

Part 1 General

1.1 REQUIREMENTS OF WORK

- .1 Supply, install, commission, provide warranty and fully document a complete instrumentation and control (I&C) system as shown on the Drawings and as specified herein. The I&C system contains vendor component subsystems specified in this and other Sections of the Specification.
- .2 Component subsystems of the I&C system will include, but are not limited to, the following:
 - .1 Primary elements and transmitters
 - .2 Final control elements
 - .3 I&C field devices
 - .4 I&C junction boxes and marshalling panels
 - .5 Instrumentation cabling
 - .6 Instrumentation power supplies
 - .7 Conduit and cable tray
- .3 The Contractor's responsibility also includes receiving, uncrating, examining for shortages or damage, assembling, field fitting, installing, mounting, wiring and testing of vendor supplied component subsystems.
- .4 Where packaged, stand-alone control systems are supplied under other Divisions of this Specification, provide cabling to connect to the required remote monitoring and/or control functions. Provide end-to-end Commissioning of all required remote monitoring and/or control functions. Ensure the correct functionality of any equipment supplied under other Divisions of this Specification.
- .5 Documentation referred to in 1.1.1 to include as a minimum:
 - .1 Equipment descriptive data
 - .2 Equipment installation, service manuals, O&M Manuals and recommended spare parts lists
 - .3 Schematics and interconnection wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.
 - .4 Records of conductor identification, field terminals, changes, etc.
 - .5 Instrumentation and control panel Shop Drawings, face layouts, schematics and point-to-point wiring diagrams sealed by a Professional Engineer registered in the Province of Manitoba.
 - .6 Submit individual loop drawings based on the provide typicals
 - .7 Records of as-built information for the complete instrumentation system.
- .6 Documentation provided is formatted as follows:

- .1 *Piping & Instrumentation Diagrams (P & IDS)* – depict the general intent of the control systems and are to be used as the governing document for the scope of Work.
 - .2 *Instrument Index* – an index of the detailed information for the devices shown on the P & IDs. The index lists the appropriate support documentation for the devices’ supply and installation. The instrument index is the controlling document for the supply of materials.
 - .3 *Input/Output (I/O) Index* – an index of the control system I/O points shown on the P & IDs, giving the supporting documentation as per the instrument index.
 - .4 *Instrument Specification Sheet* – detail the relevant data for the supply of devices.
 - .5 *Instrument Loop Diagrams (ILDs)* – show typical interconnections and hook-up of devices. The Contractor is to reproduce an ILD for each device and record all relevant as-built information on each sheet for submission at the completion of the Work. Fill in all terminal and wiring numbers etc. from the Shop Drawings as they become available. A set of ‘B’ size (11 x 17) ACAD Drawings and associated files will be made available to the successful Contractor.
 - .6 *Location Drawings* – indicate in plan and/or elevation views where the instrument elements are physically located. These Drawings are provided to assist the Contractor in estimating the amount of cable and ducting required.
 - .7 *Standard Details* – provide a reference for installation, operation and other instructions pertinent to a particular device.
 - .8 *Detailed Specification* – lists qualifications, quality of materials and workmanship, and supplementary information.
- .7 .Definitions
- .1 .1 Interpret specialized terms not explicitly defined herein in accordance with ISA-S51.1, NEMA-ICS-1, ANSI/IEEE-Std-100, and The Communications Standard Dictionary, by Martin H. Weik.
- .8 References
- .1 This Specification contains references to the following Documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed Documents, the requirements of this Section prevail.

Reference	Title
API RP550-86	Manual on Installation of Refinery Instruments and Control Systems, Part I--Process Instrumentation and Control Sections 1 Through 13
ASME Section VII-89	Rules for Construction of Pressure Vessels
ASTM B68-86	Seamless Copper Tube
ASTM D883-89	Terms Relating to Plastics
IEEE 100-88	Dictionary of Electrical and Electronic Terms
ISA RP7.1-56	Pneumatic Control Circuit Pressure Test
ISA RP12.6-87	Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations

ISA S5.4-76	Instrument Loop Diagrams
ISA S18.1-79	Annunciator Sequences and Specifications
ISA S51.1-79	Process Instrumentation Terminology
NEMA 250-85	Enclosures for Industrial Controls and Systems
NEMA ICS 1-88	General Standards for Industrial Control and Systems
NEMA ICS 2-88	Industrial Control Devices, Controllers, and Assemblies
NFPA 70-90	National Electrical Code (NEC)
SAMA PMC 17-10-63	Bushings and Wells for Temperature Sensing Elements
UBC-88	Uniform Building Code
UL 1012-89	Power Supplies
UL 94-80	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Weik, Martin H. Communications Standard Dictionary, Van Nostrand Reinhold Co., 1983

