
Supplemental heat																					X		X				
Space Temp - Display/Adjust/Override		X																					X				
Points / Equipment Not Identified on List																							X	X		X	Functional Requirements to be determined by York Regions project team through an RFI.
Where Applicable		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X		X		

		Analog Points															Digital points						Misc.				
		Input												Output			Input			Output							
	Point name EQ Type	Temperature	CO2/CO/NO2	Velocity	Diff. Press.	Pressure	Low Limit	Flow	Timer	Position	Speed	Humidity	Lux	Electric	Damper	H / C Valve	Status	Position	Switch	Start/Stop	On/Off	Damper	Alarm	Weekly Sch.	BACNET Object Exchange	Graphic	Notes
VAV'S	**VAV**																						X	X		X	AHU-3
Space Temp - Display/Adjust/Override		X																					X				
Supply Air Temp		X						X															X				
Room CO2			X																				X				All Zones
Damper Control														X									X				
Damper Position										X													X				
VFD's (Applies to all systems with VFD's)	**VFD**																						X	X		X	Associate graphic with associated equipment
Start / Stop																				X			X				
Speed						X		X			X			X									X				
Feedback																	X						X				
Alarm																	X						X				
Duct Smoke Detectors	**SD**																X						X			X	Provide ventilation system shutdown upon detection of smoke
Heating Coil	**HC**	X														X	X	X								X	
Space Temp - Display/Adjust/Override		X																					X				

PART 1. GENERAL

1.1 General

.1 Provide a complete security system design and installation that meets the design intent as indicated within the Contract Documents. Provide all labour and materials for a complete and fully functional security system.

.2 Contractor shall be, as a minimum, CANASA (Canadian Alarm and Security Association) certified. Additional certifications that are required include CFAA (Canadian Fire Alarm Association) certified, and NFPA (National Fire Protection Association) certified.

.3 All security equipment and components are to be supplied and installed by the Contractor unless components are verified to be functional, meet the design intent, and the Region has approved reuse of existing equipment. The Contractor shall submit all requests to reuse equipment in writing.

.4 Conform to the Region’s Standards, including SCADA Standards and Wiring and Tagging Standards, (included in the appendices), where applicable.

.5 Related documents: CANASA Canadian Alarm and Security Association installation guidelines.

.6 Submit to the Electrical Safety Authority (ESA) and any other authority having jurisdiction the necessary number of working drawings and specifications for examination and approval prior to commencement of Work.

.7 Provide all labour and materials for any changes or alterations required by the authorized inspector of the ESA and of any other authority having jurisdiction. Modifications required as a result of required changes shall occur without delay to the progress of the construction schedule and shall be supplied at no additional cost to the Region.

.8 Contractor shall provide training for the Region’s designated personnel. The training shall cover all aspects of normal operation and routine maintenance on the systems and equipment installed.

.9 Contractor shall provide a complete in-place warranty service for all system components provided. The warranty duration shall be for a period of two (2) years from the date of Total Performance of the Work, and shall provide all necessary material required to replace defective products during this period. Third party warranties shall not be acceptable.

1.2 Related Sections

.1 Division 13 – SCADA and Instrumentation

.2 Division 16 - Electrical

1.3 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13710 – Security System as indicated in Schedule ‘A’ of the Bid Form.

1.4 Honeywell EBI Security System Installers

.1 Prior to submitting the proposed system design submittal and component submittal to the Region for approval, the Contractor shall consult with the equipment supplier representative named below for component selection and to verify that the proposed design provides the intended functionality:

.1 Honeywell

Account Executive: Marc Kingsbury

85 Enterprise Blvd

Markham, Ontario L6G 0B5

(289) 333-1333 fax

(416) 895-7926 Mobile

.2 The installation and integration of the Honeywell EBI security system(s) must be completed by, one of the installers listed herein.

.3 Approved EBI System Installers (alphabetical order)

.1 A-1 Service Group

201 Spinnaker Way, Unit #12

Concord, Ontario

L4K 4C6

Contact: Mr. John Plainos

jplainos@a1-servicegroup.com

Phone: 905-669-4095 x 222

.2 Guild Electric

470 Midwest Drive

Toronto, Ontario

M1P 4Y5

Contact: Mr. Rob Smith

rob.smith@guildelectric.com

Phone: 416-288-8222 x 628

.3 Plan Group

27 Vanley Cres.

North York, Ontario

M3J 2B7

Contact: Mr. Rob Steinhaur, Account Executive

rsteinhaur@plan-group.com

Phone: 416-635-9635 x 3476

.4 OZZ Electric Inc.

20 Floral Parkway

Concord, Ontario

L4K 4R1
Contact: Mr. Paul Sheppard, Service/Cabling Manager
psheppard@ozzelectric.com
Phone: 416-678-3029

1.5 References

.1 EEMAC TC3 PVC Fittings for use with Rigid PVC Conduit and Tubing.

.2 CSA C22.2 No. 211.2 Rigid PVC (Unplasticized) Conduit.

.3 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.

.4 CSA C22.2 No. 211.2-M1984(R1999), Rigid PVC (Unplasticized) Conduit.

.5 Surveillance System Related References:
  .1 Canadian Interference-Causing Equipment Standard (ICES)-003
  .2 Canadian Standards Association (CSA)
  .3 Conformity for Europe (CE)
  .4 Consultative Committee for International Radio (CCIR)
  .5 Electronic Industry Association (EIA)
  .6 Electrical Testing Laboratories (ETL)
  .7 Federal Communications Commission (FCC)
  .8 Joint Photographic Experts Group (JPEG)
  .9 Moving Picture Experts Group (MPEG)
  .10 National Television Systems Committee (NTSC)
  .11 Phase Alternating by Line (PAL)
  .12 Underwriters Laboratories Inc. (UL)

1.6 Network Connectivity

.1 The Region’s Project Manager will coordinate the installation of Network System components with the Region’s network representatives where communication network connectivity is required to facilitate communications to the master security station located at Regional Headquarters. The Contractor shall provide all network connections, associated network components and commissioning efforts.

.2 A TCP/IP Ethernet network switch and telephone based modem shall be located within the Honeywell security system cabinet.

1.7 Shop Drawings

.1 Submit shop drawings showing proposed location of all equipment and components to be installed under this Contract. Clearly indicate if existing equipment is being proposed for reuse.

.2 At a minimum, the submitted design shall include:
  .1 Schematic riser diagram showing all components
  .2 Wiring requirements between components, including conduit requirements
  .3 Component interconnection diagrams
  .4 Uninterrupted Power Supply (UPS) and battery calculations

.3 Additional Requirements:
  .1 Functional description.
  .2 Performance data.
  .3 Physical, electrical and environmental requirements.
  .4 Location drawing.
  .5 Equipment descriptive literature.
  .6 Wiring details.
  .7 For programmable equipment, communication links and networks, submit bill of materials. Include in bill of materials hardware documentation.
    1. For hardware items include and clearly identify: Description, make, model, part number and serial number.
    2. For documentation include: Title and publisher for each item.
  .8 For Programmable Equipment Hardware:
    1. Product description for each item including:
      1. Wiring and installation instructions.
      2. Functional description.
      3. Performance data.
      4. Physical, electrical and environmental requirements.
      5. Adapters and controllers.
    2. Equipment layout drawings showing location of hardware, boards, jacks, cables and terminals.
    3. Related field tag numbers and wire numbers, module tag assignment, rack module assignment, terminal and terminal strip numbers.
    4. Location and identifier and pin assignment of plugs, jacks, and cables.
    5. Switch settings and addresses, firmware.
    6. Interconnection Diagrams including wiring, cables, jacks between internal and external components, power supplies, processors, communications modules, racks, I/O modules and peripherals. Label terminals, jacks and pins. Show settings for

jumpers and switches. Show address for each hardware module and point.

7. Scaled plans showing equipment mounting with working clearance and equipment mounting elevations.

.4 Review of the shop drawings by the Consultant shall not in any way relieve the Contractor of responsibility for errors or omissions, or from the necessity of furnishing such Works and materials as may be required to provide a fully functional system. .

PART 2. PRODUCTS

2.1 Control Panel

.1 Honeywell Tema Server2 Control Panel: TS2 up to 16 doors using Weigand Interface Units (“WIU”) (each WIU capable of managing one access controlled door with either 1 in reader or 1 in and 1 out reader at the door). Provided with TCP/IP network connectivity and 128MB DDR SRAM. Include 6amp AX-AL600ULX Panel and Lock power supply with ACM8 lock distribution with Fire Interface. Include Full Size Cabinet and cabinet tamper switch. Equipment shall be ULC listed.

.2 Honeywell Vista Alarm Panel for intrusion devices: Vista 128BPE Control, Burg, Commercial Panel 128 zones, transformer, 12V 7amp battery with UDS1100 device server, zone expanders and 3amp power supply. Equipment shall be ULC listed.

.3 Surge Suppression shall be integrated into the panel design to provide system power surge protection. Surge suppression shall be Ditek Corp. 120SR for 120VAC feeds and Ditek MRJ45C5E for Ethernet ports, or approved equal.

.4 Panel mount Uninterruptable Power Supply (UPS) shall power all security, access control and network equipment. . UPS model shall be American Power Conversion (APC) by Schneider Electric Pro BR 1300G or approved equal.

2.2 Keypad

.1 Honeywell 6160 Series Remote Keypad: Honeywell commercial LCD remote keypad, 32 character backlit display, 12VDC, ULC listed.

.2 Honeywell Code Pad Reader HID 5355AGK14

.3 Honeywell Vista 6160.

2.3 Input/Output Module

.1 Digital I/O Module A01, allowing for up to 4 inputs/outputs per unit.

2.4 Weigand Interface Unit

.1 Honeywell A08 Weigand Interface Unit, allows for control of one door configured as either 1 in reader or 1 in reader and 1 out reader.

2.5 Intercom

.1 TOA Canada Corporation N8000 IP intercom system. Master Intercom N-8500MS with 32 character LCD display and Q-N-8540WP Outdoor Door Station. These devices are Power Over Ethernet (POE) and connect directly to the building LAN via POE network switch. Include YC-280 wall mount bracket for Master station and either flush mount back box model YC-150 or surface mount back box YS-13A depending on application.

2.6 Multi-technology iClass Reader

.1 Card Readers: Provide multi-technology iClass / proximity card readers where shown on the Drawings. Card Readers shall be rated for indoor and outdoor use, have multicolour LED with audible notification to indicate operator status. Card readers shall operate on 5-16 VDC. Provide thin line mullion style readers where required to match door frame configuration.

.2 HID Corporation, Multi-technology card reader RP15/RP40/RPK40.

2.7 Proximity Card

.1 Hand held proximity cards used by the Region are HID Corporation ProxCard II, HU-1326LSSSV

.2 Hand held proximity cards shall be provided by the Region.

2.8 Long Range Card Reader

.1 Long range proximity card reader, 1.9 - 2.5 m (6’ – 8’).

.2 HID Corporation, 5375 MaxiProx card reader.

2.9 Long Range Proximity Tag

.1 Long range proximity card tag, 125kHz proximity active vehicle tag.

.2 HID Corporation, 1351 ProxPass.

2.10 Door Contacts

.1 Magnetic door contacts.

.2 George Risk Industries, GRI 29A, or approved equivalent.

2.11 Batteries

.1 Control panel shall be provided with rechargeable battery systems complete with charger and battery manager indicating battery fault.

.2 Gel Cell batteries, 12V,Amp-hour capacity shall be based on 12-hour battery operation at full load..

.3 Exaltor Corp, or approved equivalent.

2.12 Exit Device/Panic Bars

.1 Push pad exit device, dull chrome finish, UL Listed Panic Hardware (FVSR), SA163 (N), tested in accordance with ANSI A156.3, 1989, Grade 1.

.2 Ingersoll Rand Company Inc. Von Duprin 99K-NL Series Exit Devices, or approved equivalent.

2.13 Electric Door Strikes

.1 Heavy duty, stainless steel construction, 3000 lbs. Static strength, UL 1034, ANSI/BHMA Grade 1, .25 Amps @ 24VDC.

.2 Assa Abloy Canada Inc. - Hess Series Strikes 1006, or approved equivalent.

2.14 Electrical Power Transfer

.1 Transfer of electrical power from door frame to the edge of a swinging door; two (2) 18 AWG wiring, 24VDC, 2A, 16A maximum surge.

.2 Ingersoll Rand Company Inc -Von Duprin EPT-2, or approved equivalent.

2.15 Transformers

.1 120V input, 16V output, 60 Hz, single phase rating, copper conductors, dry type, sized for application.

.2 Transformers shall be designed, constructed and rated in accordance with UL, CSA and NEMA standards.

.3 All transformers to be of a single manufacturer.

.4 Jack A Frost Ltd., 1640, or approved equivalent.

2.16 Modems

.1 Modem: Analog dial-up line type, RS-232 interface, 115VAC, 60 Hz, connection speed up to 33.6 kbps, downloading speed up to 56kbps, CSA, UL Listed.

.2 U.S. Robotics 56k V.90 Data Faxmodem.

2.17 Request to Exit Sensors

.1 Wall mounted high impact ABS plastic enclosure, alarm output: form “C” contact, single or double door use, adjustable to 60s, UL Listed.

.2 Bosch Security Systems Inc. Detection Systems DS150i, or approved equivalent.

2.18 Exit Pushbutton

.1 Wall mount brushed stainless steel plate enclosure, momentary switch output, SPDT 10A @ 125/250 VAC, UL Listed.

.2 Tyco International Inc. -Kantech PB-EXIT, or approved equivalent.

2.19 Glass Break Detectors

.1 Detect breakage of plate, tempered, layered, laminated and wired glass types, complete with automatic environment test circuitry, detection range 9m, alarm contact 50mA @ 24VDC, UL Listed.

.2 Bosch Security Systems Inc. Detection Systems DS1101i, or approved equivalent.

2.20 Motion Detectors

.1 Wall mount motion monitor with temperature compensation, high impact ABS plastic enclosure, alarm output: form “C” contact, 125mA @ 28 VDC, tamper and trouble output contacts, UL Listed.

.2 Detection Systems DS940Q, Optex DX40 or approved equivalent.

2.21 Audio Annunciator

.1 Wall mount, 24VDC, 100dB @ 10’, UL Listed.

.2 Toxalert International Inc. HORN/REM, or approved equivalent..

2.22 Closed Circuit Video Equipment System (CCVE)

.1 Honeywell Digital Video Manager.

  .1 The Digital Video Management System (DVMS) shall be designed and developed to the following standards:

    1. ISO 9001 (2000)

2. ISO/IEC 15504 Level 3 or higher (SPICE 2.0 Software Process Improvement and Capability Determination)
3. American Software Engineering Institute - Capability Maturity Model (SEI CMM) Level 3 or higher

.2 The Digital Video Management System (DVMS) shall include:
1. Database Server(s)
2. Camera Server(s) or DVRs depending on the Site requirements
3. Security or Control Systems
4. Operator Stations
5. IP Connected Keyboards
6. Network connected cameras and/or network connected video encoders
7. Analog Cameras connected to DVRs (smaller sites)
8. Recording capability for sixty (60) Days

.2 The Digital Video Management System (DVMS) shall be expandable to support a minimum of 4096 total cameras. As a minimum, the system shall support the following network cameras and camera streamers:

.1 Camera Streamers / Video Encoders:
1. Honeywell HNVE1
2. AXIS Communications M7001
3. AXIS Communications Q7401
4. AXIS Communications Q7404
5. AXIS Communications Q7406
6. AXIS Communications 240Q
7. AXIS Communications 241S
8. AXIS Communications 241SA
9. AXIS Communications 241S Blade
10. AXIS Communications 241Q
11. AXIS Communications 241QA
12. AXIS Communications 241Q Blade
13. AXIS Communications 243Q Blade
14. AXIS Communications 247S

.2 Network Cameras:
1. Honeywell ACUIX IP Dome PTZ Camera
2. Honeywell EQUIP HCD554IP(X) Camera
3. Honeywell EQUIP HCS554IP(X) Camera
4. Honeywell EQUIP HD4DIP(X) Mini-dome Camera
5. Honeywell EQUIP HD3MDIP(X) Mini-dome Camera
6. Honeywell EQUIP HD4MDIP(X) Mini-dome Camera
7. Honeywell HCX13M
8. Honeywell HCX3
9. Honeywell HCX5D
10. Honeywell Rapid Eye™ Multi Media
11. Honeywell Rapid Eye™ Multi Media LT4

12. Honeywell Rapid Eye™ Multi Media LT9
13. Honeywell Rapid Eye™ Hybrid
14. AXIS Communications M1011
15. AXIS Communications M1011W
16. AXIS Communications M1031W
17. AXIS Communications M1054
18. AXIS Communications M1103
19. AXIS Communications M1104
20. AXIS Communications M1113
21. AXIS Communications M1114
22. AXIS Communications M3011
23. AXIS Communications M3014
24. AXIS Communications M3113-R
25. AXIS Communications M3114-R
26. AXIS Communications M3203
27. AXIS Communications M3204
28. AXIS Communications P1311
29. AXIS Communications P1343
30. AXIS Communications P1344
31. AXIS Communications P1346
32. AXIS Communications P1347
33. AXIS Communications P3301
34. AXIS Communications P3304
35. AXIS Communications P3343
36. AXIS Communications P3344
37. AXIS Communications P5532
38. AXIS Communications P5534
39. AXIS Communications P5544
40. AXIS Communications Q1755
41. AXIS Communications Q1910
42. AXIS Communications Q6032
43. AXIS Communications Q6034
44. AXIS Communications 205
45. AXIS Communications 206
46. AXIS Communications 206M
47. AXIS Communications 206W
48. AXIS Communications 207
49. AXIS Communications 207MW
50. AXIS Communications 207W
51. AXIS Communications 209FD
52. AXIS Communications 209FD-R
53. AXIS Communications 209MFD
54. AXIS Communications 210
55. AXIS Communications 210A
56. AXIS Communications 211
57. AXIS Communications 211A
58. AXIS Communications 211M
59. AXIS Communications 211W
60. AXIS Communications 212 PTZ
61. AXIS Communications 213 PTZ

62. AXIS Communications 214 PTZ
63. AXIS Communications 215 PTZ
64. AXIS Communications 216FD
65. AXIS Communications 216FD-V
66. AXIS Communications 216MFD
67. AXIS Communications 216MFD-V
68. AXIS Communications 221
69. AXIS Communications 223M
70. AXIS Communications 225FD
71. AXIS Communications 231D+
72. AXIS Communications 232D+
73. AXIS Communications 233D
74. Sony IPELA SNC-CS10
75. Sony IPELA SNC-CS11
76. Sony IPELA SNC-CS20
77. Sony IPELA SNC-CS50
78. Sony IPELA SNC-CM120
79. Sony IPELA SNC-DF40
80. Sony IPELA SNC-DF50
81. Sony IPELA SNC-DF70
82. Sony IPELA SNC-DF80
83. Sony IPELA SNC-DF85
84. Sony IPELA SNC-DM110
85. Sony IPELA SNC-DM160
86. Sony IPELA SNC-DS10
87. Sony IPELA SNC-DS60
88. Sony IPELA SNC-P1
89. Sony IPELA SNC-P5
90. Sony IPELA SNC-RX530
91. Sony IPELA SNC-RX550
92. Sony IPELA SNC-RX570
93. Sony IPELA SNC-RZ25
94. Sony IPELA SNC-RZ50
95. Panasonic WV-NP244
96. Panasonic WV-NS202
97. Panasonic WV-NW484
98. Panasonic WV-NS954
99. Panasonic WV-NW964
100. Panasonic WV-NP502
101. Panasonic WV-NW502

.3 Analog Cameras

1. Honeywell AQUIX
2. Honeywell HD3X
3. Honeywell HD4X
4. Honeywell HD5X
5. Honeywell HD7X

.3 A DVMS workstation computer will be provided by the Region and shall be installed by the Contractor. The installed DVMS systems shall be loaded with all the necessary software and configured by the Contactor to be fully integrated with the Honeywell EBI system.

.4 Network and Video Cabling

.1 A Local Area Network (LAN) shall be provided for communication between the system elements. All interfaces to the LAN shall be a minimum of 1000BaseTX Ethernet. The LAN may use additional technologies within the backbone for greater speed or distance. Acceptable types are:

1. Fiber Distributed Data Interface (FDDI)
2. 1000BaseSX or 1000BaseLX Gigabit Ethernet
3. Asynchronous Transfer Mode (ATM)

.2 The LAN shall use standard network cables. Acceptable cable types are:

1. Optical Fiber
2. Category 6 Unshielded Twisted Pair (UTP)

.3 The LAN shall be logically and/or physically separate from any existing LAN infrastructure. Interconnection to other LANs shall be through one of the following:

1. A Layer 3 listed network switch
2. As an additional virtual local area network (VLAN) to the existing LAN equipment. Where required to interconnect VLANs, a router or Layer 3 capable switch shall be provided

.5 It is not acceptable for network video cables to be run back to the Camera Server. All communications with the Camera Server shall be via the LAN. Each network camera or video streamer shall have a single network interface to be used for video and Pan/Tilt/Zoom communications.

.6 Analog Cameras connected to Video Streamers or Digital Video Recorders shall utilize RG59U Coaxial Video Cable with Bayonet Neill–Concelman (BNC) connectors for distances less than 750 linear feet. All coaxial cable to be 95% Copper Braided Coax cable. All analog cameras to be connected directly to Video Streamers or Digital Video Recorders with no splices.

.7 Supply a complete and working closed circuit video equipment (CCVE) system.

2.23 Wiring and Miscellaneous

.1 Provide all RS-232, RS-485, Optical Fibre, LON Communication and Ethernet cabling, and Fibre and Ethernet jacks as required for a complete network, if applicable.

.2 RS-485 Cables

.1 EIA Industrial RS-485.

.2 Conductors: Twisted pair, each conductor No. 22 AWG stranded copper.

1. Pairs: 2.

2. Shield: Aluminum-polyester and 90% copper tinned braid.
3. Jacket: Black UV resistant PVC.
4. Electrical Characteristics at 20°C
    1. Capacitance: 36.1 pF/m
    2. Impedance: 120 ohms
    3. Propagation Velocity: 78%
5. Belden Inc. Datalene Insulated 3107A.

.3 Instrumentation Cables (4-20mA)
.1 Belden #8760
1. #18 AWG.
2. 16-stranded copper.
3. Beldfoil aluminium polyester shield.
4. Twisted shielded pair.
5. Bare #20AWG copper drain wire.

.4 Ringnet Cables
.1 Low capacitance EIA RS-232/422
1. #24AWG.
2. 7x32-stranded copper.
3. Overall Beldfoil aluminium polyester shield plus tinned copper braid shield (65% coverage minimum).
4. 4 conductors.
5. EIA RS-232 applications.
6. Belden #9829, or approved equivalent.

.5 Serial Cables
.1 Belden #9945
1. #22AWG.
2. 7-stranded copper.
3. Overall Beldfoil aluminium polyester shield plus 65% minimum tinned copper braid shield.
4. 9 conductors. Select Belden trade number to suit number of conductors required for the specific application – Belden #99xx.
5. EIA RS-232 applications.

.6 Wiring Accessories
.1 Wire and cable markers: Printable, self-laminating, self-adhesive markers, white background, black lettering on white background, vinyl plastic or polyester film suitable to environment in which it will be utilized. E-Z-Code by Thomas & Betts Ltd., or approved equivalent. Wire marker to be sleeved with clear heat shrink tubing.
.2 Terminal blocks: 600 V, 25 A minimum rating, modular, 35 mm DIN rail mounted, provision for circuit number labelling, individually removable, sized to accommodate conductor size and circuit current. Sak Series by Weidmuller Ltd., UK Series by Phoenix Terminal Blocks

Ltd., WK Series by Wieland Electric Inc., or Asea Brown Boveri Ltd.-Entrelec.

.3 Field wiring terminations: Where screw-type terminal blocks are provided, supply insulated fork tongue terminals. Sta-Kon by Thomas & Betts Ltd., or Scotchlok by 3M Canada Inc.

.4 Moisture and waterproofing: In wet locations, with Liquid Tape by Ideal Industries Inc..

.5 Cables ties: Nylon, one-piece, self-locking type, by Thomas & Betts Ltd., Burndy Inc., or Wieland Electric Inc.

.6 Electrical insulating tape: Scotch 33 by 3M Canada Inc.

.7 Cable grips: To accommodate type and geometry of cable supported, single weave, variable mesh design, by Thomas and Betts Ltd., Crouse Hinds, or Woodhead Canada Ltd.

.8 Cable pulling lubricant: Compatible with cable covering and not to cause damage or corrosion to conduits or ducts. Yellow 77 by Ideal Industries Inc..

.9 Input 120VAC power to all security related access control panels must be provided at each location identified in the design Drawings and must be isolated from all other loads.

2.24 Automatic Vehicle Access Gate and Loop Sensor

.1 Where connecting the existing high speed automatic rising vehicle access gate: configure gate to open via multi technology card reader compatible with Honeywell EBI system. Gate is to reopen on vehicle exit via vehicle sensing loop and reset loop. Gate shall also be configured to open and close with user configurable timer based on specific dates and times.

.2 Security system installer to ensure automatic arm is integrated with security system.

2.25 Locksmithing and Door Hardware

.1 Locksets and cylinders to be as specified in Section 08710 – Door Hardware.

PART 3. EXECUTION

3.1 Installation – Wires and Cables

.1 All conductors shall be routed in Region approved raceway.

.2 Provide conductors of number and size, including corresponding raceways required to provide the intended function and as required by the manufacturer.

.3 Pull cable into ducts, conduits and cable trays in accordance with cable manufacturer's recommendations. Use cable grips suitable for cable type, or pulling eyes fastened directly onto cable conductors.

.4 Limit pulling tension and minimum bending radii to those recommended by manufacturer.

.5 Prevent damage to cable jackets by utilizing adequate lubricant when pulling cables through ducts and conduits.

.6 Support cables in manholes and utility tunnels on cable trays or cable racks.

.7 Arrange cables in parallel rows on cable trays. Maintain cable spacing by fastening cables, with cable ties, a minimum of every 2000 mm on straight horizontal runs and to each rung at bends, including two rungs of adjoining straight sections. Fasten cables on vertical tray runs every 1000 mm.

.8 Connect cables to electrical boxes and equipment enclosures located in wet or sprinkled areas with watertight cable connectors.

.9 Provide cable grips for vertical and catenary cable suspension installations to reduce cable tension at connectors and at cable bends.

.10 Install through wiring in junctions and pull boxes having no connection within the box. Leave a minimum of 150 mm of slack inside box.

.11 Facilitate making of joints and connections by leaving sufficient slack in each conductor at panelboards, outlet boxes and other devices.

.12 Do not connect more than three lighting circuits for three phase panels and two lighting circuits for single phase panels, to a common neutral.

.13 Size component feeder circuits such that the voltage drop does not exceed four percent.

.14 Install instrumentation signal wires in separate raceways from power and control wiring.

.15 Provide mechanical protection for cables within 1500 mm of the floor in buildings and within 2000 mm above grade outdoors.

.16 Identify each cable by attaching a cable marker at each end, in all intermediate manholes, junction boxes and pull boxes.

.17 Provide cable grips on vertical and horizontal cable suspensions.

.18 Install cables to conserve headroom in exposed locations and to minimize the amount of interference in spaces through which they pass.

.19 Do not install horizontal runs in hollow masonry walls.

.20 Passage through any structural member or precast slab shall be approved by the Consultant.

.21 Where exposed, install raceways and cables parallel with building lines and group neatly.

.22 Maintain the integrity of all fire separations by sealing around all cables where they pass through any fire barriers. Generally this includes all floors, ceilings and concrete and masonry walls.

.23 As far as is practicable, all feeder wiring shall be continuous from origin to panel termination without running splices in intermediate pull boxes or splicing chambers. Sufficient slack shall be left at the termination point to make proper connections to the equipment.

.24 Do not embed armoured cables in concrete.

3.2 Installation – Honeywell EBI System and Security Devices

.1 Supply, install, test, and commission Honeywell EBI system components, communication equipment, and associated equipment to ensure functionality of complete security system and network. Report all construction defects which will affect the progress of the Work to the Region and the Consultant.

The Contract Drawings are provided to convey design intent only.. The Contractor is responsible for verifying the quantities and part numbers contained in the following table, and for all additional components, cables, etc. required to provide a fully functional system.

.2 A minimum of 20% of alarm inputs and 20% of relay outputs shall be provided as spares. Unless otherwise noted in the Contract Drawings the Honeywell EBI security system inputs and outputs shall not exceed 80% of the listed connections.

.3 The Honeywell EBI Control Panel, Vista Remote Keypad and additional nodes (if required) shall be housed in NEMA 412 control panel. Control panel to be wall mounted located as shown on the Drawings. Control panel locations and other mounting locations may be re-located upon Region’s approval.

.4 Honeywell EBI Control Panels (where applicable), to be equipped with battery backup supply. Control Panel batteries to consist of two (2) 12V, 7AH batteries per control panel.

.5 Honeywell EBI system equipment and all other equipment to be installed according to manufacturers’ recommendations.

.6 The facility doors that are to be included under this Section are identified in the following tables along with equipment and quantities. The Contractor is responsible for verifying the quantities and equipment listings, and for all additional components, cables, etc. required to complete the Work as defined in the Specifications and on the Drawings.

Ground Floor Level

Part #	Description
TS2	Honeywell Temaline Control Panel
6160	Honeywell Vista Series Remote

Part #	Description
	Keypad
128BPE	Honeywell Vista Commercial Intrusion Panel
TK_C21P	Honeywell Lonworks Digital I/O Module
TK_S014	Honeywell Lonworks Weigand Interface Unit
RP15/RP40/RPK40	HID Corporation, Multi technology card reader to suit application
Hess Series Strikes 1006, or similar.	Electric Strike
GRI 29A, or similar	Magnetic Door Contact
	Overhead Magnetic Door Contact
	Motion Sensor (360 degree)
	Motion Sensor (directional)
	Glass Break Detector
Detection Systems DS150i, or similar	Request to Exit Sensors (set to shunt forced entry only – not to release doors)
	Arming Button

Second Floor Level

Part #	Description
TS2	Honeywell Temaline Control Panel
6160	Honeywell Vista Series Remote Keypad
128BPE	Honeywell Vista Commercial Intrusion Panel
TK_C21P	Honeywell Lonworks Digital I/O Module
TK_S014	Honeywell Lonworks Weigand Interface Unit
RP15/RP40/RPK40	HID Corporation, Multi technology card reader to suit application
Hess Series Strikes 1006, or similar.	Electric Strike
GRI 29A, or similar	Magnetic Door Contact
	Overhead Magnetic Door Contact
	Motion Sensor (360 degree)
	Motion Sensor (directional)
	Glass Break Detector
Detection Systems DS150i, or similar	Request to Exit Sensors (set to shunt forced entry only – not to release doors)
	Arming Button

PLEASE REFER TO THE MARKED DRAWINGS FOR THE SPECIFIC SECURITY AND LOCKSMITHING REQUIREMENTS.

Leslie Street Sewage Pumping Station – 7033 Leslie St., Markham, Ontario
Typical Application Types

Application Type #1 - Main Entry Doors:
(Suitable for main entry doors equipped with access control and the ability to arm/disarm the intrusion system - typically include one main entrance and one entry at garage locations)

Equipment
Magnetic Door Contact (single door)
Request to Exit Motion Sensor
Electric Strike
Entry Card Reader (mounted exterior)
Exit/Arming Card Reader (mounted interior)
Arming Pushbutton (mounted interior)

Application Type #2 - Secondary Entry Doors:
(Suitable for doors that will be used for access control once the security intrusion system has been disarmed - no arming or disarming from these locations)

Equipment
Magnetic Door Contact (single door)
Request to Exit Motion Sensor
Electric Strike
Card Reader (mounted exterior)

Application Type #3 – Emergency / Perimeter Exits
(Suitable for doors and/or entry points where monitoring of a “door forced open” alarm is required - typically placed on all emergency exits or perimeter doors where entry by access control is not required)

Equipment
Magnetic Door Contact (single door)
Request to Exit Motion Sensor
Peizzo Buzzer - local alarm to sound upon “door held open alarm”

Application Type #4 - Overhead Garage Door:
(Suitable for garage door entry points to detect illegal entry.)

Equipment
Magnetic Door Contact suitable to application

Application Type #5 – Overhead Garage Door with Access Control
(Suitable for garage door entry that will be used for access control once the security intrusion system has been disarmed – no arming or disarming from these locations)

Equipment
Card Reader (mounted exterior)
Magnetic Door Contact (single door)

Application Type #7 - Secondary Entry Doors (Electromagnetic Lock):
(Suitable for doors that will be used for access control once the security intrusion system has been disarmed - no arming or disarming from these locations)

Equipment
Entry/Exit Card Reader
Electromagnetic Lock
Magnetic Door Contact (single door)
Request to Exit Motion Sensor

.7 Motion detectors to be installed as identified on the Drawings and integrated into Honeywell EBI and Vista systems.

.8 Glass break sensors to be installed as identified on the Drawings and integrated into Honeywell EBI and Vista systems.

.9 Contractor to supply all necessary wiring, termination equipment/devices and other necessary equipment not specified in this Section, but which is necessary to implement a fully functional Honeywell EBI security system and mechanical key lock system.

.10 All wires shall be CSA approved and shall have a flame test value equal to, or lower than, the local building or fire code where it is being used.

.11 End of line supervision shall be used on all installations. End of line resistors shall be installed at the detection device and <u>not</u> the control panel.

.12 All devices shall be installed with a continuous, splice free cable run, wherever possible.

.13 If splices are required, the splices shall be made in junction boxes. Splice box locations shall be marked on the wiring diagram.

.14 Wire lists shall be permanently affixed inside the control panel.

.15 Security wiring shall not run in parallel within 12” of 110 V AC or higher voltage electrical wiring or conduit.

.16 All applicable local, provincial or federal codes referenced in Division 16 – Electrical shall be followed.

.17 The location of equipment shown on Drawings may be revised by the Consultant during construction, at no additional cost to the Region, provided that the new the location is within 6 metres of original location.

.18 Install transformers complete with mounting brackets and hardware in positions which conform to the manufacturer's instructions.

.19 The Contractor shall provide all necessary lugs and mounting equipment not already provided with transformers.

.20 For the Region's water and wastewater facilities, Honeywell Vista Control Panel relay outputs to be wired to facility field controller providing security system discrete dry contact inputs to the SCADA system. Inputs to be wired fail safe and shall include the following:

- .1 Intrusion Alarm
- .2 Security System Armed/Disarmed
- .3 Spare

.21 The facility shall be required to communicate with Honeywell EBI Central Server at Region Headquarters via TCP/IP. Activation of switch/hub ports on networking equipment maintained by the Region's Information Technology ("IT" or "ITS") group to be coordinated by the Region. The Contractor shall provide a minimum of five Working Days' prior notification to the IT group for activation of network ports.

.22 IP addresses to be released by Region upon request.

.23 If local IT Network infrastructure is not present, Wireless 3G network equipment should be used. York Region ITS will supply the pre-configured Wireless 3G, Modem and 4 port switch as well as installation specifics.

.24 The Contractor will install all required conduits and junction boxes as well as the exterior antenna for the 3G Wireless Equipment in a location determined by ITS to achieve adequate network connectivity. Network switch is to be located within the Honeywell security system cabinet. Both modem and switch shall be powered from Honeywell UPS power supplies.

.25 All replaced or extra equipment is to be delivered to the Region upon completion of the Work of this Section.

.26 Where magnetic locking devices are to be used, and where permitted by federal, provincial, or municipal codes referenced in Division 16 - Electrical, all necessary permits, engineered drawings, and fire alarm interconnection shall be completed.

.27 Comply with all applicable ordinances when installing access control systems.

.28 All manufacturers' requirements and the requirements of the Ontario Electrical Safety Code for grounding and bonding shall be followed by the Contractor.

.29 Magnetic door contacts to be installed on all exterior access doors and interior doors, as identified on the Drawings.

.30 Electric door strikes to be installed on all doors as identified on the Drawings. Door key locks to allow for key override of door strikes in all cases.

3.3 Installation – Honeywell EBI Enterprise Software Integration

.1 Integrate the facility into the Region's existing Honeywell EBI Enterprise software.

.2 The Contractor is to coordinate work with the Region to integrate the facility into the Regions' existing Honeywell EBI system.

.3 The Contractor is to allow for two (2) Working Days to perform this installation and integration in its lump sum price for Section 13710 in the Bid Form. This Work shall occur no less than fifteen (15) Working Days prior to the anticipated date of Substantial Performance of the Work. The Contractor is to coordinate this Work with the Region's Security & Life Safety Coordinator (Security & Life Safety Coordinator) who can be contacted at (905) 830-4444 ext. 1712.

3.4 Operation - General

.1 Operation of Honeywell EBI security system shall function similar to existing Honeywell EBI systems installed at the Region's water and wastewater and corporate facilities. The Contractor to confirm all security system functions and operation of the system with the Security & Life Safety Coordinator prior to the commencement of any programming.

.2 Overview: A general overview of the operation of the system is as follows:

.1 The system shall allow for monitoring of intrusion detection alarms inside the system alarm monitoring module, in addition to giving command and control of supported intrusion detection devices. Once alarms are brought into the system they shall be stored in the system audit trail.

.2 All system events not designated as alarm conditions shall be stored in the system audit trail.

.3 Each door shall be programmed to generate "Forced Door" and "Door Open Too Long" alarms. These alarms shall have the ability to have a user-definable time delay. Request to exit (RTE) motion sensors to be installed on interior of all perimeter exit doors equipped with door contacts to prevent false forced entry caused by egress of personnel. RTEs to be configured to shunt forced entry only; RTEs are not to be configured to release the electric strike mechanisms in place.

.4 The system shall upload/download information to the control panels automatically while the control panels are in communication with the host server application. A data download may also be initiated manually. This may consist of either controller database information or alarms and events.

.3 Authentication to Honeywell EBI System shall be via programmed Door Groups, Time Groups and Access Groups.

.4 Main entry doors to be assigned Access Group “A”.

.5 HID Corporation Reader and combination HID Corporation Reader and Arming Button to function as method of arming/disarming security system respectively.

.6 Upon presentation of proximity card identified as Region Water and Wastewater personnel to card reader, Honeywell EBI Control Panel will activate electric door strikes on Access Group “A” doors, allowing those doors to be opened.

.7 Upon authorized entry to facility, this shall automatically disable Control Panel security thereby disarming the system. “Security System Disarmed” input will be signaled to field controller.

.8 Prior to exiting facility, personnel will arm the security system by presenting card to their interior card reader and pushing “Confirm” pushbutton (Arming Button). This sequence of events will arm the security system. “Security System Armed” input will be signaled to field controller. The action of breaking the door contact is not to arm the security system.

.9 Upon manual key entry to facility, “Intrusion Alarm” input will be signaled to field controller.

.10 Upon illegal forced entry to facility, “Intrusion Alarm” input will be signaled to field controller. Control Panel will maintain the “Security System Armed” input signal to field controller.

3.5 <u>Field Quality Control</u>

.1 Cable and Wire – 1000 Volt and Below

.1 Conduct insulation resistance measurements using a “Megger” (500 V instrument for circuit up to 350 V system, 1000 V instrument for 351-600 V systems).

.2 Record test results in a log book and submit to the Consultant for reference. Replace or repair circuits which do not meet requirements of the Electrical Safety Authority and any other inspection authorities having jurisdiction. With equipment disconnected, measure insulation resistance of the following circuits:

1. Power and lighting feeders: Phase-to-phase, phase-to-ground.
2. Control circuits: To ground only.

.3 Do not perform “Megger” tests on equipment containing solid-state components.

.4 Disconnect power factor correction capacitors from system prior to testing.

.2 . Instrumentation Wiring

.1 Check continuity of each conductor using ohmmeter of DC buzzer. Megger or 120 volt filament lamp testing is not acceptable.

.3 Carry out functional tests with Region's representative to confirm field wiring, interlocks, and RPU functionality.

.4 Depending upon magnitude and complexity, divide security system into convenient sections, energize one section at a time and verify operation of that section.

.5 Upon completion of sectional tests, undertake group testing.

.6 Verify complete system for operational sequencing.

.7 For local testing, each device and sensor must be tested and marked off one by one until all are tested. Each sensor shall be verified to the zone.

.8 Submit one copy of all test results to the Consultant.

.9 Coordinate with the Region to develop a preliminary list of system passwords. Provide a written list of all passwords, keywords, serial numbers and/or configurations that are encountered during the installation of the operating system and application software. This information to be provided in writing to the Region's Security & Life Safety Coordinator.

.10 Remove all temporary passwords used in commissioning and construction activities. Remove all factory default passwords and provide new unique passwords where factory default passwords exist.

.11 Assign all warranties, licenses and product registration to the Region.

.12 Turn over to the Region's Security & Life Safety Coordinator, all installation software, user manuals, accessory cables, calibration units, or any other material accompanying the installed equipment.

3.6 Wiring Identification

.1 Identify wiring including fibre optic cabling and wire markers.

.2 Colour code power, feeder and branch conductors at both ends with coloured plastic tapes. Tapes are not required where conductors are identified by jacket colour. Maintain phase and colour sequence throughout.

.3 Identify each conductor, including spares, with a unique alphanumeric designation to facilitate troubleshooting and maintenance as identified by Region of York SCADA Tagging Standards as included in the appendices.

.4 Identify RPU wiring at terminal blocks and connection points with RPU terminal (I/O) address numbers as identified by Region of York Tagging Standards included in the appendices.

3.7 Site Testing

.1 Following installation of Honeywell EBI System at the facility, Site testing to be performed. Testing to be coordinated with the Region.

.2 Record test results in a log book and submit to the Consultant for reference. Replace or repair circuits which do not meet the requirements of the Electrical Safety Authority and any other inspection authorities having jurisdiction.

.3 The facility to be tested to confirm operation of Honeywell EBI System in accordance with Subsection 3.5 Operation – General.

.4 The Region’s representative must be present for all testing. The Region’s representative to confirm that testing has been satisfactorily completed and that system is ready for operational use as intended.

.5 All facility exterior access doors to be tested for valid entry and intrusion entry by presentation of test proximity card(s) to reader. Corresponding inputs to SCADA system to be confirmed. System to be tested with both valid and invalid proximity cards.

.6 All applicable doors are to be tested for valid entry and intrusion entry. Corresponding inputs to SCADA system to be confirmed.

.7 Key override to facility through main entry door to be tested for by manually opening door with mechanical key. Corresponding inputs to SCADA system are to be confirmed.

.8 Security system arming/disarming to be tested and verified.

.9 All event and alarm conditions that are logged to Honeywell EBI Control Panel to be verified.

.10 Local testing to be performed at the facility. Following successful demonstration of local testing, operational testing to be performed utilizing the Region’s existing Honeywell EBI Server.

.11 Following successful integration with Honeywell EBI Server, shift programming of the facility, if applicable, to be coordinated through the Region’s Security & Life Safety Coordinator.

END OF SECTION

PART 1. GENERAL

1.1 Scope

.1 The instrument and equipment testing shall confirm in detail that the field instruments and other equipment have been supplied and installed in accordance with the Contract Documents. Testing includes:
  .1 Confirmation that the units have been correctly installed.
  .2 Confirmation that the units have been correctly calibrated.
  .3 Confirmation that all discrete and analog signals (both new and existing) to be transmitted to and from the units are available and functioning correctly.
  .4 Verification that the units are capable of working as specified in the Contract Documents.
  .5 Verification that all panel FAT deficiencies have been completed.
  .6 Complete plant PAC panel I/O check to verify field wiring from field device to PAC I/O.
  .7 Complete equipment supplier (“vendor”) PLC panel I/O check to verify field wiring from field device to PAC I/O.
  .8 Verification that all interlocks are functioning as intended and in the correct mode of operation.
  .9 Acceptance of Work completed by the Contractor.

.2 The instrument and equipment testing is to be conducted and witnessed by the facility Start-Up Team consisting of the Consultant, the Contractor’s System Integrator personnel or Subcontractor (the “System Integrator”), the Region’s Process Control System (“PCS”) Group, the Region’s Operations Group and instrument suppliers as required.

.3 The Start Up Team consisting of the Consultant, the Contractor’s System Integrator, the Region’s PCS Group and the Region’s Operations Group will jointly develop the SAT and Start-Up Plan at the pre-construction meeting. The Consultant will be responsible for developing and issuing the high level SAT and Start-Up Plan based on the pre-construction meeting discussions.

.4 The Start-Up Team will review the SAT and Start-Up Plan and revise, if necessary, at a pre-equipment and instrument testing meeting. The Contractor shall be responsible for expanding and providing details for the SAT and Start-Up Plan to clearly identify the proposed test procedure.

.5 Where it is identified that the requirements of the Contract have not been met, the Contractor shall rectify all deficiencies immediately to allow for re-testing during the same test phase.

.6 Testing will be deemed complete by the Region when all features, functions and information required in the Contract Documents have been verified as present and functioning, and documented as accurate within the anticipated operating range for the process being monitored.

.7 Region PCS Group Scope:

.1 The Region's PCS Group will ensure that computer servers/workstations are provided to System Integrator for installation of software provided under the Contract.

.2 The Region's PCS Group will ensure that network switches are programmed and configured. The Contractor shall be required to supply and/or install switches as specified in the Contract.

1.2 Related Sections

.1 The Contractor shall refer to Section 13933 - Software Site Acceptance Testing in its entirety for additional requirements. Instrument and equipment testing will form a component of the Site Acceptance testing.

.2 Division 13 – SCADA and Instrumentation specifications.

1.3 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13930 – Instrument and Equipment Testing as indicated in Schedule 'A' of the Bid Form.

1.4 Submittals

.1 Submit the following documents prior to conducting the Instrument Acceptance Testing:

.1 Calibration Procedure(s) to be followed in the test. The calibration method and tools will not cause greater than +/- 0.5 percent error in any test;

.2 Any special procedure(s) to be followed in the test;

.3 Provide written confirmation of Site verification, set-up and calibration to be done by the equipment manufacturers.

.2 Use a Field Instrument Acceptance form approved by thee Consultant to document test results. Prior to commencing the Work of this Section, submit the Field Instrument Acceptance form for to the Consultant for approval.

.3 Update shop drawings, Instrument Data Sheets, calibration reports and "As Built" drawings including: P&ID, control schematics and electrical drawings as required to match field conditions.

1.5 Testing Schedule

.1 Submit testing procedures and schedules of Work a minimum of 31 Days prior to the projected test date for the individual component. This schedule will include specific dates for when the various test procedures are to be carried out and identify the assistance required from the Region's staff.