.9 Related Work:

- .1 Mechanical
- .2 Electrical

.10 Qualifications

- .1 The instrumentation Subcontractor shall be a firm normally engaged and fully competent in the type of Work described in this Section of the Specification. The firm shall have been continuously and successfully engaged in this business for at least five years.
- .2 Qualified journeyman instrument mechanics that are familiar with the devices being installed shall perform all instrument hook-ups, calibrations, and checkouts.
- .3 Qualified journeyman electricians shall perform all control wiring installation and connections.

.11 Codes, Rules, Permits & Fees

- .1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this Work.
- .2 Comply with all rules of the Electrical Safety Act of the Province, CSA Standards, the ULC and the applicable building codes, whether specifically shown on Drawings or not.
- .3 Give all required notices, submit Drawings, obtain all permits, licenses and certificates and pay all fees required for this Work.
- .4 Furnish a certificate of final inspection and approvals from an inspection authority to the Contract Administrator.

.12 Standards of Workmanship

- .1 Execute all Work in a manner, which will result in the completed installation presenting an acceptable appearance, to a level of quality defined in the general conditions of this Specification.

- .2 Employ a competent supervisor and all necessary licensed tradesmen to complete the Work in the required time.
 - .3 Arrange and install products to fit properly into designated building spaces.
 - .4 Install products in accordance with the recommendations and ratings of the product manufacturers.
- .13 Contract Drawings and Specifications
- .1 Refer to Division 1.
 - .2 Supply and install all items and accessories specified by the Drawings or the Specification in the quality and quantity required. Perform all operations as designated by the Specification according to the methods prescribed, complete with all necessary labour and incidentals.
 - .3 Treat any item or subject omitted from this Division's Specifications or Drawings, but which is mentioned or reasonably specified in other Divisions' Specifications or Drawings and pertains to the instrumentation and control system, as being integral to the overall system. Provide such specified items or subjects.
 - .4 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.
 - .5 If discrepancies or omissions in the Drawings or Specifications are found, or if intent or meaning is not clear, consult the Contract Administrator for clarification before submitting Bid in accordance with B4.
 - .6 The responsibility to determine which Division provides various products and Work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of Specifications.

1.2 EQUIPMENT

- .1 Receiving, Storing, and Protection of Components during Construction
 - .1 Examine each component upon delivery to Site. Report all damage noted to the Contract Administrator prior to accepting or rejecting delivery. All instrumentation primary elements, control components, panels, etc. shall be placed in a secure, dry, heated storage building. Maintain the space temperature above 10°C and the space relative humidity below 50 percent.
 - .2 Perform a preliminary examination upon delivery to ensure that:
 - .1 All instrumentation and control components supplied for this project under this Section of the Specification comply with the requirements stated in the instrument Specification sheets.
 - .2 All instrumentation and control components supplied under other Sections of this Specification, to be connected to instrumentation and control components supplied under this Section of the Specification, comply with the requirements stated in the Contract Documents.
 - .3 Itemize all non-conformities noted above and forward them to the Contract Administrator. Any delays in construction resulting from the

delivery to Site of non-conforming instrumentation and control components shall be borne by the Contractor.

- .4 Do not install primary elements or other sensitive equipment until construction is sufficiently completed to provide an "operating condition" environment. Notify the Contract Administrator prior to installing any equipment of this type.
- .5 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage.
- .6 Return all damaged equipment to the factory for total corrective repairs. If deemed necessary by the Contract Administrator, the damaged equipment shall be replaced with new product. The Contractor shall bear any costs due to construction delays resulting from the delay in delivery of acceptable equipment.