.2 Conduct a review of the PAC panel on Site to ensure that all panel FAT deficiencies have been corrected prior to any filed wiring being completed. This review shall be coordinated with the Consultant and the sign off sheet must be completed and signed by the Contractor and the Consultant.

.3 The Contractor shall conduct its own I/O check and instrument and equipment verification. Contractor completed and signed off I/O Check sheets and instrument and equipment verification sheets are to be completed and submitted to the Consultant for review.

.4 Contractor I/O checks are not to be performed until a minimum of 90% of all I/O is wired to each PAC.

.5 The Consultant may, at its discretion, choose to witness a subsequent I/O check and instrument and equipment verification with the Contractor. The Contractor and all required Subcontractors shall participate as required.

.6 Completed I/O Check sheets and Equipment/Instrument verification sheets signed by the Contractor and the Consultant are to be submitted to the Region for review a minimum of 14 Days prior to scheduling the Region to witness the I/O check and instrument and equipment verification.

.7 Following the Contractor's own I/O check and instrument and equipment verification and the Consultant's review, the Region will witness an I/O check and instrument and equipment verification in the presence of the Contractor and Consultant. The Contractor and all required Subcontractors will participate as required.

.8 In some cases, testing may be scheduled outside normal business hours in order to accommodate operating issues and/or low flow conditions.

.9 Testing may be interrupted by the Region's staff for emergency process operations.

.10 Submit test results to the Consultant at the end of each test period. Final test reports are to be accepted and signed off by the Consultant, the Contractor's System Integrator and Region PCS Group.

PART 2. PRODUCTS (NOT USED)

PART 3. EXECUTION

3.1 General

.1 Provide a qualified electrician and/or instrument technician with a minimum of 5 years of relevant experience, and who is otherwise acceptable to the Region, to assist in testing and quickly repairing minor deficiencies for re-testing in the same test phase.

.2 Have the following documents on hand prior to conducting Instrument and Equipment Acceptance Testing:

.1 Reviewed shop drawings, including data sheets, for each instrument installed (multiple copies for multiple installations);

.2 "For Construction" P&IDs, process narratives, control schematics and electrical drawings;

.3 Configuration and calibration certificates from the manufacturer(s) for each calibrated instrument, where specified in the Contract Documents;

.4 PAC panel FAT report identifying deficiencies identified during the panel FAT process.

.5 Results of factory performance tests, where specified in the Contract Documents;

.6 Instrument field calibration reports, where specified in the Contract Documents;

.3 Inspect and document that each instrument and piece of equipment matches the reviewed shop drawings. The inspection shall include, but not be limited to the following (as applicable):

.1 Verifying that the instrument Product details match shop drawings and Contract Documents, (including Instrument Data Sheets);

.2 Confirming the soundness of instrument, that is, confirm that the instrument is without any damaged parts;

.3 Confirming completeness in all respects as specified for instrumentation;

.4 Confirming the correctness of setting, alignment, and relative arrangement;

.5 Confirm that all PAC panel FAT deficiencies have been corrected.

.6 Inspecting the power, signal, and grounding wiring identified on the control schematics and documenting the results. All wiring shall be verified for continuity.

3.2 I/O Loop Check

.1 I/O loop check is to be performed by the Contractor for the complete loop where possible by exercising the field device and monitoring the input at the PAC. Some I/O loops may be confirmed during the instrument and equipment calibration and testing when approved by the Consultant.

.2 Where an instrument loop cannot be checked with the instrument functioning, a current generator shall be used to verify the continuity of the analog loop.

.3 Where a digital loop cannot be checked with the field device, jumpering is permitted to verify the continuity of the digital loop.

.4 PAC output loops shall be verified by forcing the corresponding output from PAC program.

.5 I/O loop check shall be accepted and signed off by the System Integrator and the Consultant when all I/O points pass loop checks.

3.3 Instrument Acceptance

.1 Devices shall also to be tested for their repeatability, accuracy and operation by varying the process and simultaneously measuring and recording the information displayed by:
  .1 An independent measuring instrument;
  .2 The local transmitter indicator;
  .3 All remote digital/mechanical indicators;
  .4 The 4-20 mA (or digital value) measured at terminal blocks in PAC panels and operator panels.

.2 Compare test results against the instrument calibration reports and planned PAC analog input range. As an example, flow sensors will require testing using a “draw and fill” test of a local container.

.3 Where no field calibration has been done, perform a calibration test. Go up, down, then back up the instrument range, testing at five (5) points each time: 0%, 25%, 50%, 75% and 100%.

.4 The instrument switches, such as pressure switches or building flood alarms, shall be tested for their accuracy and operation by varying the process conditions (for example: high then low pressure) and simultaneously measuring and recording the information displayed by:
  .1 An independent measuring instrument;
  .2 The instrument switch;
  .3 All remote lights and indicators;
  .4 The digital input status measured at both the RPU and operator panels’ terminal blocks.

.5 Test results shall be compared against the instrument calibration/setting reports and planned PAC discrete input setting.

.6 Verify that all instrument/equipment interlocks function as intended in accordance with the Contract Documents.

.7 ISO calibration labels shall be applied to instrument following successful calibration and testing.

3.4 Testing Tools and Equipment

.1 Protect instruments and equipment that may be damaged by testing. If any damage occurs, the Contractor shall be fully responsible for replacement of damaged parts and/or components.

.2 Use calibration tools that will not cause greater than +/- 0.5% error in any test. The accuracy of the calibration tools must be traceable to National Calibration Standards. The Region's preference is the use of electronic calibration equipment that will provide a form of electronic documentation, transferable in a standard spreadsheet format.

.3 Comply with the applicable Region's Health and Safety requirements (Contractor/Constructor Policy and Guideline) and Confined Space Entry requirements. Provide the proper safety equipment for entering (manholes and other) confined spaces, and hazardous gas locations.

3.5 Supplements

.1 The supplements listed below, following the "END OF SECTION", are part of this Specification.

.1 Section 13930A – Instrumentation Installation Calibration Sheets

END OF SECTION

Region of York PCS Instrument Installation Sheet

Region Project #:	T-12-16
Project Name:	Leslie Street Sewage Pumping Station Upgrades
Consultant:	GHD Inc.
Contractor:	
Instrument Installer:	
System Integrator:	
Instrument Supplier:	
Region PCS:	

General	
Instrument Tag:	
Description:	
Manufacturer:	
Model #:	
Serial #:	
Calibration Range:	
Calibration Label Applied:	
Installation Date:	

Pre-Start Up	Checked By	Date	Comments
Sensor Installation/Mounting			
Transmitter Installation Mounting			
Wiring/conduit terminations, colour, seals			
Fuse rating for instrument power supply			
Tagging/Nameplate			
Comply with Division 13 & 16			
Power Supply			
Spare parts provided			
Calibration Completed			

Start Up	Checked By	Date	Comments
Verify Instrument Operation			
Verify operation under min process conditions			
Verify operation under max process conditions			

Acceptance			
Inspection Result:		Pass/Fail:	
Contractor:		Consultant:	
Date:		Date:	
System Integrator:		Region PCS:	
Date:		Date:	
Supplier:			
Date:			

Version: 1.0
Release Date: Feb. 18, 2011

Date: 10/07/2012

Region of York PCS Instrument Calibration Sheet

Region Contract #:	T-12-16
Project Name:	Leslie Street Sewage Pumping Station Upgrades
Consultant:	GHD Inc.
Contractor:	
System Integrator:	
Region PCS:	
Instrument Supplier:	

General	
Instrument Tag:	
Description:	
PAC:	
Input Point:	
Manufacturer:	
Element Model #:	
Element Serial #:	
Transmitter Model #:	
Transmitter Serial #:	
Calibration Range:	
Factory Calibration Sheet Attached	

Service			
Level		Temperature	
Flow		pH	
Pressure		Dissolved Oxygen	
Differential Pressure		Gas Monitoring	
Chlorine Residual		Turbidity	
Weight		Fluoride Residual	
Other			

Type			
4-20 mA		0-5 VDC	
0-20 mA		Digital Input	
Other			

Power Source			
120 VAC		24 VDC	
Other			

Range Test			
0%		75%	
25%		100%	
50%		Digital	

Hardwired Interlocks			
Equipment Tag:			
HiHi		Lo	
Hi		LoLo	
Fault			
Equipment Tag:			
HiHi		Lo	
Hi		LoLo	
Fault			
Equipment Tag:			
HiHi		Lo	
Hi		LoLo	
Fault			
Equipment Tag:			
HiHi		Lo	
Hi		LoLo	
Fault			

Test Equipment

Date: 10/07/2012

Equipment:	
Manufacturer	
Model #:	
Serial #:	
Calibration Date:	
Calibration Certificate:	
Certifier:	

Acceptance			
Contractor:		Consultant:	
Date:		Date:	
System Integrator:		Region PCS:	
Date:		Date:	
Supplier:			
Date:			

Version:	1.0
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PART 1. GENERAL

1.1 Summary

.1 Section covers all installed control panels, control devices and control assemblies used throughout the Contract, including but not limited to those provided as part of a packaged system where provided by an equipment manufacturer.

.2 Coordinate instrumentation requirements, including but not limited to ratings, system interface voltages, wiring requirements and termination requirements to ensure compatibility between control panels, instrumentation and all connected devices for a fully functional system

.3 Provide network interface of connected devices, including but not limited to network hardware, active network components, communication interconnections, communication hardware and network interface components for system controls and connected devices for a fully functional system.

.4 Coordinate communication protocols to ensure proper data transfer and compatibility between all connected devices, including but not limited to instrumentation, networked system devices, operator interface terminals, modems, autodialers, radios, remote terminal units (RTU's) and control panels.

1.2 Special Requirements

.1 Controls and Instrumentation Integrator: The Contractor shall ensure that the SCADA system integrator specified in Section 13480 – SCADA Integrator will coordinate the components used throughout the Contract.

.2 The panel shop Subcontractor should be named in the Bid Form in Schedule 'B' List of Subcontractors.

1.3 Related Sections

.1 Division 13 – SCADA and Instrumentation

.2 Division 16 - Electrical

1.4 References

.1 Canadian Standards Association

.2 NECA (National Electrical Contractors Association) Standard of Installation

.3 Instrumentation, Systems, and Automation Society (ISA):
- .1 S5.1, Instrumentation Symbols and Identification.
- .2 PR12.6, Installation of Intrinsically Safe Systems for Hazardous Locations
- .3 S5.4, Standard Instrument Loop Diagrams.

- .4 S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
- .5 S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.4 National Electrical Manufacturers Association (NEMA):

- .1 ICS 1, Industrial Control and Systems: General Requirements.
- .2 ICS 2, Industrial Control Devices, Controllers and Assemblies.
- .3 ICS 3, Industrial Control and Systems: Factory Built Assemblies.
- .4 ICS 4, Industrial Control and Systems: Terminal Blocks.
- .5 ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
- .6 ICS 6, Industrial Control and Systems: Enclosures.
- .7 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.5 Underwriters Laboratory (UL):

- .1 CSA/UL 508/508A – Industrial Control Panels
- .2 CSA/UL 698/698A - Industrial Control Panels For Hazardous Locations

1.5 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13961 – Electrical Control Panels, Controls and Devices as indicated in Schedule ‘A’ of the Bid Form.

1.6 System Description

.1 Control Panels And Control Systems: Provide all project control panels, panel mounted devices, raceways, wiring, panel mounting framework and hardware, power circuits, control circuits and all appurtenances for controlling, monitoring and alarming of the various functions, for a complete operating control system as specified in the Contract Documents.

- .1 Provide all necessary control devices, controllers, motor starters, intrinsic isolation devices, auxiliary control devices, door mounted pilot devices, control relays, power supplies, remote and/or field devices and accessories for a complete operating system.
- .2 Where a control panel is provided as part of a packaged system, coordinate the requirements specified for a complete operating system.

.2 Provide all wiring between field devices and control panels: Provide and terminate control and instrumentation cables for each piece of equipment and each device and test each for proper operation.

.3 Site conditions:
  .1 Site Maximum Ambient Temperature: 50 degrees Celsius
  .2 Site Minimum Ambient Temperature: -17 degrees Celsius
  .3 Site Elevation 150 meters above sea level

1.7 Submittals

.1 General Product Data:
  .1 The Contractor shall be responsible for the accuracy and completeness of all aspects of the controls submittal.
    1. Within thirty (30) Days of the notice to commence, provide Controls and Instrumentation Integrator qualifications, and Panel Fabrication Shop qualifications.
    2. Within ninety (90) Days of the notice to commence, provide:
      1. Hardware product information submittal, including but not limited to Product data sheets, shop drawings, related calculations, layout diagrams and interconnection diagrams.
      2. Power supply load calculations.
      3. Heating and cooling calculations for all equipment requiring thermal management, and where specified in the Contract Document or where requested by the Region or the Consultant.
      4. Interconnection diagrams.
      5. Testing Submittals: Indicate proposed testing procedures and methods, testing firm biography and contact information.

.2 The as-built I/O points are to be modified but the drawing layouts, PAC card quantity and type, bill of materials and sheet numbering are not to be modified unless approved by the Region.
  .1 The internal and external layout drawings included in the Contract Drawings are based on typical equipment to convey the design intent, and are not to be used for fabrication.
  .2 The Consultant may increase panel size and require additional modifications during shop drawing review.

.3 All diagrams and drawings shall be provided as standard 279.4 mm x 431.8 mm (11” x 17”) format at a scale that is readily legible and prepared to ANSI standards. Submit control panel layouts, point-to-point wiring diagrams, interconnection wiring diagrams, equipment dimensions, support points, weights, and external power requirements.
  .1 Panel Layout: Show back panel and door mounted device placement, device labeling, clearance between devices and dimensions.

.2 Indicate support methods and any required structural calculations.

.3 Wiring Diagrams: Provide complete elementary and schematic wiring diagrams indicating proposed conductor and terminal block numbering for all control systems. Show all internal and external devices and equipment, control panel devices, etc.

.4 Provide a schedule of all nameplates, labels and tags.

.4 Product Data:

.1 Submit catalog data for each component being furnished showing operational characteristics and connection requirements, including supply voltage, frequency, electrical load, listed accuracies, description of operation, operating instructions, and calibration procedures.

.5 Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.

.6 Parts List: Submit a Parts List with current net prices and a list of recommended spares

.7 Coordinate and identify all interconnection wiring between installed control panels, motor control centers, field devices, and other devices.

.8 Training: Outline proposed subjects, duration and any special requirements for training (for example: facilities, computer hardware requirements, etc).

.9 Test Documentation: Upon completion of each required test, document the test and submit a copy of the test procedures used with accompanying documentation indicating name of testing firm and name of person performing test.

1.8 <u>Quality Assurance</u>

.1 Comply with the requirements of Division 13 and Division 16.

.2 Test individual components, individual control panels and control panel assembly at the control panel manufacturer’s plant.

.3 The Consultant and Region’s Representative will witness Panel Factory Acceptance Tests and inspect the completed assembly. Advise the Consultant in writing fifteen a minimum of 15 Working Days minimum prior to carrying out the tests.

.4 Control Panel(s) shall be factory assembled and tested for sequence of operation prior to delivery to the Site and shall have passed the Panel Factory Acceptance Test (FAT).

.5 Submit for approval and follow the Region’s Panel Factory Acceptance Test Document. Refer to the York Region published standard 13311 “Panel Factory Acceptance Testing Plan Template” included as an appendix, where this document shall be used as a basis for developing the submitted Panel Factory

Acceptance Test Document. The Contractor shall not schedule the testing of the control panels until such time that the Panel Factory Acceptance Test Document has been submitted and approved by the Consultant.

.6 Shop tests shall include, but not be limited to:
  .1 Standard production tests.
  .2 Interchangeability of similar items of equal rating.
  .3 Mechanical and electrical operation of switches, contactors, interlocks, draw-out mechanism, auxiliary devices and manual devices.
  .4 Functional tests on components and circuits. Where necessary, suitably simulate external devices.
  .5 Testing and calibration of metering and protection devices.
  .6 Test control panels as complete assembly. Separate testing of individual components only is not acceptable.
  .7 Prior to shipment, submit to the Consultant six (6) copies of certified final test results.

1.9 Closeout Submittals

.1 Project Record Documents: Include as-built layout diagrams, interconnection diagrams and cabling information.

.2 Operation and Maintenance (O&M) Manuals:
  .1 Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.
  .2 Submit bound copies of O&M manuals for each device, including project record documents, instructions for adjustments, calibration and preventative maintenance.
  .3 Include copies of all submitted documentation in Adobe Acrobat PDF format, supplied on compact disc (CD) media format.

1.10 Maintenance Materials

.1 Provide at least one complete set of the following:
  .1 Power fuses – 3 of each size
  .2 Control fuses – 6 of each size
  .3 Cluster LED type indicating lights – 6 of each colour
  .4 Provide six spare keys for each unique enclosure lock provided

.2 Maintenance material shall be suitably packaged with labels indicating the contents of each package. The material shall be delivered to the Region prior to system commissioning.

1.11 Warranty

.1 System Warranty Overview:
  .1 The system warranty shall consist of a full scope, in-place warranty, consistent with the provisions of the General

Conditions in the Contract documents. The warranty duration shall be 24 months from the date of Total Performance of the Work.

.2 All hardware components that are part of the completed system shall be covered by the warranty and shall cover all defective parts and labor to install the part for components listed, unless otherwise noted in the Contract Documents.

.3 The Contractor shall not provide third party warranties.

1.12 Delivery, Storage, and Handling

.1 Deliver control panels and control assemblies individually wrapped for protection and mounted on shipping skids.

.2 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic. Provide space heaters if required, to prevent condensation and keep equipment dry.

.3 Lift control panels only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.13 Qualifications

.1 Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years of experience.

1.14 Field Measurements

.1 Verify field conditions and measurements prior to fabrication.

.2 Coordinate location of all field located equipment and instrumentation with other trades prior to commencing work.

1.15 Seismic Protection

.1 Provide seismic restraint for floor mounted control panels. Restraints shall be as listed as restraint devices by the manufacturer for the system in which they are installed.

.2 Where requested by the Consultant, provide seismic calculations signed and stamped by a structural engineer licensed to practice in Ontario for system being installed indicating requirements to maintain seismic ratings, and with all supporting calculations.

1.16 Coordination

.1 Coordinate requirements and installation requirements of systems being controlled and interface into the SCADA system. .

.2 Coordinate requirements for all packaged systems, such that the packaged systems meet the intent of these specifications.

PART 2. PRODUCTS

2.1 Control Panels

.1 Each control panel and enclosure shall be shop fabricated and tested off Site, complete with selector switches, indicating lights, transmitters, power supplies, control devices, wiring, terminal blocks, plastic raceways, thermal management, circuit breakers and other associated devices, for a fully functional operating system. The control panel assembly shall meet NFPA 70 – National Electrical Code requirements and shall be provided with a UL-CSA 508A label and listing. Additionally, provide CSA Special Inspection, with associated labeling to meet the requirements of CSA SPE-1000. Panel shop shall be CSA C22.2 No.14 (Industrial Control equipment) certified.

.2 All instruments and equipment mounted outdoors shall be installed in enclosures rated for NEMA 4X service, with heating and cooling, and be suitable for operating in temperatures from -30 to +50^{o}C.

.3 Where used in hazardous environments or for applications requiring intrinsically safe barriers, the control panel shall be provided with a UL 698A label and listing.

.4 Follow ISA-RP60.6-1984, Recommended Practice for Nameplates, Labels and Tags for Control Centers where specifications do not identify requirements.

.5 Prior to shipping the control panel to the Site, provide a full function factory test to verify the intended operation and proper function of all connected devices. Where interfacing with other systems, simulate inputs and outputs as necessary to verify proper operation.

.6 The control panel shall be suitable for floor, channel and/or wall mounting as indicated in the Contract Drawings. Panel dimensions shall be as indicated in the Contract Drawings. Where panel size increases due to the proposed layout and design, the Contractor shall note accordingly within the submittal and coordinate a revised layout, verify clearances and verify field conditions with other trades prior to commencing work.

.7 Panels shall be provided with 25% usable expansion space for field siring, connections and device mounting.

.8 No components shall be mounted to the exterior side of the enclosure.

.9 All conduit penetrations shall be located at the bottom of the enclosure unless approved in writing by the Region.

.10 Enclosure Heating and Cooling: Provide enclosure cooling and heating equipment as necessary to maintain environmental variables to within manufacturer listed temperature and humidity limits.

.1 Provide thermostatically controlled heaters, fans and heat exchangers as necessary to maintain component operational temperatures and humidity ratings within manufacturer specified limits, based on site conditions.

.2 Vent Louvers: Where provided with louvered openings, provide louver filter assembly. Louvers assemblies shall be NEMA rated to match enclosure NEMA rating. Where installed in corrosive environments or on stainless steel enclosures, louver assembly shall be constructed of stainless steel.

.3 Installed devices shall not be installed where devices will be subject to direct sunlight exposure. Mount devices within enclosures or shaded structures. The Contractor shall coordinate requirements and submit design for approval by the Consultant.

.11 Unless otherwise noted within the Contract Drawings, each control panel shall be provided with a panel mounted circuit breaker and door operable circuit breaker handle.

.12 Provide panel mounted fluorescent lighting with door operated switch for each door location. Mount light above door and furnish with minimum 13 watt lamp.

.13 Door shall swing open 90 degrees without interference to provide access to the rear panel.

.14 Provide inner dead front door panel where control panel is installed outdoors or where specified in the Contract Drawings. Mount panel mounted control and interface devices on inner dead front panel. Inner dead front door panel shall be hinged with knurled finger operable bolt latch.

.15 Provide adequate space for conduit entry, termination of control cable, device wiring and raceway.

.16 Each component shall be identified with readily visible engraved identification tags.

.17 Control Panel Wiring Methods:

.1 Use a colour code scheme to differentiate connected systems within panel and as indicated within the Contract Drawings.

.2 Route and secure control panel conductors where the conductors are routed in a uniform parallel fashion using smooth bends. Do not bend conductors at sharp angles.

1. Arrange wiring neatly, cut to proper length, and remove excess wire.
2. Secure conductors to avoid incidental contact and to prevent contact with sharp surfaces where conductor damage may occur.

3. Provide abrasion protection for wire bundles which pass through holes or across edges of sheet metal.
4. Secure cable to enclosure where routed outside of wireways using nylon tie wraps. Secure nylon tie wraps using supports secured to enclosure and back panel with epoxy based adhesive.
5. Provide hinged wiring loop where transitioning from fixed face to hinged component. Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve using nylon sock material. Spiral wrap shall not be acceptable.
6. Wires installed in a compression screw and clamp: install a maximum of one for field wires entering enclosure, otherwise install a maximum of two.
7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
8. Arrange wiring to allow ease of access for testing, removal, and maintenance of circuits and components.

.3 Plastic Wire Ducts Fill: Do not exceed manufacturer's recommendation.

.4 All PLC and instrumentation interface points shall be terminated on terminal blocks or fused terminal blocks as specified in the Contract Documents.

.5 Power feeds, external power supply outputs, and other power distribution wiring to external equipment shall be terminated on a fused terminal. Properly sized fuses shall be provided for all fuse terminals.

.18 Panel shall have a metal protective pouch to hold wiring diagrams and process system information.

.19 Supply voltage: As indicated within the Contract Drawings

.20 Enclosure:

.1 NEMA 1, NEMA 3R, NEMA 3X, NEMA 4, NEMA 4X or NEMA 7 enclosure as indicated in the Contract Drawings. Where not specified in the Contract Documents, The Contractor shall provide NEMA rated, 316 stainless steel enclosure, rated for the environment in which it is installed.