1.3 SITE

- .1 Classification of Plant Areas
 - .1 Refer to Division 26

1.4 DOCUMENTATION

- .1 Submittals
 - .1 Submit Shop Drawings for all products supplied by this Division.
- .2 Operations and Maintenance Manuals
 - .1 Refer to Division 1 for general O&M Manual submittal information.
 - .2 In addition to the requirements specified in Division 1, provide the following information:
 - .1 Table of Contents - Arrange contents sequentially by systems under Section numbers. Label tabs of dividers between each to match section numbers in the Table of Contents.
 - .2 Systems Descriptions - A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.
 - .3 Maintenance and operating instructions for all equipment and controls – These operating instructions need not be manufacturer's data but may be typewritten instructions in simple language to guide the City in the proper operation and maintenance of this installation.
 - .4 A copy of all wiring diagrams complete with wire coding.
 - .5 Include type and accuracy of instruments used.
 - .6 Set of final reviewed Shop Drawings.
 - .7 Provide a tabulated list of all consumables utilized (fuses, lamps, etc.) indicating where used, type, rating and reorder details.

- .3 Construction Record Drawings
 - .1 Maintain on-site a complete set of Construction Record Drawings as listed in Division 1 of this Specification.
 - .2 In addition to the requirements as stated in Division 1, record the following information on the Drawings:
 - .1 All changes, alterations or additions
 - .2 All instrumentation cable and control tubing
 - .3 All changes to the numbers and location of outlets, motors, panels and end devices that may occur during the course of the Work.
 - .3 Before requesting the Certificate of Total Performance, make any necessary final corrections to the Drawings, sign each print as a certification of accuracy and deliver all sets to the Contract Administrator for approval.

Part 2 Products

2.1 GENERAL

- .1 Refer to the requirements of Division 1
- .2 Selected Products:
 - .1 Provide products and materials that are new and free from all defects.
 - .2 The design have been based on the use of the first named product where multiple products have been listed.
- .3 Alternate Products
 - .1 Refer to Division 1 for consideration of alternate products.
 - .2 Alternate products and materials to those specified will only be considered by the Contract Administrator if they are shown in the Bid as a material variation, and if they are submitted with an appropriate price adjustment. The Contract Administrator will reserve the right to accept or reject any alternative without explanation.
 - .3 The alternate submission shall provide sufficient information to enable the Contract Administrator to determine whether the alternate is acceptable or unacceptable.
 - .4 Provide complete information on required revisions to other Work and products to accommodate each alternate product.
 - .5 The Contractor assumes full responsibility when providing alternate products or materials that all space, weight, connections, power and wiring requirements etc. are considered and compensated for. Any costs incurred for additional components, changes to other services, structural or space requirements, layouts and plans, etc. that may arise from the use of the alternate shall be borne by the Contractor.
- .4 Quality of Products

- .1 All products provided to be CSA and ULC approved where applicable.
- .2 If products specified are not CSA approved, obtain approval of the relevant provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.
- .3 Refer to Division 1 of this Specification for further information.
- .5 Uniformity of Manufacture
 - .1 Unless otherwise specifically called for in the Specification, uniformity of manufacture to be maintained for similar products throughout the Work.
- .6 Product Finishes
 - .1 Products to be manufacturers' standard finish. Where special finishes are specified refer to Division 9 for details on quality and workmanship of the finishes.
- .7 Use of Products During Construction
 - .1 Any equipment used for temporary or construction purposes is to be approved by the Contract Administrator. Clean and restore to "as new" condition all equipment prior to the time of Substantial Performance.

2.2 INSTRUMENTATION

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

2.3 IDENTIFICATION

- .1 Refer to Division 26 for general identification requirements. Provide lamicoïd nameplates with 6 mm black lettering on white background. Identify the loop tag number (where applicable) and the device name, function, and instrument range or setpoint value on the nameplate.
- .2 Where it is not possible to attach a lamicoïd nameplate to a field instrument component, provide the component with a stainless steel metal tag firmly wired to the device and identified with the loop tag number.
- .3 Identify all wires where they terminate at the marshalling panels, junction boxes and field devices with a heat shrink sleeve with machine printed labeling.
- .4 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.

- .5 Provide neatly typed circuit directories for panel power distribution systems to indicate loops or devices powered by the circuit and the fuse size.
- .6 Identify all exposed control conduits at all pull box locations, where the conduits enter or leave a room, and 13 m on centre throughout the room. This shall apply to conduits above removable ceilings. Use Thomas & Betts TY-RAP 5532-M labels conduit identification.
- .7 For direct current wiring use black for positive and white for negative.
- .8 For thermistor wiring to motors use red and blue coloured, insulated wire.

Part 3 Execution

3.1 SITE EXAMINATION

- .1 Refer to the requirements of Division 1.
- .2 No additional compensation will be given for extra Work due to existing conditions that a Site examination prior to Bid should have disclosed.