1. NEMA 1 Enclosures: Steel, Polyester Powder Coat Painted, Grey RAL 7035.
2. NEMA 3R Enclosures: Steel, Polyester Powder Coat Painted, Grey RAL 7035.
3. NEMA 3X or NEMA 3RX:14 gauge 316 Stainless Steel, Brushed Stainless Finish.
4. NEMA 12 Enclosure: Steel, Polyester Powder Coat Painted, Grey RAL 7035.
5. NEMA 4 or 4X Enclosure: 14 gauge 316 Stainless Steel, Brushed Stainless Finish.

6. NEMA 7 Enclosure: Copper free aluminum, Natural Finish.

.2 Fabricate enclosures from sheet steel.

1. Provide single door enclosures with 2.67 mm (12 gauge) sides top, and back.
2. Provide double door enclosure with a 3.43 mm (10 gauge) back with 2.67 mm (12-gauge) top and sides.
3. Provide multi-door enclosures with 3.43 mm (10 gauge) sides, top, and back.

.3 Size enclosure for all required components and to permit adequate ventilation with all required clearances. The size indicated on the Contract Drawings is used as a basis of design only.

.4 Provide heavy duty removable lifting angles and/or lugs where panel weight exceeds 68 kg (150 pounds.

.5 Provide suitable grounding stud on door and body.

.6 Provide oil-resistant door gasket attached with oil resistant adhesive.

.7 Provide integral door stop for all 2 door enclosures and doors 762 mm (30 in) and wider.

.8 Seams shall be continuously welded and ground smooth.

.9 Remove all sharp edges.

.10 Cut, punch, or drill cut-outs for face-of-panel mounted instruments and smoothly finish with rounded edges, maintaining the NEMA/EEMAC rating.

.11 Install door mounted equipment flush mounted and properly sealed, maintaining NEMA/EEMAC rating. Internal mounted panels to be at least 1.6 mm sheet steel, uniform size, with spare removable panels for future use.

.12 Fabricate panels, install instruments, plumb and wire in the factory. Arrange wiring and ducts in the control panel to match floor and/or ceiling conduits. Test wiring and plumbing prior to shipment.

.13 Locate all face-of-panel mounted devices higher than 0.8 m and lower than 2.0 m from the floor.

1. Arrange status lights above corresponding pushbuttons or selector switches.
2. Arrange digital and analog indicators above corresponding controls.
3. Centreline of OITs are to be mounted 1.7 m from the finished floor.

.21 Indoor floor mount panels to be installed on a 100 mm plinth, or as sized by the manufacturer for the panel being supported.

.22 Panel backplate shall be unistrut mounted such that the backplate depth can be adjusted in the field. There must be enough slack in any cabling going to the panel door to allow for the backplate to be adjusted.

.23 Covers/Doors: Provide continuous hinge door.
  .1 For two door enclosures and enclosures located in areas outside secured rooms, provide quarter turn 3 point T-Handle with lock cylinder operable by key.
  .2 For single door enclosures located within a secured room, provide multi point quarter turn single point latch and semi flush key cylinder,
  .3 Door hardware shall be stainless steel and shall maintain NEMA rating of enclosure.

.24 Provide interior metal panel for mounting components, finished with white enamel.

.25 Manufacturer:
  .1 Hoffman, Inc
  .2 Hammond Manufacturing
  .3 B-Line, Cooper industries
  .4 Or approved equivalent

2.2 <u>Terminal Blocks</u>

.1 Fused and Non-Fused Modular Terminal Blocks: Terminal blocks shall use screw type modular connector assemblies and shall have no exposed conductive terminals. Mount using DIN rail assembly secured to enclosure back panel.

.2 Material: Self extinguishing, UL94-V2 listed.

.3 Maintain Separation of Systems Within Enclosure:
  .1 Communications circuits - Maintain minimum 25mm of physical separation.
  .2 50-volts line to ground - Maintain minimum 25mm of physical separation (discrete I/O, analog, digital, etc).
  .3 50-volts to ground through 120-volts line to ground - Maintain minimum 75mm physical separation (discrete I/O, power distribution, etc).
  .4 Greater than 120-volts line to ground - Maintain minimum 6” physical separation (power distribution, etc).
  .5 Provide group marker for each terminal block system grouping.
  .6 Space terminal block strips no closer than 150mm centre to centre.Minimum spacing between two (2) rows of terminal blocks shall be 80mm.
  .7 Minimum space from edge of terminal strip to edge of wire duct shall be 50 mm.

.4 Provide terminal block barriers to separate 24 VDC instrument loops, 120 VAC power, 120 VAC control wiring, 24 VDC control wiring and grounding.Terminal ground bus: Provide ground bus terminal blocks, with each connector bonded to enclosure through terminal strip din rail for control power grounding connections.

.5 Fused Type Terminal Blocks:

- .1 Minimum 15-Amp rated.
- .2 Feed through type with side terminating terminals.
- .3 No loose parts which may fall off when replacing fuse.
- .4 Latch in open position.
- .5 Externally accessible testing terminals

.6 Non-Fused Type Terminal Blocks:

- .1 Minimum 10-Amp rated.
- .2 Feed through type with side terminating terminals.
- .3 Externally accessible testing terminals

.7 Provide a minimum of twenty-five (25) percent spare terminal blocks for each control panel.

.8 Labeling: Provide printed plastic terminal strip markers indicating circuit identification to match drawing designation. Markers shall be readily visible and mounted on terminal block. Identification tag designations for each terminal block shall match those shown on the wiring diagrams.

.9 Provide centre jumper bars to connect common wires and terminals. All common terminals to have the same number.

.10 For each instrument or piece of equipment, group all field wiring together at the terminal strip. Provide a common group marker for each set.

.11 Supply twenty (20) spare fuses of each fuse type rating in a DIN rail mountable storage box with each Control Panel.

.12 Terminal Block Colour Code:

- .1 Data/Communications – Orange
- .2 AC Power – Hot: Black, Neutral: White
- .3 24 VDC Power – Positive: Blue, Negative: Grey
- .4 Ground – Green
- .5 Intrinsic Barrier – Red
- .6 Discrete DC - Blue
- .7 Discrete AC - Red
- .8 Analog – Black, White
- .9 Interlock control circuits and interposing relay circuits energized from external source - Yellow

.13 Manufacturer:

- .1 Weidmuller Canada
- .2 WAGO Kontakttechnik GmbH & Co.
- .3 Phoenix Contact Ltd.
- .4 Or approved equivalent

2.3 Signals and Interfaces

.1 Analog signals are 4-20 mA DC and conform to the compatibility requirements of ISA Standard 50.1. Provide the signal conversion necessary for compatibility with instruments and the interface to the digital controllers.

.2 Install signal isolators (24 VDC externally powered if not loop-powered devices) on all analog loops with cabling running outside buildings, speed control signals into variable frequency drives and soft starts. Provide two (2) spare isolators of each type.

.3 Current/Current converters are to be utilized where more than two (2) loads are present in the current loop or if otherwise recommend by the manufacturer.

.4 Provide interposing relays with switch, if required, for retransmission of isolated discrete (digital) signals to digital controllers. Relays shall be rated for switching 6 Amps, 250 VAC, SPDT, pin-base, plug-in style with neon indicator.

.5 Supply and install timers as shown on the Drawings. Timers to be DPDT with 5 A and 120 VAC unless otherwise noted in the Drawings.

.6 Provide one (1) spare network cable to be run between network access closet and control panel.

.7 Provide factory made network patch cables as required to connect all networked devices.

.8 Furnish, mount, and wire control components such as relays, timers, and other equipment to provide the interfacing and interlocking between the motor starter and associated protective circuits, or other type of control circuit function applicable to a particular final control element. Use sealed and plug-in type components.

.9 The Drawings show the interface for equipment. The Drawings are typical for the equipment expected to be furnished and are provided to show the intended control functions and interfaces. Provide intended panel functional interfaces.

2.4 Plastic Raceway

.1 Product Description: Non-metallic plastic channel with hinged or snap-on cover, suitable for control wiring, branch circuit wiring, data and other low voltage wiring.
  - .1 To be utilized only in dry interior locations. The raceway and all system components must be UL listed and exhibit non-flammable self-extinguishing characteristics.
  - .2 Both raceway and cover shall be manufactured from rigid molded polyvinyl-chloride compound.
  - .3 Raceway splices shall incorporate overlapping joints so that enclosed cables are completely protected.
  - .4 Raceway shall be securely fastened to the back panel.
  - .5 Colour: White

.2 Wireway Size: Size wireway so that fill ratio does not exceed 20 percent of the interior cross section area of the wireway. As a minimum, provide a 50 mm x 76 mm (2 in x 3 in) wireway.

2.5 Panel Mount Control Devices

.1 Legend: Each panel mounted device shall have an engraved aluminum legend plate indicating function "Hand-Off-Auto", “Local – Remote”, “Start”, “Stop”, “Reset”, “Alarm”, “Fault”, “ON”, etc. as required to describe the control mode or function or as specified elsewhere in the Contract Documents.

.2 Selector Switches and Push Button Switches:

.1 Selector switches and push button switches shall be listed as heavy-duty and oil tight by the manufacturer. Provide a minimum of one (1) normally open and one (1) normally closed contact for each selector and pouch button switch provided.

.2 Mushroom Operator Switch: Mushroom operator switches shall be used as emergency stop switches and shall be push to operate, maintained and twist release type. Provide circular high contrast yellow and red lettering legend indicating “Emergency Stop”.

1. Where installed on critical process control equipment or in an area likely to ensure incidental contact, provide round aluminum mushroom operator guard.

.3 Manufacturer:

1. Square D - Schneider Electric Inc, Class 9001 Type K
2. Rockwell Automation Inc., Bulletin 800/H
3. Or approved equal

.3 Status and Alarm Indicating Lights:

.1 Indicating lights shall be cluster type Light Emitting Diode (LED) suitable for operation at system control voltage. The LED colour shall be coordinated with the alarm or indicated function as indicated in the table below:

Lens Colour	**Status and Alarm Condition Indication**
Red	Equipment Energized - Motor Running, Valve Open or Circuit Breaker Closed. Alarm Indication – Abnormal Condition.
Green	Equipment De-Energized - Motor Stopped, Valve Closed, Circuit Breaker Open.
Amber	Equipment Control in “Auto” Mode. Controlled by Internal or External Control or Sensing Device(s).
Blue	Equipment Control in “Remote” Mode. Controlled from Remote Location – PLC or Remote Panel.
White	Power On Indication

.2 Indicating lights shall be push-to-test type and each provided with control power to enable the push-to-test lamp function.

.3 Manufacturer:

1. Allen Bradley, 800T series
2. Or approved equal

.4 Indicating Bank and Beacons:

.1 Illuminated beacon shall be of modular stacking design, NEMA rated to meet enclosure rating, with metal support base and stem, flashing Light Emitting Diode (LED) assembly and suitable for operation at system control voltage. The LED colour shall be coordinated with the alarm or indicated function:

Lens Colour	**Status and Alarm Condition Indication**
Red	Equipment Energized - Motor Running, Valve Open or Circuit Breaker Closed. Alarm Indication – Abnormal Condition.
Green	Equipment De-Energized - Motor Stopped, Valve Closed, Circuit Breaker Open.
Amber	Equipment Control in “Auto” Mode. Controlled by Internal or External Control or Sensing Device(s).
Blue	Equipment Control in “Remote” Mode. Controlled from Remote Location – PLC or Remote Panel.

.2 Lamp housing shall be constructed of UV stabilized polycarbonate material.

.3 Provide suitable mounting bracket for mounting to vertical structure where mounting on structures.

.4 Provide suitable mounting gasket material to maintain NEMA rating where installing on enclosure.

.5 Manufacturer:

1. Telemecanique – Shcneider Electric Inc., XVB series
2. Or Approved Equal

2.6 <u>Control Relays and Limit Switches</u>

.1 Intrinsically Safe Control Relay

.1 Product Description: Panel mounted, sealed optically isolated relay for use in class I and class II listed areas.

.2 Contacts: Form A or B (normally open / normally closed or both) as required.

.3 Contact Ratings: Minimum 8 amperes continuous.

.4 Coil Voltage: As required.

.5 Listing: UL 913

.6 Manufacturer: Pepperl Fuchs Group, KFA5-SR2-Ex2.W Series or Approved Equal

.2 Time Delay Relay (On-Time Delay and Off-Time Delay)
 .1 Product Description: DIN rail mount solid-state time delay relay with base and retainer. Time delay after Energization or after De-Energization as required.
 .2 Provide with surge supressor diode.
 .3 Contacts: Form A or B (normally open / normally closed or both) as required.
 .4 Contact Ratings: Minimum 10 amperes continuous.
 .5 Coil Voltage: As required.
 .6 Manufacturer: IDEC Co., GT5 Series or Approved Equal

.3 General Purpose Plug-in Relay
 .1 Product Description: Din rail mount miniature, sealed relay with base and retainer and Light Emitting Diode (LED) indicator.
 .2 Provide with surge suppression diode.
 .3 Contacts: Form A or B (normally open / normally closed or both) as required.
 .4 Contact Ratings: Minimum 10 amperes continuous.
 .5 Coil Voltage: As required.
 .6 Socket: To match relay and meet conditions of installation.
 .7 Manufacturer: Allen Bradley, 700-HC Series or Approved Equal

.4 Field Mounted Limit Switch
 .1 Product Description: Heavy-duty, lever-operated limit switch. Actuator type as required for application.
 .2 Contacts: Form A or B (normally open / normally closed or both) as required.
 .3 Contact Ratings: Minimum 10 amperes continuous.
 .4 Enclosure: NEMA 6P
 .5 Manufacturer: Square D/Schneider Inc, Class 9007 Type C or Approved Equal

2.7 Interposing Relays

.1 Interposing relays shall be provided for all input and output circuits connected to PLC’s, control devices where driving loads or interfacing with external devices.

.2 For interfacing with devices using voltages above 5-VDC and located within Class I or Class II environments, provide intrinsically safe interposing relay listed for use within classified area.

2.8 Analog Signal Isolators

.1 Analog instruments located in different control panels shall not be wired in series. Provide analog signal isolators for analog signals that are sent from one control panel to another.

2.9 Communications Hardware

.1 Communication Protocol Converter
  .1 The communications system shall utilize communication protocol conversion devices where required to transform and transmit device level communication protocols to a common system level protocol. Unless specified elsewhere in the Contract Documents, the common system protocol shall be Ethernet (IEEE 802.3). Each native device I/O bit shall be accessible over the network using this common system protocol.
    1. Media converters shall be manufacturer listed for use in industrial environments.
    2. Media converters shall be din rail mounted within a listed and suitable enclosure.
    3. 24 VDC power supply.

2.10 Electrical Transient Protection

.1 Description: All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting cabling from lightning discharges and nearby electrical systems.

.2 Control panels served by electrical service that is 100 A or more:
  .1 Panel mount Transient Voltage Surge Supressor (TVSS).
  .2 UL 1449 Listed.
  .3 LED Status indicator.
  .4 100,000 amps per phase surge capacity
  .5 Voltage rating to match panel supply voltage
  .6 Manufacturer: Square D, XW Series, or Approved Equal

.3 Control panels served by less than 100 A electrical service:
  .1 Din rail mount Transient Voltage Surge Supressor (TVSS).
  .2 UL 1449 Listed.
  .3 LED Status indicator.
  .4 45,000 amps per phase surge capacity
  .5 Voltage rating to match panel supply voltage
  .6 Manufacturer: Square D, Multi 9 SPD Series, or Approved Equal

.4 Provide each TVSS with panel mounted circuit breaker rated in accordance with the manufacturer’s requirements.

2.11 Power and Distribution

.1 Circuit Breakers: Panel mount NEMA AB 1, bolt-on type thermal magnetic and instantaneous magnetic trip circuit breaker. Circuit breaker thermal elements shall be of the bimetallic type and shall be capable of withstanding sustained overload and short-circuit currents without injury and without affecting the calibration of the bimetallic element. The thermal element shall have inverse time characteristics. The instantaneous elements shall trip the circuit breaker at the minimum standard trip setting.
  .1 Provide common trip handle for multiple pole circuit breakers.
  .2 Minimum integrated short circuit rating
    1. Circuit Breakers rated 240-Volts - 10,000 amperes RMS symmetrical.
    2. Circuit Breakers rated 480-Volts - 42,000 amperes RMS symmetrical.
    3. Circuit Breaker rating shall match or exceed the serving panel’s interrupting rating.
    4. Series rated breakers shall not be acceptable.
  .3 Provide externally operable handle for main circuit breaker disconnect. Breaker handle minimum requirements:
    1. Shall be either flange mount or door mount with door interlock design.
    2. Handle shall be lockable in the on and off positions.
    3. Design shall require handle to be in off position to open door with manual defeat mechanism.
    4. Stainless steel or painted cast metal design.
    5. Listed for use with installed circuit breaker.
    6. Design shall prevent binding and shall not require manual adjusting to close door.
    7. NEMA rating shall match enclosure NEMA rating.

.2 Incoming Power And Power Distribution Blocks:
  .1 Material: High impact thermoplastic with tin plated copper lugs, size and ampacity per requirements.
  .2 Manufacturer listed finger safe cover.
  .3 Panel mounted.
  .4 Manufacturer: Square D, Class 9080, or approved equal.

.3 Incoming Power Ground Bus:
  .1 Provide ground bus for power connection to enclosure back panel.
  .2 Bond back panel to enclosure using back panel bonding washer provided by the panel manufacturer.
  .3 Provide connection to door mounted ground studs.
  .4 Manufacturer: General Electric Co., TGK24CP, or approved equal.

2.12 Control Power Transformer

.1 Description: Panel mounted industrial control transformer:
  .1 Epoxy encapsulated copper windings.
  .2 55 degrees Celsius rise, 105 degrees Celsius insulation.
  .3 NEMA ST-1 compliant.
  .4 Integral fusing with finger safe covers.
  .5 Voltage:
    1. Primary: As Indicated in Contract Drawings
    2. Secondary: 120 VAC
  .6 Rating: As required for system, plus 25 percent spare capacity

.2 Use Limitations: Control Power transformers shall be permitted for use in transforming power for use as control panel general control and distribution power for use by relays, indicating lamps, panel mount receptacles and Power Supply input source. Where providing system control power for use by system controls and active system components refer to Subsection 2.13 - Power Supply below for requirements.

.3 Fusing: Control transformers shall be equipped with primary and secondary fusing and sized for all connected equipment and components, plus 25 percent spare capacity.

.4 Each control transformer shall be provided with manufacturer listed “finger safe” terminals.

.5 Provide fused disconnecting means for each connected control power distribution leg.

.6 Maintain a minimum 305 mm (12 in) separation from Radios, PLC’s and other active components located within the control panel.

.7 Manufacturer: Sola, SBE Series or Approved Equal

2.13 Power Supply

.1 Description: Panel mounted linear power supply:
  .1 Regulation: .01 percent output variation at rated voltage with 10 percent input variation.
  .2 Ripple; 3.0 mV max peak to peak
  .3 Transient Response Time: 50 msec.
  .4 Stability .5 percent
  .5 Operating Temperature Range: 0 degrees Celsius to 50 degrees Celsius.
  .6 Voltage:
    1. Primary: 120-VAC, 60-Hz
    2. Secondary: 24-VDC
  .7 Rating: As required for system, plus 25 percent spare capacity

.2 Use Limitations: Power supplies shall be used for powering PLC's, Radios and all other active low voltage control devices.

.3 Provide fused disconnecting means for each connected control power distribution leg.

.4 Maintain a minimum 50 mm (2 in) separation form adjacent devices located within the control panel.

.5 Manufacturer: Phoenix Contact Ltd., QUINT Series or Approved Equal

2.14 Pressure Switch

.1 Description: Pressure actuated switch
  .1 User Adjustable Range: 8-200 PSI
  .2 Deadband: 1 – 11 PSI
  .3 Configuration: One SPDT output contact, 10-Amp
  .4 Diaphram: Stainless Steel
  .5 Process Connection: 1/2-inch NPT
  .6 Enclosure Rating: NEMA 4X

2.15 Control Power Uninterruptable Power Supply (UPS)

.1 Description: Panel mounted Uninterruptible Power Supplies (UPS):
  .1 120-VAC, 60-Hz Input, +/- 10 percent of rated input voltage.
  .2 Operating Temperature Range: 0 degrees Celsius to 50 degrees Celsius.
  .3 Form C dry contact relay for low battery and general fault alarm indication.
  .4 Cold start capability.
  .5 Finger safe screw terminals.
  .6 Voltage:
    1. Primary: 120-VAC, 60-Hz
    2. Secondary: 120-VAC, 60-Hz
  .7 Rating: As required for a minimum system run time of fifteen (15) minutes with all devices active.
  .8 Battery: Lead Absorbed Glass Mats (AGM), Valve-regulated lead-acid battery (VRLA) type, sized per the application and rating requirements.

.2 Maintain separation form adjacent devices to enable ease of maintenance.

.3 Provide fused disconnecting means for each connected control power distribution leg.

.4 Manufacturer: Phoenix Contact Ltd., QUINT-UPS Series or Approved Equal

2.16 Autodialer

.1 Product Description: Unit capable of dialing up to 16 programmed phone numbers, each 60 digits in length and transmitting either a pre-recorded message or an alphanumeric message based on up to 8 user defined inputs. The Autodialer shall be capable of interfacing through a network connection for integration into the SCADA system.

.2 Networking Connections: Modbus

.3 Operational Requirements:
  .1 Recordable Message Length: up to 400 seconds.
  .2 Alarm response delay: up to 9999 seconds.
  .3 Autocall test function.
  .4 Alarm Reset Time: up to 99.9 minutes.
  .5 Input Monitoring Capability to detect loss of power.
  .6 Speakerphone.
  .7 Onboard battery backup sized for 13 hours of run time.
  .8 Standard touch tone phone interface.

.4 Supply Voltage: As indicated in Contract Drawings.

.5 Enclosure: NEMA 1, panel mounted.

.6 Source Quality Control: Test controller in accordance with NEMA IA 2.2.

.7 Warranty: 5 year manufacturer warranty.

.8 Manufacturers:
  .1 RACO Manufacturing and Engineering Co., Inc., Verbatim, VPLC Series
  .2 Or approved equal

2.17 Submersible Pump Moisture Detection Relay

.1 Product Description: Panel mount interface relay used in conjunction with sensor located within submersible pump to provide status output for monitoring presence of moisture within pump motor housing.

.2 Coordinate requirements and compatibility with pump supplier prior to submitting equipment for approval.

.3 Requirements:
  .1 DIN rail mount, sealed relay with base and retainer and Light Emitting Diode (LED) indicator for status indication.
  .2 Provide with surge suppression diode.
  .3 Output Contacts: Form A or B (normally open / normally closed or both) as required.
  .4 Output Contact Ratings: Minimum 10 amperes continuous.
  .5 Coil Voltage: As required.
  .6 Socket: To match relay and meet conditions of installation.

.7 Manufacturer: Xylem Inc., Flygt, MiniCAS II or approved equal.

PART 3. EXECUTION

3.1 Existing Work

.1 Disconnect and remove all abandoned controls, control enclosures and instrumentation. Coordinate the removal of controls in existing control panels that are required to remain in operation as part of the construction phasing.

.2 Maintain operation of existing controls for installations and equipment remaining active.

.3 Extend existing control installations using materials and methods compatible with new electrical installations.

.4 Clean, test and repair existing controls and relays to remain or to be reinstalled.

3.2 Installation

.1 Equipment Locations: The locations of equipment and instrumentation are approximate. The exact locations and routing of wiring and cables shall be governed by structural conditions, Site conditions, physical interferences and by the location of electrical terminations on equipment.

   .1 Enclosures and equipment shall be located and installed so that they will be readily accessible for operation and maintenance. Minimum clearances shall be in accordance with the ESA.

   .2 Where Site conditions require changes in locations and arrangements, or when the Region exercises the right to require changes in location of equipment that do not impact material quantities or cause material rework, the Contractor shall make such changes without additional cost to the Region.

.2 Install in accordance with NECA “Standard of Installation.”

.3 Install enclosures and boxes plumb. Anchor securely to wall, floor and structural supports at each corner in accordance with manufacturer recommendations and as specified elsewhere in the Contract Documents.

.4 Install individual control devices and relays in enclosures where not factory installed.

.5 Make electrical wiring interconnections.

.6 Install nameplates and labels.

.7 Provide grounding and bonding of control panel and devices in accordance with manufacturer's requirements and as specified elsewhere in the Contract Documents.

3.3 Adjusting

.1 Each device shall be field tested, adjusted and tuned to operate with the process loop. Field test results shall be recorded and submitted to the Region for their records.

3.4 Field Testing and Commissioning

.1 Installation and Start-Up
  .1 Develop a specific plan for the startup and commissioning and for any required cutover. No startup or cutover activities shall be performed until the plan has been successfully approved by the Region and Consultant in writing.
  .2 The Consultant reserves the right to retest functions as needed to demonstrate that system performs as intended.
  .3 The Consultant's decision shall be final regarding completeness of testing and final acceptance.
  .4 Procedures, Forms, and Checklists:
    1. Conduct all testing in accordance with, and documented on, Consultant-accepted procedures, forms, and checklists.
    2. Describe each test item to be performed.
    3. Have space after each test item description for sign off by appropriate party after satisfactory completion.

.2 Electrical Tests
  .1 Insulation Tests
    1. Perform resistance measurements through all bolted connections with low-resistance ohmmeter.
    2. Measure insulation resistance of each control circuit-to-ground.
    3. Perform an insulation resistance test at 1,000 Volts DC on all control wiring. For units with solid-state components, follow manufacturer's recommendations.
  .2 Test Values: Control wiring insulation test resistance shall be a minimum of two megohms.

.3 Each hardwired point shall be tested and approved with a point verification test prior to the start of the operational tests.
  .1 Point testing shall include point to point testing of all field connected devices and where modifications have been made to factory provided control panels.

.2 Point testing shall not occur until after calibration of devices has occurred.
.3 Make corrections and repairs where found prior to proceeding to operational testing.

.4 Operational Tests:
.1 Check electrical circuits for continuity and for short circuits.
.2 Check all control devices including interlocks, indicating lights, control relays, timers, time delay relays, and push buttons for correct operation.
.3 Verify that all thermal overload heater elements are installed in each motor starter and properly sized for the actual motor full load current.
.4 Subsequent to energizing equipment, demonstrate function of each system in accordance with the requirements for the project.

.5 Functional Performance Testing:
.1 Test procedures shall be developed and submitted for approval prior to commencing work and shall indicate comprehensive step-by-step procedures.
.2 Functional Performance Test shall not occur until after operational check, electrical checks and point testing has occurred.
.3 Verify sequence of operation including testing of safety controls, interposing controls, loop checks, alarm annunciation, remote annunciation, local control operation without automation, etc.
.4 Equipment to be tested shall include all installed systems in this specification.
.5 Acceptance of installed systems shall not commence until after successful functional performance test has been witnessed by the Consultant and Region.

3.5 <u>Demonstration and Training</u>

.1 Furnish eight (8) hours of instruction for each unique control panel, to be conducted at project site with Operators. Coordinate with the Region for times and dates of training. Training times and dates shall be as directed by the Region and shall be coordinated by the Contractor.
.1 Demonstrate control panel operation and system function.
.2 Identify control panel devices and their function.
.3 Identify special features and interface points.
.4 Review standard maintenance practices.

END OF SECTION

PART 1. GENERAL

1.1 Introduction

.1 The Software Acceptance Test (SAT), performed in conjunction with the Region’s staff, is focused on ensuring that all instrumentation, equipment, SCADA and controller hardware and software is working properly and that all software configurations match the requirements identified in the Detailed Software Design, including the detailed process narratives and logic flow diagrams. The Contractor shall list each SAT testing milestone within the Contractor submitted construction schedule. The Contractor shall test the software under all possible process conditions in order to ensure the robustness of the software and operational scenarios in order to validate that the installed components and systems perform as intended.

.2 The flow chart included below as Figure 1 has been included in this document to provide an overview of anticipated SAT procedures.

.3 SAT testing shall be carried out for all SCADA and controller software including packaged and Contractor supplied Products as a complete system.

.4 The SAT shall be repeated for each phase of the Contract where temporary and permanent facilities are installed, and where systems are removed or demolished.

1.2 Prerequisites

.1 Equipment start-ups shall have completed with the manufacturer representatives including all mechanical equipment required to fully test the operation of the software.

.2 All instrumentation shall have been installed, calibrated and tested prior to starting SAT.

.3 All network equipment shall have been installed and tested prior to starting SAT.

.4 The final SAT and Start-Up Test plan is to be submitted and approved by the Consultant and the Region a minimum of 28 Days in advance of the SAT.

.5 All panel I/O shall have been wired up, tested and signed off 100% by the Contractor, System Integrator and Panel Fabricator prior to commencing SAT unless otherwise approved by the Consultant. If any I/O is not available, the Contractor must submit a request to defer I/O testing until after the SAT for review and approval at the same time when the SAT and Start Up test plan is submitted for review. The request must identify the reason for deferring I/O testing along with a proposed revised date when the I/O will be tested.

1.3 Related Sections

.1 Comply with the provisions of Section 01300 – Submittals and Division 13 – SCADA and Instrumentation. Instrument and equipment testing is to be completed and signed off prior to commencing SAT.

.2 The Contractor is to assume for testing purposes that the Region's operations and PCS staff will be available during normal working hours Monday-Friday (7:30am – 3:30pm). Any request for testing to be completed outside of these hours must be submitted to the Consultant in writing a minimum of 14 Days in advance and must be approved by the Region.

1.4 Start Up Team

.1 The Start Up Team consisting of representatives of the Consultant, the Contractor, the System Integrator, the Region's PCS Group and the Region's Operations Group will jointly develop the testing plan and the SAT and Start Up Plan. The Contractor shall be solely responsible for planning, coordinating, preparing and implementing the final Software Acceptance Testing (SAT) and commissioning plan.

.2 The start up team shall review and revise the proposed commissioning plan as submitted by the Contractor. Where a meeting is required, the contractor shall schedule a meeting no later than 42 Days prior to the proposed testing period. The Contractor shall be responsible for expanding and providing details for the SAT and Start Up Plan to clearly identify the proposed test procedure for the equipment and software.

.3 The SAT testing shall be witnessed by the facility Start Up Team and shall be conducted by the Contractor.

.4 Members of the Start Up Team are to be identified at the pre-SAT and Start Up meeting. These team members will be involved throughout the process and are to be changed only with the approval of the Consultant and Region. The Region will provide guidance in the Start Up meeting as to which of the Region's representatives will be actively participating and reviewing the process of the SAT.

1.5 Purpose and Scope

.1 The goal of software testing is to ensure that the completed systems meet the operational design intent requirements, and do not contain any functional issues would otherwise cause the connected systems to function as intended. Software installed or modified under the Contract must not adversely affect the operation of other systems currently in operation at the facility. All functionality that is currently available within the system that is to remain shall remain available at the completion of the testing.

.2 All software installed under the Contract shall be tested to confirm that the software developed, tested and installed under the

Contract provides the intended operation and functionality. Where there is a discrepancy within the Contract Documents or where the intended function of any component or system is unclear; the Contractor shall seek direction from the Region and the Consultant. The Region and the Consultant will provide clarification, and the Contractor shall make any required adjustments to provide the intended functionality at no additional cost to the Region.

.3 All software shall meet the requirements of the Contract Documents including all operational control, monitoring and alarming, as well as integration of all equipment and systems supplied by the Contractor.

.4 Testing is intended to demonstrate that all software developed not only works locally at the facility but that all software is fully functional on the Region-wide SCADA system. All Region-wide testing shall be conducted concurrently with the local testing to confirm operation throughout the Region-wide system.

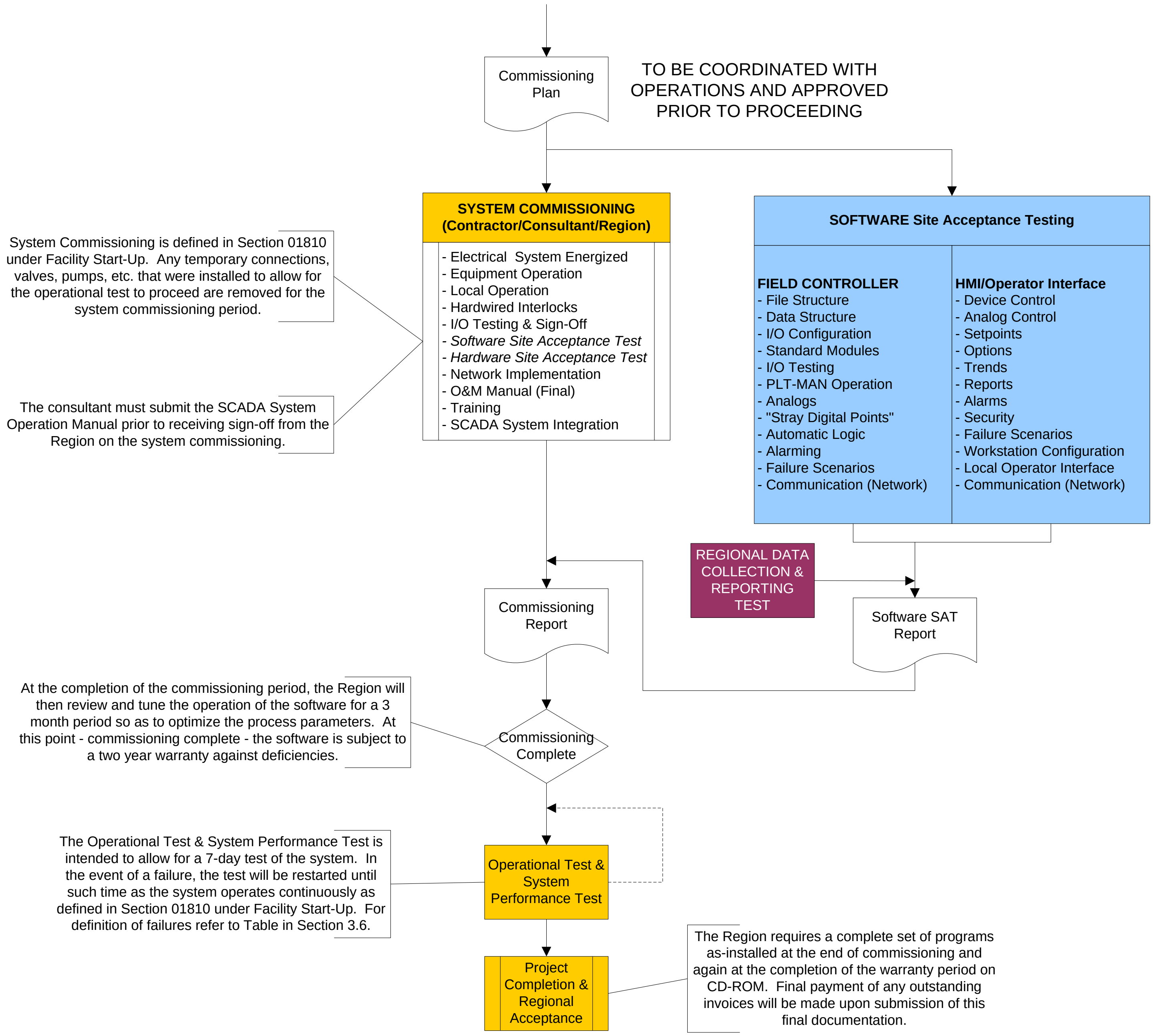

Figure 1 - Site Acceptance Testing Program

1.6 Definitions

.1 Software testing is defined as the execution of a program to find its faults, not just a process to verify its correctness.

.2 Verification: The process of proving the program's correctness.

.3 Validation: An attempt to find errors by executing a program in the controllers, SCADA Servers, Control nodes, and Monitoring nodes.

.4 Debugging: Diagnosing the precise nature of a known error then correcting it. Debugging is a "fix" activity, not strictly a testing activity.

.5 Errors: Human mistakes; errors in design definition or interpretation of the design by the programmer.

.6 Defects: Improper program conditions that are generally the result of an error. Not all errors produce defects (as with incorrect program comments, for example).

.7 Bugs: A fault that is a program defect found when the program is being tested or is in operational use. Bugs result from defects, but all defects do not necessarily produce bugs.

1.7 Measurement and Payment

.1 The Work outlined in this Section shall be included in the lump sum price for Section 13933 – Software Site Acceptance Testing as indicated in Schedule 'A' of the Bid Form.

1.8 Objectives

.1 The following identifies the overall objectives of the PCS Site Acceptance Test.
   .1 Confirm and document that the Process Automation Controller (PAC) I/O matches the panel shop drawings in terms of input/output configuration, tagging and function;
   .2 Confirm and document that the individual device logic operates all field equipment correctly and safely, as described in the detailed process control narrative;
   .3 Confirm and document that the treatment process and plant-wide control logic operates the facility correctly and safely, as determined by the FAT and also described in the detailed process control narrative;
   .4 Confirm and document that the data integration with Proficy Historian and other third party software operates correctly as tested in the FAT and described in the detailed process control narrative;
   .5 SAT testing shall be conducted for both plant PACs and vendor PACs.

1.9 Approach

.1 As part of the testing process regression testing shall be incorporated into all test plans to demonstrate that any changes made to the software do not impact other areas of the logic. This approach will ensure that corrections/modifications have not adversely affected the previously tested (and debugged) systems and system components.

.2 Testing shall be both progressive and regressive. Progressive testing introduces and tests new functions and uncovers problems in the newly added or modified modules and in their interfaces. Regressive testing concerns the effects of newly introduced changes or system components on all previously integrated (tested) code.

.3 The goal of software testing shall ensure that the system released for use by the Region meets its requirements, is error-free as possible and does not adversely affect other systems.

1.10 Test Success Criteria

.1 Test success shall be based on the number of defects and the defect severity levels encountered during the testing period. The Region and the Consultant at their discretion shall determine to restart a new SAT.

1.11 Completion Criteria

.1 Testing of software is deemed to be complete when all features, functions and information required in accordance with the Process Control Narratives, Process and Instrumentation Drawings, and the complete functionality as described in the Contract Documents has been verified as present and functioning, and documented as accurate within the anticipated operating range for the process being monitored and controlled.

1.12 Participants and Responsibilities

.1 The roles and responsibilities for test planning and testing are summarized below.

.2 SAT and Start-UpTest Planner (Contractor):
   .1 Develops the complete SAT and Start-Up test plan
   .2 Develops the schedule.
   .3 Coordinates all meetings identified in the Contract Documents to develop and implement the test plan.
   .4 Coordinates the involvement of all team members and equipment manufacturers required to be present during testing.
   .5 Develops/compiles the test data..
   .6 Oversees the test planning and test plan execution of the Process Control System.

.7 Obtains approval for test plan and schedule from Consultant and the Region.

.3 Consultant:
- .1 Reviews and approves test plan.
- .2 Documents test results and classifies defect severity.
- .3 Identifies system “design” defects (where the design does not match the specification) and coding defects (where the system does not behave as specified).
- .4 Reviews test results.
- .5 Assigns Level 1, 2 and 3 faults. Logs action required and taken in the Software Action Log.
- .6 Assigns Level 4, 5 and 6 faults. Logs action required and taken in the Software Action Log.
- .7 Maintains Software Action Log.
- .8 Maintains Deficiency Log related to other trades: electrical, instrumentation, vendor packages, and others.
- .9 Presents Change Requests to Region for prioritization.
- .10 Schedules approved change request work.
- .11 Maintains Change Request Log.

.4 System Integrator:
- .1 Responsible for defining the procedure required to complete the SAT and Start-Up tests.
- .2 Responsible for directing the SAT and start-up testing and for providing input to the Contractor as to which Subcontractors or trades are required to complete the tests identified within the test plan.
- .3 Installs and tests all software for functionality as per the detailed process control narrative.
- .4 Fixes critical defects.
- .5 Documents test results and forwards to the Contractor.

.5 The Region:
- .1 Coordinate with Region’s operations staff to avoid conflicts and minimize impact to operations of construction activities.

.6 PCS Group (Region):
- .1 Participates and assists in the acceptance testing.
- .2 Responsible for signing-off on the acceptance testing, on behalf of the Region, that the system is fully functional as defined within the detailed process control narrative.
- .3 Oversee the integration of the software into the Region-wide SCADA system.
- .4 Responsible for the configuration of the historian.

PART 2. DOCUMENTATION

2.1 General

.1 Site Acceptance Plan to be developed based on standard Region SAT templates. Refer to Section 13933B - Region of York

Software Site Acceptance Test Plan Example included as a supplement to this Section.

.2 Refer to Section 01810 – Equipment Testing and Facility Start-Up for start up requirements.

2.2 Testing Schedule

.1 Testing procedures and schedules of work shall be submitted for review and final approval a minimum of 28 Days prior to the projected test date or as specified elsewhere in the Contract Documents. This will include specific dates for when the various test procedures are to be carried out, and when Regional staff assistance is required.

.2 This schedule must be approved in writing by the Consultant and the Region prior to commencement of testing.

.3 The Contractor shall allow some flexibility in their schedule to allow for emergency requests on the Region's staff as operation of the facility takes precedence over testing, and for any unexpected findings.

.4 The completed Site Acceptance Test Report must be presented within 7 Days after completion of the SAT in order to identify and resolve all critical issues which affect scope, cost or schedule in a timely manner.

PART 3. EXECUTION

3.1 General

.1 This part provides an outline of the Works to be carried out by the Contractor, the Consultant, the System Integrator, the Region's Project Manager, the Region's PCS Group and the Region's Operations team as part of the PCS Site Acceptance Test(s).

3.2 Test Sub-Phase

.1 The types of software tests (referred to here as test sub-phases) are:

.1 Individual instruments, equipment, and process units: these sub-phases test/verify that all devices and their larger system parts (for example process units and duty tables) perform as specified in the Contract Documents.

.2 Intra-system Integration: tests/verifies the interfaces between units and the associated process logic related to multiple units, treatment processes, facility areas, and/or liquids, solids and plant-wide operating strategies.

.3 Function: tests/verifies the functions that the program is to perform as set out in the detailed process control narratives.

.4 Performance/Operational: tests/verifies the system's performance under a variety of conditions (normal/abnormal) and verifies these results against the detailed process control narratives. Includes testing of the system's configuration, security, backup/recovery, and reliability in the planned network architecture.

.5 System Wide Integration: tests/verifies the operation of the facility with other sites that are integral to the facility that is being upgraded under this Contract. Testing shall include integration and testing on the Region wide SCADA system.

3.3 Testing Cut-Off Points

.1 Testing cut-off points also need to be established in the test plan and reflected in the testing schedule. Level 1, level 2 and level 3 faults must be corrected as a first priority and testing should not proceed to the next sub-phase until all level 1, 2 and 3 faults are corrected.

3.4 Successful Completion

.1 The SAT is deemed successful when the following items have been completed:

   .1 SAT Test plan has been completed and signed-off.

   .2 All Level 1, 2 and 3 faults identified during the SAT have been corrected and verified for correct operation.

.2 The completed SAT plan has been reviewed and signed off by the Contractor, System Integrator, Consultant, and Region (including the Region's PCS and Operations).

3.5 Defect Handling and Management Change Requests

.1 During testing, the need for changes to the system will be identified. This will be as a result of a test failure or as a result of an incorrectly specified requirement (test did not fail, but the requirement is incorrectly specified).

.2 For test failures, the defect must be recorded in the SAT test document.

.3 All defects are to be documented by the System Integrator and the Consultant. All defects are to be immediately reviewed and resolved during the SAT period.

.4 The following "Fault Severity Index" shall be used for handling defects.

Defect Severity Level	Defect Description
1.	Fault causes system to crash. System rendered unusable/non-functional.
2.	Fault occurs in a critical function. Function is rendered unusable. A critical function is defined as a function that is required to maintain operation of the facility without manual intervention by the operations team.
3.	Fault occurs in a critical function. A portion of the function is rendered unusable.
4.	Fault occurs in a <u>non-critical</u> function. Function is rendered unusable.
5.	Fault occurs in a <u>non-critical</u> function. A portion of the function is rendered unusable.
6.	Cosmetic (e.g. typo) and would be unlikely to result in loss of confidence by users.

Figure 2 - System Faults

3.6 Facility Startup Period

.1 Following successful completion of the SAT testing, the facility startup period may commence. The Contractor, the Consultant, the System Integrator and Region Operations team, at a minimum are to be present during the facility startup period.

.2 The Consultant will to maintain a log of faults/deficiencies encountered during the facility startup period. The Contractor/System Integrator/Programmer shall immediately correct faults/deficiencies at the request of the Consultant. If any Level 1, level 2 or level 3 fault occurs during the facility startup period, the test period will be restarted from Day 1 after completion of the software modifications and testing by the System Integrator.

.3 Following completion of the facility startup period, the fault/deficiency log is submitted to the Region for review. Sign-off by the Contractor, the System Integrator, the Consultant, the Region's Project Manager, the Region PCS Group and the Region Operations team are required at the completion of the facility startup period.

3.7 Supplements

.1 The supplement listed below, following the "END OF SECTION", forms a part of this Specification.

 .1 Section 13933B - Region of York Software Site Acceptance Test Plan Example

END OF SECTION

REGION OF YORK

SOFTWARE SITE ACCEPTANCE TEST PLAN

EXAMPLE

Version 1.0

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1.0 DOCUMENT SUMMARY

This document details the Site Acceptance Test Plan for the Leslie Street Sewage Pumping Station. It includes the following information:

- Roles and responsibilities of the SAT team participants
- SAT schedule
- Description of the testing environment
- Procedure for performing each test
- Detailed test plan checklist

1.1 Reference Documents

The table below summarizes those documents which are referenced throughout the SAT Test Plan.

Table 1: Reference Documents

TITLE	REVISION	DATE
Leslie Street Sewage Pumping Station Process Control Narrative	1.0	04/18/2011
Leslie Street Sewage Pumping Station Factory Acceptance Test Plan	1.0	04/20/2011

2.0 ROLES AND RESPONSIBILITIES

The following key people will participate in this SAT:

Table 2: Roles and Responsibilities

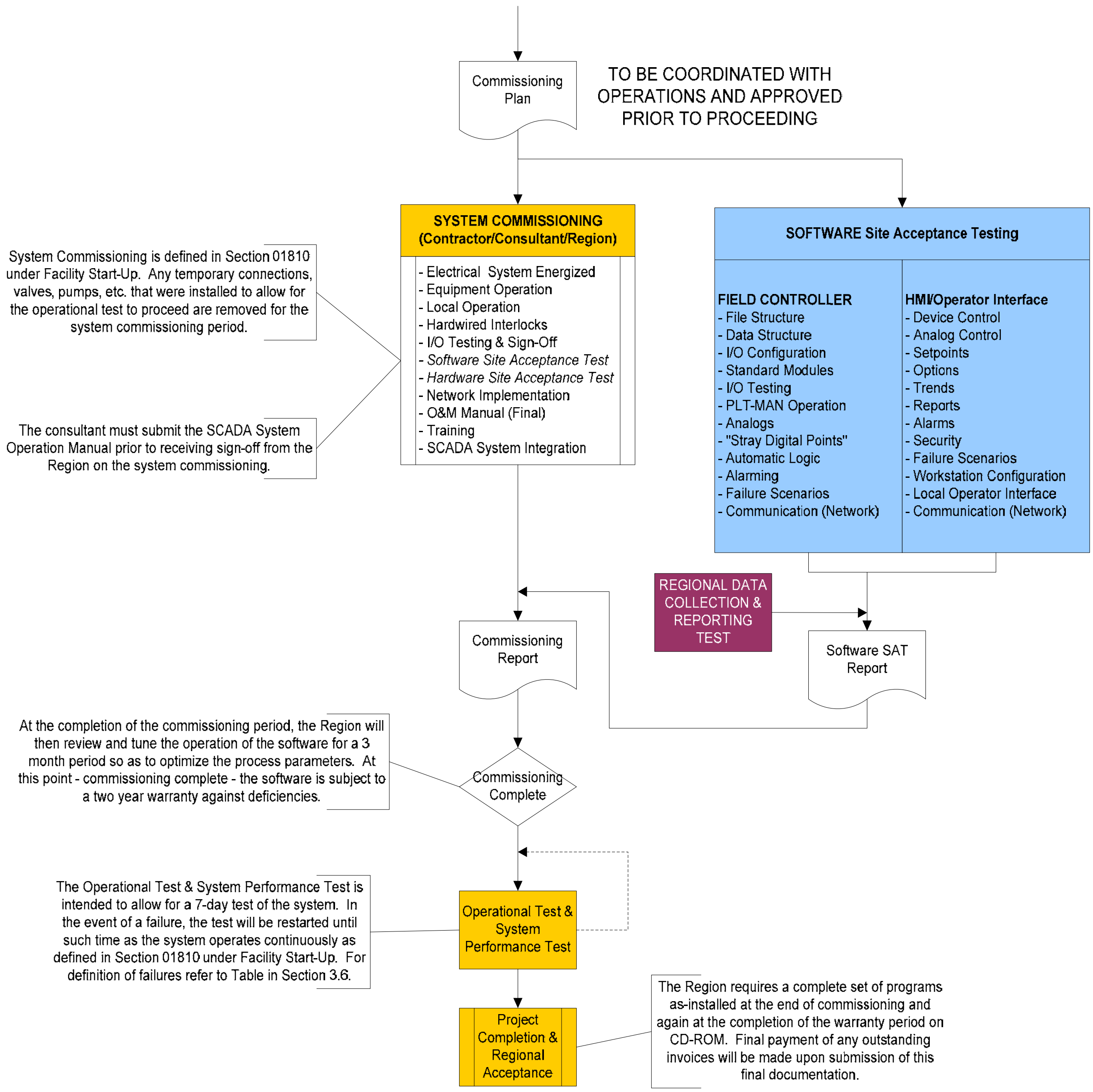
NAME	ROLE	RESPONSIBILITIES
	Consultant Representative –	▸ Preparation of the SAT Test Plan ▸ Setup of the SAT testing environment ▸ Scheduling of the SAT test ▸ Execution of the SAT Test Plan ▸ Signing off of test cases ▸ Producing the SAT test reporting including a listing of all issues/deficiencies and the appropriate corrective action plan
	Region Representative	▸ Documenting issues/deficiencies ▸ Signing off of test cases
	Contractor Representative	
	Other	

3.0 SAT SCHEDULE

SAT testing for the Leslie Street Sewage Pumping Station excluding any vendor-supplied packages will occur at _____________ in several stages as per the following schedule:

- Date of SAT: MM, DD, YYYY

Figure 3-1 – SAT Schedule



4.0 TESTING ENVIRONMENT

All Site Acceptance Testing is to be performed on the actual equipment which is to control the process. No substitutions will be accepted.

- MTSS ControlLogix 1756-L61 Processor c/w firmware V19.11
- RSLogix 5000 V19.01
- GE Proficy iFix 4.0 Running on the HUB2 Server c/w a Terminal Services session or dedicated View Node for Operator Interface
- Local Panel Mounted Operator Interface Terminal

5.0 SOFTWARE REVIEW

The following table summarizes the PAC and HMI software items which are to be reviewed and accepted.

Table 3: Software Review

REVIEW ITEM	☑	CORRECTIVE ACTION
Confirm relevant SCADA standards have been followed for PAC and HMI/OIT development		
Review of all HMI/OIT graphics		
Review of graphical navigation		
Confirm integration of graphical navigation with existing SCADA system		
Review security levels		
Review alarm configuration		
Review all issues/deficiencies reported at the FAT and ensure the appropriate corrective action has been completed		

6.0 TESTING PROCEDURE

Testing should proceed as per the following order by performing each test listed in section 6.1 for each process. Refer to subsections 6.1.1 through 0 for a complete test procedure for each test case.

1. Sewage Pumping Process
2. Building Services
3. Standby Power

6.1 Test Cases

Individual process testing should include all applicable sections listed below and should be documented with pass/fail results and any corrective action required at the end of each process section.

1. Device Drivers – Control mode, Setpoints, ranges, alarming, etc.
2. Analog Instruments – Scaling, alarming, statistical analysis, etc.
3. Miscellaneous I/O – Field alarms
4. Automatic Logic – Setpoints, duty, etc.
5. Automatic Logic – Normal operation
6. Automatic Logic – Abnormal operation
7. Fault Response – loss of control signal, field alarms, hardware failure, etc.

6.1.1 Device Drivers

The following sections outline the step by step test procedure for devices which are monitored and/or controlled by the software.

6.1.1.1 Motorized Device Test Procedure

A motorized device may be any pump, blower, conveyor, etc. that is either constant speed or variable speed.

- Local/Remote Selection
  - *Toggle the Control Mode field input using the selector switch*
  - Confirm that device switches from LOCAL to REMOTE-MANUAL/REMOTE-AUTO mode within the PAC logic
  - Confirm that the HMI/OIT graphic changes to match the field input at the following locations:
    - Device popup
    - Process Screen
- REMOTE-MANUAL/REMOTE-AUTO Selection
  - *Toggle REMOTE-MANUAL/REMOTE-AUTO selection through the HMI/OIT*
  - Confirm that devices switches from REMOTE-MANUAL to REMOTE-AUTO and back within the PAC logic
  - Confirm that the HMI/OIT graphic changes to match the PAC logic at the following locations:
    - Device popup
    - Process Screen
- REMOTE-MANUAL Operation
  - *Start device from HMI/OIT I Device Popup*
  - Confirm that the appropriate Digital Output turns ON
  - *Confirm that the device starts and the Running Status Digital Input turns ON*
  - Confirm that the HMI/OIT graphic changes to match the field input at the following locations:
    - Device popup
    - Process Screen
  - *Change the speed setpoint from the HMI/OIT Device popup*

- Confirm that the device varies its speed within the operating range of the VFD and that the Speed Feedback Analog Input signal updates to reflect the change in setpoint
- Confirm that the speed feedback appears on the HMI/OIT Device popup
- *Wait for the minimum on timer to elapse*
- *Stop device from HMI/OIT Device popup*
- Confirm that the appropriate Digital Output turns OFF
- *Confirm that the device starts and the Running Status Digital Input turns OFF*
- Confirm that the HMI/OIT graphic changes to match the field input at the following locations:
  - Device popup
  - Process Screen
- *Return the speed setpoint and speed feedback to zero*

- Field Alarms
  - *Toggle/force a hardwired alarm field input ON*
  - Confirm that the HMI/OIT graphic changes to match the hardwired alarm condition at the following locations:
    - Device popup
    - Process Screen
    - Alarm Banner

6.1.1.2 Actuated Valve Test Procedure

An actuated valve may be any valve which is discrete or modulating.

- Local/Remote Selection
  - *Toggle the Control Mode field input using the selector switch*
  - Confirm that valve switches from LOCAL to REMOTE-MANUAL/REMOTE-AUTO mode within the PAC logic
  - Confirm that the HMI/OIT graphic changes to match the field input at the following locations:
    - Valve popup
    - Process Screen
- REMOTE-MANUAL/REMOTE-AUTO Selection
  - *Toggle REMOTE-MANUAL/REMOTE-AUTO selection through the HMI/OIT*
  - Confirm that valves switches from REMOTE-MANUAL to REMOTE-AUTO and back within the PAC logic
  - Confirm that the HMI/OIT graphic changes to match the PAC logic at the following locations:
    - Valve popup
    - Process Screen
- REMOTE-MANUAL Discrete Operation
  - *Open valve from HMI/OIT Valve Popup*
  - Confirm that the appropriate Digital Output turns ON
  - *Confirm that the Digital Input signal representing the valve closed status turns OFF and the Digital Input signal representing the valve opened status turns ON*
  - Confirm that the HMI/OIT graphic changes to match the field input at the following locations:
    - Valve popup
    - Process Screen
  - *Wait for the minimum open timer to elapse*
  - *Close valve from HMI/OIT Valve popup*
  - Confirm that the appropriate Digital Output turns OFF
  - *Confirm that the Digital Input signal representing the valve closed status turns ON and the Digital Input signal representing the valve opened status turns OFF*

- Confirm that the HMI/OIT graphic changes to match the field input at the following locations:
  - Valve popup
  - Process Screen
- REMOTE-MANUAL Modulating Operation
  - *Change the position setpoint from HMI/OIT Valve popup*
  - Confirm that the valve position updates in the field to match the change in setpoint and that the appropriate Analog Input signal updates to reflect the change in setpoint
  - Confirm that the position feedback displays correctly at the following locations:
    - Valve popup
    - Process Screen
- Field Alarms
  - *Toggle/force a hardwired alarm field input ON*
  - Confirm that the HMI/OIT graphic changes to match the hardwired alarm condition at the following locations:
    - Valve popup
    - Process Screen
    - Alarm Banner

6.1.2 Analog Instruments

The following sections outline the step by step test procedure for analog instruments which are monitored by the software.

- Scaled Value
  - Confirm that the PAC engineering unit minimum and maximum match the calibrated instrument span
  - *If available, place the instrument into simulation mode to verify the 4-20mA signal*
  - Confirm that values of 4, 12, and 20mA are received on the appropriate Analog Input
  - *Return the instrument to normal operation*
  - Confirm that the value shown on the instruments local display matches that of the HMI/OIT at the following locations:
    - Analog popup
    - Banner
- Spike Filter
  - For any instruments using a 'Fast' update rate, the Spike Filter may be required to dampen any spikes on the 4-20mA signal
  - *Confirm that all instruments using 'Fast' updates, rate (if any) have an appropriate Spike Filter set in the PAC logic. Appropriate filter values can be verified by reviewing the instrument signal trend.*
- Clamping Limit
  - *All flowmeters should have a low end signal clamp set*
  - Confirm each flowmeter signals required low end clamp by adjusting any process equipment to attain an expected flow of zero
  - *Set the low end clamp in the PAC logic to a value slightly above the reading noted in the PAC when a zero value is expected*
  - Confirm that the HMI/OIT displays a value of zero
- Out Of Range Alarm (OOR)
  - *Disconnect one of the twisted pair connections from the instrument*

- Confirm the Out Of Range alarm is received by the HMI/OIT at the following locations after the PAC time delay for each alarm has elapsed:
  - Analog popup
  - Process Screen
  - Alarm Banner
- Reconnect the twisted pair connection from the instrument
- *Acknowledge the alarm.*
- Confirm the alarm resets

- Alarming
  - Determine appropriate values for the alarm setpoints associated with each instrument and note them in the test tables
  - *Force the analog value in the field to exceed the HiHi, Hi, Lo, and LoLo limits one at a time*
  - Confirm that the appropriate alarm is received by the HMI/OIT at the following locations after the PAC time delay for each alarm has elapsed:
    - Analog popup
    - Process Screen
    - Alarm Banner
  - *Acknowledge each alarm individually*
  - Confirm each alarm resets
- Rate of Change Alarm (ROC)
  - *Ensure that the ROC setpoint is set such that it is less than "Extreme value difference / 60"*
  - *Force the analog value in the field to an extreme low value.*
  - Confirm the Rate of Change alarm is received by the HMI/OIT at the following locations after the PAC time delay for each alarm has elapsed:
    - Analog popup
    - Process Screen
    - Alarm Banner
  - *Remove the force on the analog value in the field and wait a few minutes*
  - *Acknowledge the alarm*
  - Confirm the alarm resets
  - *Repeat the ROC test with an extreme high value*

6.1.3 Miscellaneous I/O

The following sections outline the step by step test procedure for field points which are monitored by the software.

- Field Alarms
  - *Toggle/force the field input to be ON*
  - Confirm that the alarm appears on the HMI/OIT at the following locations:
    - Process Screen (where applicable)
    - Alarm Banner
  - *Acknowledge the alarm at the HMI/OIT*
  - Confirm that the alarm appears as acknowledged but does not clear
  - *Toggle/force the field input to be OFF*
  - Confirm that the acknowledged alarm resets
- Field Status Points
  - *Toggle/force the field input to be ON*
  - Confirm that the HMI/OIT is updated to display the status point on the appropriate Process Screen
  - *Toggle/force the field input to be OFF*

- Confirm that the HMI/OIT is updated to display the status point on the appropriate Process Screen

6.1.4 Automatic Logic – Normal Operation

- Refer to the individual process sections for a complete automatic logic normal operation test procedure

6.1.5 Automatic Logic – Abnormal Operation

- Refer to the individual process sections for a complete automatic logic abnormal operation test procedure

7.0 SEWAGE PUMPING PROCESS

The following sections provide tables to record the Pass/Fail results and any corrective actions required for the sewage pumping process.

7.1 Equipment List

The following table summarizes all equipment associated with the sewage pumping process.

Table 4: Sewage Pumping Process Equipment List

EQUIPMENT TAG NAME	EQUIPMENT DESCRIPTION	EQUIPMENT SPECS
MTSS_RSP_PMP1	Raw Sewage Pump 1	VFD
MTSS_RSP_PMP2	Raw Sewage Pump 2	VFD
MTSS_RSP_PMP3	Raw Sewage Pump 3	VFD
MTSS_RSP_PMP4	Raw Sewage Pump 4	VFD
MTSS_WWEL_LIT1	Wet Well 1 Level Transmitter 1	__ - __ m
MTSS_WWEL_LIT2	Wet Well 2 Level Transmitter 1	__ - __ m
MTSS_RSP_FIT1	Station Flow Transmitter	__ - __ L/s
MTSS_RSP_PIT1	Station Discharge Pressure	__ - __ kPa

7.2 Control Modes

The following table summarizes the various control modes for each device.

Table 5: Sewage Pumping Process Control Modes

EQUIPMENT TAG NAME	EQUIPMENT DESCRIPTION	LOCAL MANUAL ☑	COMPUTER MANUAL ☑	COMPUTER AUTO ☑
MTSS_RSP_PMP1	Raw Sewage Pump 1	√	√	√
MTSS_RSP_PMP2	Raw Sewage Pump 2	√	√	√
MTSS_RSP_PMP3	Raw Sewage Pump 3	√	√	√
MTSS_RSP_PMP4	Raw Sewage Pump 4	√	√	√

7.3 *Pump Testing Results*

Record pump testing results in the following table.

Table 6: Pump Testing Results

Test Point	RSP_PMP1 Raw Sewage Pump 1						RSP_PMP2 Raw Sewage Pump 2						RSP_PMP3 Raw Sewage Pump 4						RSP_PMP4 Raw Sewage Pump 4					
	PROCECSS		POP_UP		BANNER		PROCECSS		POP_UP		BANNER		PROCECSS		POP_UP		BANNER		PROCECSS		POP_UP		BANNER	
	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O
Remote/Local operation																								
COMP/MAN operation - Run/Stop																								
COMP/MAN operation - Speed																								
AUTO operation - Run/Stop																								
AUTO operation – Speed																								
Command Digital Output																								
Hardwired Alarm (Fault)																								
Overload																								
Emergency Stop																								
Alarm 1																								
Alarm 2																								
Alarm 3																								
Alarm 4																								
VFD Fault																								
VFD Ready																								

Test Point	RSP_PMP1 Raw Sewage Pump 1						RSP_PMP2 Raw Sewage Pump 2						RSP_PMP3 Raw Sewage Pump 4						RSP_PMP4 Raw Sewage Pump 4					
	PROCECSS		POP_UP		BANNER		PROCECSS		POP_UP		BANNER		PROCECSS		POP_UP		BANNER		PROCECSS		POP_UP		BANNER	
	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O
VFD Bypass																								
Speed Deviation Alarm																								
Speed Feedback Signal Out Of Range Alarm																								

7.4 Valve Testing Results

There are no controlled valves associated with the sewage pumping process.

7.5 Analog Testing Results

Test the functionality outlined in the tables. Record results as indicated. Note that all alarms are to be latched requiring operator reset with the exception of the calibration mode alarms.

Table 7: Analog Testing Results

Tag Fragments 3 & 4	Test Point	WWEL_LIT1 Wet Well 1 Level						WWEL_LIT2 Wet Well 2 Level						RSP_FIT1 Discharge Flow						RSP_PIT1 Discharge Pressure					
		PROCESS		POPUP		BANNER		PROCESS		POPUP		BANNER		PROCESS		POPUP		BANNER		PROCESS		POPUP		BANNER	
		H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O
VAL	Current Value																								
CLB_VAL	Calibration Mode Value Hold																								
CLB_ALRM	Calibration Mode Alarm																								
HIHI_ALRM	HiHi Alarm																								
HI_ALRM	Hi Alarm																								
LO_ALRM	Lo Alarm																								
LOLO_ALRM	LoLo Alarm																								
OOR_ALRM	Out of Range Alarm																								
ROC_ALRM	Rate of Change Alarm																								
FLT_ALRM	Fault Alarm																								
PCNT	Percent Value																								
ENG_SPAN / ENG_ZERO	Instrument Range & Units																								

Tag Fragments 3 & 4	Test Point	WWEL_LIT1 Wet Well 1 Level						WWEL_LIT2 Wet Well 2 Level						RSP_FIT1 Discharge Flow						RSP_PIT1 Discharge Pressure					
		PROCESS		POPUP		BANNER		PROCESS		POPUP		BANNER		PROCESS		POPUP		BANNER		PROCESS		POPUP		BANNER	
		H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O	H	O
ACK	Alarm Acknowledge																								
RSET	Alarm Reset																								

7.6 Flow Totalization Results

Test the functionality outlined in the tables and record the results.

Table 8: Flow Totalization Results

Test Point	RSP_FIT1 Discharge Flow
Volume Today	
Volume Yesterday	
Volume Sunday	
Volume Monday	
Volume Tuesday	
Volume Wednesday	
Volume Thursday	
Volume Friday	
Volume Saturday	
Volume This Month	
Volume Last Month	
Cumulative Volume	

7.7 Discrete Alarms & Events Testing Results

The following table summarizes the I/O points associated with discrete alarms and events to be completed with Pass/Fail indications. Those alarm latches marked enabled are set by default. A checkmark in the Pass/Fail column will indicate that the default (Enabled) setting is accepted and verified for functionality. Latch enables, which must be toggled, are to be marked with an ‘L’ for Latched, or a ‘U’ for Unlatched and a checkmark noted for functionality.

Table 9: Discrete Alarm Testing Results

RACK/SLOT/ POINT	TYPE	A / E	TAG NAME	DESCRIPTION	LABEL/UNITS	ALARM LATCH		PASS/FAIL ✓
						ENABLED	PASS/FAIL ✓	
0/5/9	DI	A	RSP_PMP1_LIT1_BKUP_DI	Raw Sewage Pump 1 LIT Mode Alarm	0:NORMAL 1:ALARM	✓		
0/5/13	DI	A	RSP_PMP1_LVL_BKUP_DI	Raw Sewage Pump 1 Multitrode Mode Alarm	0:NORMAL 1:ALARM	✓		
0/6/9	DI	A	RSP_PMP3_LIT2_BKUP_DI	Raw Sewage Pump 3 LIT Mode Alarm	0:NORMAL 1:ALARM	✓		

RACK/SLOT/ POINT	TYPE	A / E	TAG NAME	DESCRIPTION	LABEL/UNITS	ALARM LATCH		PASS/FAIL ✓
						ENABLED	PASS/FAIL ✓	
0/6/13	DI	A	RSP_PMP3_LVL_BKUP_DI	Raw Sewage Pump 3 Multitrode Mode Alarm	0:NORMAL 1:ALARM	✓		
0/7/1	DI	A	WWEL_LSOF1_DI	Wet Well 1 Overflow Alarm	0:NORMAL 1:ALARM	✓		
0/7/2	DI	A	WWEL_LSHH1_DI	Wet Well 1 High High Level Alarm	0:NORMAL 1:ALARM	✓		
0/7/3	DI	A	WWEL_LSLL1_DI	Wet Well 1 Low Low Level Alarm	0:NORMAL 1:ALARM	✓		
0/7/4	DI	A	WWEL_LSLL1_BYPS_DI	Wet Well 1 Low Low Level Lockout Bypass	0:NORMAL 1:ALARM	✓		
0/7/9	DI	A	RSP_PMP_LVL_DI	Pumps On Multitrode Mode	0:NORMAL 1:ALARM	✓		
0/7/10	DI	A	RSP_PMP_LIT_DI	Pumps On Ultrasonic Mode	0:NORMAL 1:ALARM	✓		
0/7/11	DI	A	RSP_PMP_PAC_DI	Pumps On PAC Mode	0:NORMAL 1:ALARM	✓		
0/7/12	DI	E	RSP_PMP_AUTO_DI	Pumps On Auto Mode	0:OFF 1:AUTO			
1/2/9	DI	A	RSP_PMP2_LIT1_BKUP_DI	Raw Sewage Pump 2 LIT Mode Alarm	0:NORMAL 1:ALARM	✓		
1/2/13	DI	A	RSP_PMP2_LVL_BKUP_DI	Raw Sewage Pump 2 Multitrode Mode Alarm	0:NORMAL 1:ALARM	✓		
1/3/9	DI	A	RSP_PMP4_LIT2_BKUP_DI	Raw Sewage Pump 4 LIT Mode Alarm	0:NORMAL 1:ALARM	✓		
1/3/13	DI	A	RSP_PMP4_LVL_BKUP_DI	Raw Sewage Pump 4 Multitrode Mode Alarm	0:NORMAL 1:ALARM	✓		
1/4/1	DI	A	WWEL_LSOF2_DI	Wet Well 2 Overflow Alarm	0:NORMAL 1:ALARM	✓		
1/4/2	DI	A	WWEL_LSHH2_DI	Wet Well 2 High Level Alarm	0:NORMAL 1:ALARM	✓		
1/4/3	DI	A	WWEL_LSLL2_DI	Wet Well 2 Low Level Alarm	0:NORMAL 1:ALARM	✓		

7.8 Automatic Control Setpoints

The following table summarizes those points which are considered setpoints and may be operator adjustable via the SCADA system.

Table 10: Sewage Pumping Process Control Setpoints

CONTROL SETPOINT	DATA TYPE	UNITS	SIG. DIGITS	INPUT RANGE		DEFAULT	PASS/FAIL ☑
				MIN	MAX		
Pump 1 Duty	Integer	-	-	1	5	1	
Pump 2 Duty	Integer	-	-	1	5	2	
Pump 3 Duty	Integer	-	-	1	5	3	

CONTROL SETPOINT	DATA TYPE	UNITS	SIG. DIGITS	INPUT RANGE		DEFAULT	PASS/FAIL ☑
				MIN	MAX		
Pump 4 Duty	Integer	-	-	1	5	4	
Duty 1 Start Setpoint	Float	m	2	0.00	5.00		
Duty 1 Stop Setpoint	Float	m	2	0.00	5.00		
Duty 2 Start Setpoint	Float	m	2	0.00	5.00		
Duty 2 Stop Setpoint	Float	m	2	0.00	5.00		
Duty 3 Start Setpoint	Float	m	2	0.00	5.00		
Duty 3 Stop Setpoint	Float	m	2	0.00	5.00		
Duty 4 Start Setpoint	Float	m	2	0.00	5.00		
Duty 4 Stop Setpoint	Float	m	2	0.00	5.00		

7.9 Alarm Setpoints

The following table summarizes those points which are considered alarm setpoints and may be operator adjustable via the SCADA system. Record alarm setpoint defaults at the time of commissioning.

Table 11: Sewage Pumping Process Alarm Setpoints

TAG	DESC	LOW LOW		LOW		HIGH		HIGH HIGH		PASS/FAIL ☑
		DEF	PRI	DEF	PRI	DEF	PRI	DEF	PRI	
WWEL_LIT1	Wet Well 1 Level 1		Hi		Low		Low		Hi	
WWEL_LIT2	Wet Well 2 Level 1		Hi		Low		Low		Hi	
WWEL_FIT1	Station Flow		Hi		Low		Low		Hi	
WWEL_PIT1	Discharge Pressure		Hi		Low		Low		Hi	

7.10 Trending Points

The following table summarizes those values collected historically for trending purposes both by the iFix Historian Collector and the OIT Historian Collector.

Table 12: Sewage Pumping Trending

TAG	TAG DESCRIPTION	POLLED / UNSOLICITED	COLLECTION RATE / DEADBAND	PLOT INTERVAL	PASS/FAIL ☑
MTSS_WWEL_LIT1	Wet Well 1 Level 1	POLLED	30s	1s	
MTSS_WWEL_LIT2	Wet Well 2 Level 1	POLLED	30s	1s	
MTSS_WWEL_FIT1	Station Flow	POLLED	30s	1s	
MTSS_WWEL_PIT1	Discharge Pressure	POLLED	30s	1s	

7.11 Automatic Logic Test Scenarios

The following sections outline the automatic testing scenarios for the Leslie Street Sewage Pumping Station and should be completed with Pass/Fail results and corrective actions or comments where applicable. Refer to the Process Control Narrative for a complete description of the automatic control sequence.

7.11.1 Duty Setpoint Update

Pass ☐

- Using the HMI/OIT Duty Pop-up, enter new values for the pump duty sequence
- *Confirm that any of the following scenarios causes an error resulting in the existing duty values remaining*
    - *Any two pumps set as the same duty*
    - *Any two duty set as the same pump*
    - *Any duty value greater than 5*
    - *Any duty values less than 1*
- *Confirm that entering duty 5 for pump 1, 2, 3 or 4 will result in the remaining pump duties being re-sequenced and the duty 5 pump status becomes "Not Available"*
- Using the HMI/OIT Duty Pop-up, enter new values for the duty start and stop setpoints
- *Confirm that any of the following scenarios causes an error resulting in the existing setpoints remaining*
    - *Duty 1 Start greater than Duty 2 Start*
    - *Duty 2 Start greater than Duty 3 Start*
    - *Duty 3 Start greater than Duty 4 Start*
    - *Duty 1 Stop greater than Duty 2 Stop*
    - *Duty 2 Stop greater than Duty 3 Stop*
    - *Duty 3 Stop greater than Duty 4 Stop*
    - *Duty 1 Stop greater than Duty 1 Start*
    - *Duty 2 Stop greater than Duty 2 Start*
    - *Duty 3 Stop greater than Duty 3 Start*
    - *Duty 4 Stop greater than Duty 4 Start*
    - *Duty 4 Start greater than the Wet Well Level Engineering Unit Maximum*
    - *Duty 1 Stop less than the Wet Well Level Engineering Unit Minimum*
    - *Any two setpoints not separated by a minimum dead band (5% of the wet well level span by default)*

7.11.2 Normal Operation

Pass ☐

Note that the following sequence of tests will depend on the inflow to the station and that the start and stop setpoints may need to be adjusted during the testing to allow more pumps to start than are actually required to lower the wet well level.

- Using the PAC/HMI/OIT, place all 4 pumps into AUTO mode
- Using the HMI/OIT, set Pump 1 as Duty 1, Pump 2 as Duty 2, Pump 3 as Duty 3, and Pump 4 as Duty 4
- Press the "Apply" button
- *Confirm that the duty entries are accepted and are copied from the New column to the Current column*
- Using the HMI/OIT, enable automatic duty rotation on "All Stop"

- Using the HMI/OIT enter acceptable start and stop setpoints for each duty pump
- Using the HMI/OIT, select Wet Well 1 as the Controlling Level
- Allow the level of the Controlling Level Wet Well to reach a value above the Duty 1 Start Setpoint
- *Confirm that the Duty 1 Pump (Pump 1) starts*
- *Confirm that the Duty 1 Pump speed is varied proportionally with the Controlling Level between the Duty 1 and 2 Start Setpoints reaching 100% speed at the Duty 2 Start Setpoint*
- *Confirm that the Duty 2 Pump (Pump 2) starts and runs at 100% speed when the Controlling Level rises above the Duty 2 Start Setpoint*
- *Confirm that the Duty 3 Pump (Pump 3) starts and runs at 100% speed when the Controlling Level rises above the Duty 3 Start Setpoint*
- *Confirm that the Duty 4 Pump (Pump 4) starts and runs at 100% speed when the Controlling Level rises above the Duty 4 Start Setpoint*
- *Confirm that the Duty 4 Pump (Pump 4) stops once the Controlling Level falls below the Duty 4 Stop Setpoint*
- *Confirm that the Duty 3 Pump (Pump 3) stops once the Controlling Level falls below the Duty 4 Stop Setpoint*
- *Confirm that the Duty 2 Pump (Pump 2) stops once the Controlling Level falls below the Duty 4 Stop Setpoint*
- *Confirm that the Duty 1 Pump (Pump 1) stops once the Controlling Level falls below the Duty 4 Stop Setpoint*

7.11.3 Duty Activation

Pass ☐

- Using the PAC/HMI/OIT, place all 4 pumps into AUTO mode
- Using the HMI/OIT, set Pump 1 as Duty 1, Pump 2 as Duty 2, Pump 3 as Duty 3, and Pump 4 as Duty 4
- Press the “Apply” button
- *Confirm that the duty entries are accepted and are copied from the New column to the Current column*
- Using the HMI/OIT, enable automatic duty rotation on “OFF”
- Using the PAC, force the Controlling Level to a value between all duty start and stop setpoints
- *Confirm that all pumps are stopped*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 1
- *Confirm that the oval turns red and that the Duty 1 Pump (Pump 1) starts*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 2
- *Confirm that the oval turns red and that the Duty 2 Pump (Pump 2) starts*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 3
- *Confirm that the oval turns red and that the Duty 3 Pump (Pump 3) starts*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 4
- *Confirm that the oval turns red and that the Duty 4 Pump (Pump 4) starts*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 4
- *Confirm that the oval turns grey and that the Duty 4 Pump (Pump 4) stops*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 3
- *Confirm that the oval turns grey and that the Duty 3 Pump (Pump 3) stops*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 2
- *Confirm that the oval turns grey and that the Duty 2 Pump (Pump 2) stops*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 1
- *Confirm that the oval turns grey and that the Duty 1 Pump (Pump 1) stops*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 2

- *Confirm that a message is shown indicating that the Duty 2 device cannot be started before the Duty 1 device*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 1
- *Confirm that the oval turns red and that the Duty 1 Pump (Pump 1) starts*
- Using the HMI/OIT, click on the oval in the “Active” column for Duty 2
- *Confirm that the oval turns red and that the Duty 2 Pump (Pump 2) starts*
- *Using the HMI/OIT, click on the oval in the “Active” column for Duty 1*
- *Confirm that a message is shown indicating that the Duty 1 device cannot be stopped before the Duty 2 device*

7.11.4 Automatic Duty Rotation

Pass ☐

- Using the PAC/HMI/OIT, place all 4 pumps into AUTO mode
- Using the HMI/OIT, set Pump 1 as Duty 1, Pump 2 as Duty 2, Pump 3 as Duty 3, and Pump 4 as Duty 4
- Press the “Apply” button
- *Confirm that the duty entries are accepted and are copied from the New column to the Current column*
- Using the HMI/OIT, enable automatic duty rotation on “All Stop
- Allow the level of the Controlling Level Wet Well to reach a value above the Duty 1 Start Setpoint
- *Confirm that the Duty 1 Pump (Pump 1) starts*
- Wait until the Controlling Level falls below the Duty 1 Stop Setpoint
- *Confirm that the duty table is rotated and that Pump 1 becomes Duty 4 with Pumps 2, 3, and 4 becoming Duty 1, 2, and 3 respectively*
- Allow the level of the Controlling Level Wet Well to reach a value above the Duty 1 Start Setpoint
- *Confirm that the Duty 1 Pump (Pump 2) starts*
- Using the HMI/OIT, change the automatic duty rotation enable to act on “Time” and set the time delay to 1 hour
- Using the PAC, force the timer to elapse
- *Confirm that the duty table is rotated once again and that the new Duty 1 Pump (Pump 3) resumes operation and that the previous Duty 1 Pump (Pump 2) now stops as Duty 4*
- Using the HMI/OIT, change the automatic duty rotation to “OFF”
- Wait until the Controlling Level falls below the Duty 1 Stop Setpoint
- *Confirm that the Duty 1 Pump stops but that no duty rotation occurs*

7.11.5 Failover Duty Rotation

Pass ☐

- Using the PAC/HMI/OIT, place all 4 pumps into AUTO mode
- Using the HMI/OIT, set Pump 1 as Duty 1, Pump 2 as Duty 2, Pump 3 as Duty 3, and Pump 4 as Duty 4
- Press the “Apply” button
- *Confirm that the duty entries are accepted and are copied from the New column to the Current column*
- Using the local selector switch, take Pump 1 out of Remote
- *Confirm that Pump 1 becomes Duty 5 and shows “Not Available” and that the remaining 3 pumps now occupy duty positions 1, 2, and 3*
- Using the local selector switch, place Pump 1 back into Remote
- *Confirm that Pump 1 becomes Duty 4 and shows “Available” and that the remaining 3 pumps do not change duty positions*

7.11.6 Abnormal Operation – LIT Mode Pass ☐

- Place all pumps into AUTO using the Device Pop-up
- Using the HMI/OIT, set Pump 1 as Duty 1, Pump 2 as Duty 2, Pump 3 as Duty 3, and Pump 4 as Duty 4
- Press the "Apply" button
- *Confirm that the duty entries are accepted and are copied from the New column to the Current column*
- Allow the level of the Controlling Level Wet Well to reach a value above the Duty 1 Start Setpoint
- *Confirm that the Duty 1 Pump (Pump 1) starts*
- Adjust the Ultrasonic Level Transmitter relay setpoints to cause any pump start relay to be activated
- *Confirm that all pumps becomes interlocked through the software and shut down and that a Pump X Ultrasonic Mode alarm is generated*

7.11.7 Abnormal Operation – Multitrode Mode Pass ☐

- Place all pumps into AUTO using the Device Pop-up
- Using the HMI/OIT, set Pump 1 as Duty 1, Pump 2 as Duty 2, Pump 3 as Duty 3, and Pump 4 as Duty 4
- Press the "Apply" button
- *Confirm that the duty entries are accepted and are copied from the New column to the Current column*
- Allow the level of the Controlling Level Wet Well to reach a value above the Duty 1 Start Setpoint
- *Confirm that the Duty 1 Pump (Pump 1) starts*
- Toggle the dip switches on the Multitrode controller to cause any pump start relay to be activated
- *Confirm that all pumps becomes interlocked through the software and shut down and that a Pump X Multitrode Mode alarm is generated*

7.11.8 Controlling Level Pass ☐

- Using the HMI/OIT Level Duty Popup, set the automatic rotation to disabled, and the duty level mode to AUTO
- Place both Wet Wells in service and select Wet Well 1 as the Controlling Level
- *Confirm that the HMI/OIT show Wet Well 1 as the Controlling Level*
- Disconnect the twisted pair connection from the Wet Well 1 transmitter
- *Confirm that the Wet Well 2 level becomes the Controlling Level*
- Reconnect the twisted pair connection from the Wet Well 1 transmitter
- Using the HMI/OIT, set Wet Well 2 Out of Service
- *Confirm that the Wet Well 1 level becomes the Controlling Level*

7.12 Interlocks

The following table summarizes the sewage pumping process interlock conditions and should be verified using Pass/Fail results with corrective actions or comments listed as necessary.

Table 13: Sewage Pumping Process Interlock Summary

INTERLOCK DESCRIPTION	HARDWIRED ☑	SOFTWARE ☑	PASS / FAIL ☑
Pump X LIT Mode	✓	✓	
Pump X Multitrode Mode	✓	✓	
Both Wet Well Levels Out of Range Alarm		✓	
Both Wet Well Levels Calibration Mode Alarm		✓	
Both Wet Well Levels Loss of Echo Alarm		✓	

8.0 BUILDING SERVICES

The following sections provide tables to record the Pass/Fail results and any corrective actions required for the building services.

8.1 Equipment List

There is no equipment associated with building services.

8.2 Control Modes

There are no control modes associated with building services.

8.3 Pump Testing Results

There are no pumps associated with building services.

8.4 Valve Testing Results

There are no valves associated with building services.

8.5 Analog Testing Results

There are no analogs associated with building services.

8.6 Flow Totalization Results

There is no Flow totalization associated with building services.

8.7 Discrete Alarm Testing Results

The following table summarizes the I/O points associated with discrete alarms and events to be completed with Pass/Fail indications. Those alarm latches marked enabled are set by default. A checkmark in the Pass/Fail column will indicate that the default (Enabled) setting is accepted and verified for functionality. Latch enables, which must be toggled, are to be marked with an 'L' for Latched, or a 'U' for Unlatched and a checkmark noted for functionality.

Table 14: Discrete Alarm Testing Results

RACK/SLOT/ POINT	TYPE	A / E	TAG NAME	DESCRIPTION	LABEL/UNITS	ALARM LATCH		PASS/FAIL ✓
						ENABLED	PASS/FAIL ✓	
0/5/15	DI	A	PCS_R0S5_PWRF_DI	Rack 0 Slot 5 DI Card Blown Fuse Alarm	0:NORMAL 1:ALARM	✓		
0/6/15	DI	A	PCS_R0S6_PWRF_DI	Rack 0 Slot 6 DI Card Blown Fuse Alarm	0:NORMAL 1:ALARM	✓		
0/7/7	DI	A	DWEL_LSHH1_DI	Dry Well Flood Alarm	0:NORMAL 1:ALARM	✓		
0/7/15	DI	A	PCS_R0S7_PWRF_DI	Rack 0 Slot 7 DI Card Blown Fuse Alarm	0:NORMAL 1:ALARM	✓		
1/2/15	DI	A	PCS_R1S2_PWRF_DI	Rack 1 Slot 2 DI Card Blown Fuse Alarm	0:NORMAL 1:ALARM	✓		
1/3/15	DI	A	PCS_R1S3_PWRF_DI	Rack 1 Slot 3 DI Card Blown Fuse Alarm	0:NORMAL 1:ALARM	✓		
1/4/15	DI	A	PCS_R1S4_PWRF_DI	Rack 1 Slot 4 DI Card Blown Fuse Alarm	0:NORMAL 1:ALARM	✓		
1/5/15	DI	A	PCS_R1S5_PWRF_DI	Rack 1 Slot 5 DI Card Blown Fuse Alarm	0:NORMAL 1:ALARM	✓		
1/6/0	DI	A	PCS_ATS1_EPWR_DI	UPS Power OK	0:ALARM 1:NORMAL	✓		
1/6/1	DI	A	PCS_ATS1_NPWR_DI	UPS Line Power OK	0:ALARM 1:NORMAL	✓		
1/6/3	DI	A	PCS_X1_FLT_DI	Ethernet Switch Alarm	0:NORMAL 1:ALARM	✓		
1/6/6	DI	A	SECU_YY1_INTR_DI	Security Intrusion Alarm	0:NORMAL 1:ALARM	✓		
1/6/7	DI	A	SECU_YY1_ARMD_DI	Security Disarmed Alarm	0:DISARMED 1:ARMED	✓		
1/6/9	DI	A	BLDS_FID1_DI	Building Smoke Detector Alarm	0:NORMAL 1:ALARM	✓		
1/6/10	DI	A	BLDS_TSHL1_DI	Building Hi/Lo Temperature Alarm	0:NORMAL 1:ALARM	✓		
1/6/11	DI	A	PCS_CP1_PWRF_DI	Control Panel Power Failure Alarm	0:NORMAL 1:ALARM	✓		
1/6/12	DI	A	PCS_CP1_PSU1_FLT_DI	Control Panel DC Power Fault Alarm	0:NORMAL 1:ALARM	✓		
1/6/13	DI	A	B LDS_SU1_LSHH1_DI	Building Flood Alarm (FUTURE)	0:NORMAL 1:ALARM	✓		
1/6/14	DI	A	PCS_UPS1_FLT_DI	UPS Fault/Low Battery Alarm	0:NORMAL 1:ALARM	✓		
1/6/15	DI	A	PCS_R1S6_PWRF_DI	Rack 1, Slot 6 DI Card Blown Fuse Alarm	0:NORMAL 1:ALARM	✓		

8.7.1 PAC Digital Alarms

The following tables summarize the alarm points generated internally within the PAC logic to indicate system status and failure. Each point is to be completed with Pass/Fail indications.

Table 15: PAC Processor Alarms

TYPE	A / E	TAG NAME	DESCRIPTION	LABEL/UNITS	ALARM LATCH ENABLED	ALARM LATCH PASS/FAIL ✓	PASS/FAIL ✓
AI	E	PCS_PAC1_MJRF1_AAAA[1]	Programmable Automation Controller Major Fault History 1				
AI	E	PCS_PAC1_MJRF2_AAAA[2]	Programmable Automation Controller Major Fault History 2				
AI	E	PCS_PAC1_MNRF1_AAAA[3]	Programmable Automation Controller Minor Fault History 1				
AI	E	PCS_PAC1_MNRF2_AAAA[4]	Programmable Automation Controller Minor Fault History 2				
DI	A	PCS_PAC1_BAT_ALRM	Programmable Automation Controller Low Battery Alarm	0:NORMAL 1:ALARM	✓		
DI	E	PCS_PAC1_EKS_REM	Programmable Automation Controller Key Switch In Remote Mode	0:OTHER 1:REMOTE			
DI	E	PCS_PAC1_EKS_RUN	Programmable Automation Controller Key Switch In Run Mode	0:OTHER 1:RUN			
DI	A	PCS_PAC1_FORC_ON	Programmable Automation Controller Forces In Service	0:OFF 1:ON			
DI	A	PCS_PAC1_FORC_E N	Programmable Automation Controller Forces Enabled	0:DISABLED 1:ENABLED	✓		
DI	A	PCS_PAC1_MNRF	Programmable Automation Controller Minor Recover able Fault	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_MJRF	Programmable Automation Controller Major Fault	0:NORMAL 1:ALARM	✓		

[1] AAAA – Represents the fault type, code, and date and time of the fault
[2] AAAA – Represents the fault type, code, and date and time of the fault
[3] AAAA – Represents the fault type, code, and date and time of the fault
[4] AAAA – Represents the fault type, code, and date and time of the fault

Table 16: PAC Rack/Slot Alarms

TYPE	A / E	TAG NAME	DESCRIPTION	LABEL/UNITS	ALARM LATCH		PASS/FAIL ✓
					ENABLED	PASS/FAIL ✓	
DI	A	PCS_PAC1_R0S0_ENET_ALRM	Programmable Automation Controller Rack 0 Slot 0 Ethernet Card Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S1_ALRM	Programmable Automation Controller Rack 0 Slot 1 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S2_ALRM	Programmable Automation Controller Rack 0 Slot 2 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S3_ALRM	Programmable Automation Controller Rack 0 Slot 3 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S4_ALRM	Programmable Automation Controller Rack 0 Slot 4 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S5_ALRM	Programmable Automation Controller Rack 0 Slot 5 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S6_ALRM	Programmable Automation Controller Rack 0 Slot 6 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S7_ALRM	Programmable Automation Controller Rack 0 Slot 7 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S8_ALRM	Programmable Automation Controller Rack 0 Slot 8 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S9_ALRM	Programmable Automation Controller Rack 0 Slot 9 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S10_ALRM	Programmable Automation Controller Rack 0 Slot 10 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S11_ALRM	Programmable Automation Controller Rack 0 Slot 11 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S12_ALRM	Programmable Automation Controller Rack 0 Slot 12 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S13_ALRM	Programmable Automation Controller Rack 0 Slot 13 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S14_ALRM	Programmable Automation Controller Rack 0 Slot 14 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S15_ALRM	Programmable Automation Controller Rack 0 Slot 15 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R0S16_ALRM	Programmable Automation Controller Rack 0 Slot 16 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S0_ALRM	Programmable Automation Controller Rack 1 Slot 0 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S1_ALRM	Programmable Automation Controller Rack 1 Slot 1 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S2_ALRM	Programmable Automation Controller Rack 1 Slot 2 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S3_ALRM	Programmable Automation Controller Rack 1 Slot 3 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S4_ALRM	Programmable Automation Controller Rack 1 Slot 4 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S5_ALRM	Programmable Automation Controller Rack 1 Slot 5 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S6_ALRM	Programmable Automation Controller Rack 1 Slot 6 Failure	0:NORMAL 1:ALARM	✓		

TYPE	A / E	TAG NAME	DESCRIPTION	LABEL/UNITS	ALARM LATCH		PASS/FAIL ✓
					ENABLED	PASS/FAIL ✓	
DI	A	PCS_PAC1_R1S7_ALRM	Programmable Automation Controller Rack 1 Slot 7 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S8_ALRM	Programmable Automation Controller Rack 1 Slot 8 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S9_ALRM	Programmable Automation Controller Rack 1 Slot 9 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S10_ALRM	Programmable Automation Controller Rack 1 Slot 10 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S11_ALRM	Programmable Automation Controller Rack 1 Slot 11 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S12_ALRM	Programmable Automation Controller Rack 1 Slot 12 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S13_ALRM	Programmable Automation Controller Rack 1 Slot 13 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S14_ALRM	Programmable Automation Controller Rack 1 Slot 14 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S15_ALRM	Programmable Automation Controller Rack 1 Slot 15 Failure	0:NORMAL 1:ALARM	✓		
DI	A	PCS_PAC1_R1S16_ALRM	Programmable Automation Controller Rack 1 Slot 16 Failure	0:NORMAL 1:ALARM	✓		

8.7.2 Communications OK Light — Pass ☐

- Disconnect the Ethernet link between the PAC and the HMI
- *Confirm that after a time delay, the "Communications OK" pilot light is turned off indicating a failure*
- *Confirm that a communications failure alarm is annunciated at the HMI/OIT*

8.7.3 Control Panel General Alarm Light — Pass ☐

- Acknowledge and reset every alarm within the station PAC
- *Confirm that the "Control Panel General Alarm" pilot light is off*
- Generate an alarm from any one of the process areas
- *Confirm that the pilot light is turned on and is blinking indicating an unacknowledged alarm condition*
- Acknowledge the alarm but leave it active
- *Confirm that the pilot light is on solid and is no longer blinking indicating an acknowledged alarm condition*

8.7.4 Control Panel General Alarm Horn Pass ☐

- Acknowledge and reset every alarm within the station PAC
- *Confirm that the "Control Panel General Alarm" horn is off*
- Generate an alarm from any one of the process areas
- *Confirm that the horn is turned on indicating an unacknowledged alarm condition*
- Acknowledge the alarm but leave it active
- *Confirm that the horn is off indicating that the alarm has been acknowledged*
- Reset the alarm
- Generate the alarm condition
- *Confirm that the horn is turned on indicating an unacknowledged alarm condition*
- Wait 5 minutes
- *Confirm that the horn is turned off automatically*

8.7.5 PAC OK Status to Auto-Dialer Pass ☐

- *Confirm that the digital output labeled "PAC OK Status to Auto-Dialer" is turned on indicating that the PAC is functioning*
- Generate a major fault on the PAC
- *Confirm that the digital output is off indicating a failure of the PAC*
- *Confirm the Major Fault indicator is showing "ALARM" on overview screen*
- *Confirm that the dialer responds to the digital output status and notifies operations staff of the alarm condition*

8.8 Automatic Control Setpoints

There are no automatic control setpoints associated with the building services.

8.9 Alarm Setpoints

There are no alarm setpoints associated with the building services

8.10 Trending Points

There are no trending points associated with the building services.

8.11 Automatic Logic Test Scenarios

There is no automatic logic control associated with the building services.

8.12 Interlocks

There are no interlocks associated with the building services.

9.0 STANDBY POWER

The following sections provide tables to record the Pass/Fail results and any corrective actions required for the standby power systems.

9.1 Equipment List

The following table summarizes all equipment associated with the standby power systems.

Table 17: Standby Power Equipment List

EQUIPMENT TAG NAME	EQUIPMENT DESCRIPTION	EQUIPMENT SPECS
GEN_GEN1	Standby Diesel Generator	__ kW
GEN_ATS1	Automatic Transfer Switch	
GEN_TK1_LIT1	Diesel Tank Level Transmitter	__ - __ cm

9.2 Control Modes

The following table summarizes the various control modes for each device.

Table 18: Standby Power Control Modes

EQUIPMENT TAG NAME	EQUIPMENT DESCRIPTION	LOCAL MANUAL ☑	COMPUTER MANUAL ☑	COMPUTER AUTO ☑
GEN_GEN1	Standby Diesel Generator	√		
GEN_ATS1	Automatic Transfer Switch	√		

9.3 Pump Testing Results

There are no pumps associated with standby power.

9.4 Valve Testing Results

There are no valves associated with standby power.

9.5 Analog Testing Results

Test the functionality outlined in the tables. Record results as indicated. Note that all alarms are to be latched requiring operator reset with the exception of the calibration mode alarms.

Table 19: Analog Testing Results

Tag Fragments 3 & 4	Test Point	GEN_TK1_LIT1 Diesel Tank Level Transmitter					
		PROCESS		POPUP		BANNER	
		H	O	H	O	H	O
VAL	Current Value						
CLB_VAL	Calibration Mode Value Hold						
CLB_ALRM	Calibration Mode Alarm						
HIHI_ALRM	HiHi Alarm						
HI_ALRM	Hi Alarm						
LO_ALRM	Lo Alarm						
LOLO_ALRM	LoLo Alarm						
OOR_ALRM	Out of Range Alarm						
ROC_ALRM	Rate of Change Alarm						
FLT_ALRM	Fault Alarm						
PCNT	Percent Value						

Tag Fragments 3 & 4	Test Point	GEN_TK1_LIT1 Diesel Tank Level Transmitter					
		PROCESS		POPUP		BANNER	
		H	O	H	O	H	O
ENG_SPAN / ENG_ZERO	Instrument Range & Units						
ACK	Alarm Acknowledge						
RSET	Alarm Reset						

9.6 Flow Totalization Results

There is no flow totalization associated with standby power.

9.7 Discrete Alarm Testing Results

The following table summarizes the I/O points associated with discrete alarms and events to be completed with Pass/Fail indications. Those alarm latches marked enabled are set by default. A checkmark in the Pass/Fail column will indicate that the default (Enabled) setting is accepted and verified for functionality. Latch enables, which must be toggled, are to be marked with an 'L' for Latched, or a 'U' for Unlatched and a checkmark noted for functionality.

Table 20: Discrete Alarm Testing Results

RACK/SLOT/ POINT	TYPE	A / E	TAG NAME	DESCRIPTION	LABEL/UNITS	ALARM LATCH		PASS/FAIL ✓
						ENABLED	PASS/FAIL ✓	
0/6/13	DI	A	GEN_TK1_LSH1_DI	Diesel Containment Flood Alarm	0:NORMAL 1:ALARM	✓		

9.8 Automatic Control Setpoints

There are no automatic control setpoints associated with the standby power.

9.9 Alarm Setpoints

The following table summarizes those points which are considered alarm setpoints and may be operator adjustable via the SCADA system. Record alarm setpoint defaults at the time of commissioning.

Table 21: Standby Power Alarm Setpoints

TAG	DESC	LOW LOW		LOW		HIGH		HIGH HIGH		PASS/FAIL ☑
		DEF	PRI	DEF	PRI	DEF	PRI	DEF	PRI	
GEN_TK1_LIT 1	Diesel Tank Level		Hi		Low		Low		Hi	

9.10 Trending Points

There are no trending points associated with the standby power.

9.11 Automatic Logic Test Scenarios

There is no automatic logic control associated with the standby power.

9.12 Interlocks

There are no interlocks associated with the standby power.

10.0 ISSUES & DEFICIENCIES

The following table is to be completed throughout the SAT and summarizes all issues and deficiencies requiring corrective action.

Item No.	Issue/Deficiency	Initial
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Contract #:			
Date Submitted:			
Submission Description:			
Consultant:			
Role	***Name***	***Signature***	***Date***
Review Comments			
Acceptors:			
Role	***Name***	***Signature***	***Date***

Appendix A
Input/Output List

RACK/SLOT/ POINT	TYPE	TAG NAME	DESCRIPTION	LABEL/UNITS
0/5/0	DI	RSP_PMP1_MODE_DI	Pump 1 Remote Selected	0:LOCAL 1:REMOTE
0/5/1	DI	RSP_PMP1_STAT_DI	Pump 1 Running	0:STOPPED 1:RUNNING
0/5/2	DI	RSP_PMP1_MOL_DI	Pump 1 Overload	0:NORMAL 1:ALARM
0/5/3	DI	RSP_PMP1_FLT_DI	Pump 1 Fault	0:NORMAL 1:ALARM
0/5/4	DI	RSP_PMP1_ESTP_DI	Pump 1 Emergency Stop	0:NORMAL 1:ALARM
0/5/5	DI	RSP_PMP1_ALRM1_DI	Pump 1 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:ALARM 1:NORMAL
0/5/6	DI	RSP_PMP1_ALRM2_DI	Pump 1 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
0/5/7	DI	RSP_PMP1_ALRM3_DI	Pump 1 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
0/5/8	DI	RSP_PMP1_ALRM4_DI	Pump 1 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
0/5/9	DI	RSP_PMP1_LIT1_BKUP_DI	Pump 1 LIT Mode	0:NORMAL 1:ALARM
0/5/10	DI	RSP_PMP1_VFD1_FLT_DI	Pump 1 VFD Fault	0:NORMAL 1:ALARM
0/5/11	DI	RSP_PMP1_VFD1_BYPS_DI	Pump 1 VFD Bypass	0:NORMAL 1:BYPASS
0/5/12	DI	RSP_PMP1_VFD1_RDY_DI	Pump 1 VFD Ready	0:NORMAL 1:ALARM
0/5/13	DI	RSP_PMP1_LVL_BKUP_DI	Pump 1 Multitrode Mode	0:NORMAL 1:ALARM
0/5/15	DI	PCS_R0S5_PWRF_DI	Rack 0, Slot 5 DI Card Blown Fuse Detection	0:NORMAL 1:ALARM
0/6/0	DI	RSP_PMP3_MODE_DI	Pump 3 Remote Selected	0:LOCAL 1:REMOTE
0/6/1	DI	RSP_PMP3_STAT_DI	Pump 3 Running	0:STOPPED 1:RUNNING
0/6/2	DI	RSP_PMP3_MOL_DI	Pump 3 Overload	0:NORMAL 1:ALARM
0/6/3	DI	RSP_PMP3_FLT_DI	Pump 3 Fault	0:NORMAL 1:ALARM
0/6/4	DI	RSP_PMP3_ESTP_DI	Pump 3 Emergency Stop	0:NORMAL 1:ALARM

RACK/SLOT/ POINT	TYPE	TAG NAME	DESCRIPTION	LABEL/UNITS
0/6/5	DI	RSP_PMP3_ALRM1_DI	Pump 3 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:ALARM 1:NORMAL
0/6/6	DI	RSP_PMP3_ALRM2_DI	Pump 3 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
0/6/7	DI	RSP_PMP3_ALRM3_DI	Pump 3 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
0/6/8	DI	RSP_PMP3_ALRM4_DI	Pump 3 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
0/6/9	DI	RSP_PMP3_LIT2_BKUP_DI	Pump 3 LIT Mode	0:NORMAL 1:ALARM
0/6/10	DI	RSP_PMP3_VFD1_FLT_DI	Pump 3 VFD Fault	0:NORMAL 1:ALARM
0/6/11	DI	RSP_PMP3_VFD1_BYPS_DI	Pump 3 VFD Bypass	0:NORMAL 1:BYPASS
0/6/12	DI	RSP_PMP3_VFD1_RDY_DI	Pump 3 VFD Ready	0:NORMAL 1:ALARM
0/6/13	DI	RSP_PMP3_LVL_BKUP_DI	Pump 3 Multitrode Mode	0:NORMAL 1:ALARM
0/6/15	DI	PCS_R0S6_PWRF_DI	Rack 0, Slot 6 DI Card Blown Fuse Detection	0:NORMAL 1:ALARM
0/7/0	DI	WWEL_LIT1_FLT_DI	Wet well 1 Level Transmitter Loss of Echo	0:NORMAL 1:ALARM
0/7/1	DI	WWEL_LSOF1_DI	Wet well 1 Overflow Alarm	0:NORMAL 1:ALARM
0/7/2	DI	WWEL_LSHH1_DI	Wet well 1 High High Level Alarm	0:NORMAL 1:ALARM
0/7/3	DI	WWEL_LSLL1_DI	Wet well 1 Low Low Level Alarm	0:NORMAL 1:ALARM
0/7/4	DI	WWEL_LSLL1_BYPS_DI	Low Level Lockout Bypass	0:NORMAL 1:ALARM
0/7/5	DI	RSP_FIT1_FLT_DI	Station Flowmeter Fault	0:NORMAL 1:ALARM
0/7/7	DI	DWEL_LSH1_DI	Drywell Flood Float	0:ALARM 1:NORMAL
0/7/8	DI	RSP_PIT1_FLT_DI	Station Pressure Fault	0:NORMAL 1:ALARM
0/7/9	DI	RSP_PMP_LVL_DI	Pumps On Multitrode Mode	0:NORMAL 1:ALARM
0/7/10	DI	RSP_PMP_LIT_DI	Pumps On Ultrasonic Mode	0:NORMAL 1:ALARM
0/7/11	DI	RSP_PMP_PAC_DI	Pumps On PAC Mode	0:NORMAL 1:ALARM
0/7/12	DI	RSP_PMP_AUTO_DI	Pumps On Auto Mode	0:ALARM 1:NORMAL
0/7/15	DI	PCS_R0S7_PWRF_DI	Rack 0, Slot 7 DI Card Blown Fuse Detection	0:NORMAL 1:ALARM
0/10/0	DO	RSP_PMP1_CMD_DO	Pump 1 Run Command	0:STOP 1:START
0/10/3	DO	RSP_PMP3_CMD_DO	Pump 3 Run Command	0:STOP 1:START
0/10/11	DO	RSP_BKUP_INHB_CMD_DO	Backup Control Remote Interrupt	0:NORMAL 1:ALARM
0/10/12	DO	PCS_RAD1_PL1_DO	Communications OK	0:ALARM 1:NORMAL

RACK/SLOT/ POINT	TYPE	TAG NAME	DESCRIPTION	LABEL/UNITS
0/10/13	DO	PCS_CP1_PL1_ALRM_DO	Control Panel General Alarm Pilot Light	0:NORMAL 1:ALARM
0/10/14	DO	PCS_PAC1_ADLR1_DO	PAC OK Status to Auto Dialer	0:NORMAL 1:ALARM
0/10/15	DO	PCS_CP1_HN1_ALRM_DO	Control Panel General Alarm Horn	0:NORMAL 1:ALARM
0/12/0	AI	RSP_PMP1_SPD_AI	Pump 1 Speed Indication	%
0/12/1	AI	RSP_PMP3_SPD_AI	Pump 3 Speed Indication	%
0/12/2	AI	WWEL_LIT1_AI	Wet well 1 Level Indication	m
0/12/3	AI	RSP_FIT1_AI	Station Discharge Flow	L/s
0/12/4	AI	RSP_PIT1_AI	Station Discharge Pressure	kPa
0/13/0	AI	RSP_PMP2_SPD_AI	Pump 2 Speed Indication	%
0/13/1	AI	RSP_PMP4_SPD_AI	Pump 4 Speed Indication	%
0/13/2	AI	WWEL_LIT2_AI	Wet well 2 Level Indication	m
0/13/3	AI	GEN_TK1_LIT1_AI	Diesel Tank Level Indication	cm
0/15/0	AO	RSP_PMP1_SPD_AO	Pump 1 Speed Setpoint	%
0/15/1	AO	RSP_PMP3_SPD_AO	Pump 3 Speed Setpoint	%
0/16/0	AO	RSP_PMP2_SPD_AO	Pump 2 Speed Setpoint	%
0/16/1	AO	RSP_PMP4_SPD_AO	Pump 4 Speed Setpoint	%
1/2/0	DI	RSP_PMP2_MODE_DI	Pump 2 Remote Selected	0:LOCAL 1:REMOTE
1/2/1	DI	RSP_PMP2_STAT_DI	Pump 2 Running	0:STOPPED 1:RUNNING
1/2/2	DI	RSP_PMP2_MOL_DI	Pump 2 Overload	0:NORMAL 1:ALARM
1/2/3	DI	RSP_PMP2_FLT_DI	Pump 2 Fault	0:NORMAL 1:ALARM
1/2/4	DI	RSP_PMP2_ESTP_DI	Pump 2 Emergency Stop	0:NORMAL 1:ALARM
1/2/5	DI	RSP_PMP2_ALRM1_DI	Pump 2 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:ALARM 1:NORMAL
1/2/6	DI	RSP_PMP2_ALRM2_DI	Pump 2 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
1/2/7	DI	RSP_PMP2_ALRM3_DI	Pump 2 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
1/2/8	DI	RSP_PMP2_ALRM4_DI	Pump 2 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
1/2/9	DI	RSP_PMP2_LIT1_BKUP_DI	Pump 2 LIT Mode	0:NORMAL 1:ALARM
1/2/10	DI	RSP_PMP2_VFD1_FLT_DI	Pump 2 VFD Fault	0:NORMAL 1:ALARM
1/2/11	DI	RSP_PMP2_VFD1_BYPS_DI	Pump 2 VFD Bypass	0:NORMAL 1:BYPASS
1/2/12	DI	RSP_PMP2_VFD1_RDY_DI	Pump 2 VFD Ready	0:NORMAL 1:ALARM
1/2/13	DI	RSP_PMP2_LVL_BKUP_DI	Pump 2 Multitrode Mode	0:NORMAL 1:ALARM

RACK/SLOT/ POINT	TYPE	TAG NAME	DESCRIPTION	LABEL/UNITS
1/2/15	DI	PCS_R1S2_PWRF_DI	Rack 1, Slot 2 DI Card Blown Fuse Detection	0:NORMAL 1:ALARM
1/3/0	DI	RSP_PMP4_MODE_DI	Pump 4 Remote Selected	0:LOCAL 1:REMOTE
1/3/1	DI	RSP_PMP4_STAT_DI	Pump 4 Running	0:STOPPED 1:RUNNING
1/3/2	DI	RSP_PMP4_MOL_DI	Pump 4 Overload	0:NORMAL 1:ALARM
1/3/3	DI	RSP_PMP4_FLT_DI	Pump 4 Fault	0:NORMAL 1:ALARM
1/3/4	DI	RSP_PMP4_ESTP_DI	Pump 4 Emergency Stop	0:NORMAL 1:ALARM
1/3/5	DI	RSP_PMP4_ALRM1_DI	Pump 4 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:ALARM 1:NORMAL
1/3/6	DI	RSP_PMP4_ALRM2_DI	Pump 4 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
1/3/7	DI	RSP_PMP4_ALRM3_DI	Pump 4 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
1/3/8	DI	RSP_PMP4_ALRM4_DI	Pump 4 Hi/Lo Pressure/Temperature/Leakage/Flow/Trip	0:NORMAL 1:ALARM
1/3/9	DI	RSP_PMP4_LIT2_BKUP_DI	Pump 4 LIT Mode	0:NORMAL 1:ALARM
1/3/10	DI	RSP_PMP4_VFD1_FLT_DI	Pump 4 VFD Fault	0:NORMAL 1:ALARM
1/3/11	DI	RSP_PMP4_VFD1_BYPS_DI	Pump 4 VFD Bypass	0:NORMAL 1:BYPASS
1/3/12	DI	RSP_PMP4_VFD1_RDY_DI	Pump 4 VFD Ready	0:NORMAL 1:ALARM
1/3/13	DI	RSP_PMP4_LVL_BKUP_DI	Pump 4 Multitrode Mode	0:NORMAL 1:ALARM
1/3/15	DI	PCS_R1S3_PWRF_DI	Rack 1, Slot 3 DI Card Blown Fuse Detection	0:NORMAL 1:ALARM
1/4/0	DI	WWEL_LIT2_FLT_DI	Wet well 2 Level Transmitter Loss of Echo	0:NORMAL 1:ALARM
1/4/1	DI	WWEL_LSOF2_DI	Wet well 2 Overflow Alarm	0:NORMAL 1:ALARM
1/4/2	DI	WWEL_LSHH2_DI	Wet well 2 High High Level Alarm	0:NORMAL 1:ALARM
1/4/3	DI	WWEL_LSLL2_DI	Wet well 2 Low Low Level Alarm	0:NORMAL 1:ALARM
1/4/15	DI	PCS_R1S4_PWRF_DI	Rack 1, Slot 4 DI Card Blown Fuse Detection	0:NORMAL 1:ALARM
1/5/0	DI	GEN_ATS1_EPWR_DI	ATS Emergency Power Available	0:NORMAL 1:ALARM
1/5/1	DI	GEN_ATS1_NPWR_DI	ATS Normal Power Available	0:ALARM 1:NORMAL
1/5/2	DI	GEN_ATS1_EPOS_DI	ATS Emergency Power Position	0:NORMAL 1:ALARM
1/5/3	DI	GEN_ATS1_NPOS_DI	ATS Normal Power Position	0:ALARM 1:NORMAL
1/5/4	DI	GEN_ATS1_FLT_DI	ATS General Alarm	0:NORMAL 1:ALARM
1/5/5	DI	GEN_ATS1_MODE_DI	ATS In Auto Mode	0:ALARM 1:NORMAL

RACK/SLOT/ POINT	TYPE	TAG NAME	DESCRIPTION	LABEL/UNITS
1/5/6	DI	GEN_GEN1_MODE_DI	Generator in Auto Mode	0:ALARM 1:NORMAL
1/5/7	DI	GEN_GEN1_FLT_DI	Generator General Alarm	0:NORMAL 1:ALARM
1/5/8	DI	GEN_GEN1_WARN_DI	Generator Warning	0:NORMAL 1:ALARM
1/5/9	DI	GEN_GEN1_FAIL_DI	Generator Shutdown Alarm	0:NORMAL 1:ALARM
1/5/10	DI	GEN_GEN1_BAT_DI	Generator Low Battery Alarm	0:NORMAL 1:ALARM
1/5/11	DI	GEN_GEN1_STAT_DI	Generator Running	0:STOPPED 1:RUNNING
1/5/12	DI	GEN_TK1_PSL1_DI	Diesel Tank Vacuum Alarm	0:NORMAL 1:ALARM
1/5/13	DI	GEN_TK1_LSH1_DI	Diesel Containment Flood Alarm	0:NORMAL 1:ALARM
1/5/15	DI	PCS_R1S5_PWRF_DI	Rack 1, Slot 5 DI Card Blown Fuse Detection	0:NORMAL 1:ALARM
1/6/0	DI	PCS_UPS1_ATS1_EPWR_DI	UPS Power OK	0:ALARM 1:NORMAL
1/6/1	DI	PCS_UPS1_ATS1_NPWR_DI	UPS Line Power OK	0:ALARM 1:NORMAL
1/6/3	DI	PCS_X1_FLT_DI	Ethernet Switch Alarm	0:NORMAL 1:ALARM
1/6/4	DI	PCS_CP1_INTR_DI	Control Panel Door Open	0:NORMAL 1:ALARM
1/6/5	DI	PCS_CP2_PWRF_DI	Backup Panel Power Failure	0:NORMAL 1:ALARM
1/6/6	DI	SECU_YY1_INTR_DI	Security Intrusion Alarm	0:NORMAL 1:ALARM
1/6/7	DI	SECU_YY1_ARMD_DI	Security Armed/Disarmed Status	0:NORMAL 1:ALARM
1/6/8	DI	SECU_YY1_SPRE_DI	Security System Spare	0:NORMAL 1:ALARM
1/6/9	DI	BLDS_FID1_DI	Building Smoke Detector	0:NORMAL 1:ALARM
1/6/10	DI	BLDS_TSHL1_DI	Building Hi/Low Temperature Alarm	0:NORMAL 1:ALARM
1/6/11	DI	PCS_CP1_PWRF_DI	Control Panel Power Failure	0:NORMAL 1:ALARM
1/6/12	DI	PCS_CP1_PSU1_FLT_DI	Control Panel DC Power Fault	0:NORMAL 1:ALARM
1/6/13	DI	BLDS_SU1_LSH1_DI	Building Flood Alarm	0:NORMAL 1:ALARM
1/6/14	DI	PCS_UPS1_FLT_DI	UPS Fault/Low Battery	0:NORMAL 1:ALARM
1/6/15	DI	PCS_R1S6_PWRF_DI	Rack 1, Slot 6 DI Card Blown Fuse Detection	0:NORMAL 1:ALARM
1/9/0	DO	RSP_PMP2_CMD_DO	Pump 2 Run Command	0:STOP 1:START
1/9/3	DO	RSP_PMP4_CMD_DO	Pump 4 Run Command	0:STOP 1:START

Appendix B

Process Control Narrative