3.2 COORDINATION WITH OTHER DIVISIONS

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

3.3 PRODUCT HANDLING

- .1 Use all means necessary to protect the products included in this Division before, during and after installation, and to protect products and installed Work of all other trades.

- .2 Any damage to the products and/or installed Work shall be repaired or replaced by the Contractor at no additional cost to the City and to the approval of the Contract Administrator.
- .3 Remove advertising labels from all products installed that have such labels attached. Identification or CSA labels are not to be removed.
- .4 Remove dirt, rubbish, grease, etc. resulting from Work performed under this Division of the Contract from all surfaces.

3.4 SEPARATION OF SERVICES

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

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

.4 Separation of Circuits

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

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

3.5 WIRE AND CABLE

- .1 Refer Division 26

3.6 EQUIPMENT CONNECTIONS

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

3.7 WIRING TO EQUIPMENT SUPPLIED BY OTHER DIVISIONS

- .1 Equipment supplied by the City or by other Divisions, that have external or field mounted control devices, are to be installed, wired and commissioned by this Division.

3.8 ACCESS PANELS

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

3.9 Instrument Mounting Stands

- .1 Supply and install instrumentation mounting stands as required. Stands are to be either floor or wall mounted. The mounting stands are to be fabricated from aluminum or galvanized steel.

- .2 Supply and install protective drip shields for any exterior stand-mounted instrumentation equipment. Drip shields are to extend 50 mm past the front and side faces of the equipment. Drip shields are to be fabricated from aluminum.

3.10 SEALING OF WALL AND FLOOR OPENINGS

- .1 Seal all conduit and cable entries passing through outside walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade.
- .2 Seal openings after all wiring entries have been completed.
- .3 Sealing material shall be fire resistant and shall not contain any compounds that could chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations, if required, are to be sealed. Submit shop drawing for rated assembly prior to installation of fire stop.

3.11 SLEEVES

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

3.12 CONNECTIONS TO MECHANICAL, ELECTRICAL AND EXISTING SYSTEMS

- .1 .1 Refer to Division 26 for the required tie-in procedures.

3.13 TAGGING STANDARDS FOR DEVICES AND WIRING

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

3.14 TESTING OF INSTRUMENTATION LOOPS

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

3.15 CALIBRATION

- .1 Instruments are to be factory pre-calibrated. Verify calibration after installation for all instruments installed under these Specifications. Provide a printed record of the factory calibration parameters for "smart" devices.
- .2 Prior to calibration, completely program all "smart" transmitters including entries of the appropriate range and tag number. Provide a printed record of smart device serial numbers against their assigned tag number with all programmed parameters.
- .3 Instruments to be set up and calibrated by an accredited instrument technician working under the approval of the instrument Manufacturer.
- .4 Calibrate all instruments to an accuracy of 0.5 percent of full range, or to the manufacturer's stated accuracy of the instrument whenever an accuracy of 0.5 percent is not achievable.
- .5 Prior to instrument installation perform the following applicable calibration for each instrument and its associated signal conditioning equipment:
 - .1 Calibrate all inline flow meters by a draw-down test
 - .2 Calibrate all density meters by lab samples

- .3 Calibrate all vacuum and pressure instruments by manometer or accurate test instrument and hand test pump
- .4 Calibrate gas detectors using standard gas sample
- .5 Calibrate temperature instruments against a standard lab thermometer.
- .6 Calibrate online analyzers with known samples.

3.16 COMMISSIONING

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

3.17 TRAINING

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

3.18 TEST FORMS

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

LOOP CHECK REPORT

CHECKED OUT OK

NOT APPLICABLE

FURTHER ACTION REQUIRED

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

REMARKS:

READY FOR START-UP

DATE: _____

Installed by: _____

Checked by: _____

INSTRUMENT TEST REPORT

SYSTEM: _____

SERVICE: _____ TAG NO. _____

LOCATION: _____

MAKE: _____ MODEL: _____

SERIAL NO.: _____ CSA: _____

ELEMENT: _____ RANGE: _____

DESIGN SETTING/RANGE: _____ CONTACT TO: _____ ON: _____

SIGNAL IN: _____ OUT: _____ ASSOCIATED INSTRUMENT: _____

INSTRUMENT CONDITION: _____ CONFORM TO SPEC: _____

PROJECT NO.: _____ DATA SHEET: _____

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

TESTED BY: _____ CHECKED BY: _____
 DATE: _____ DATE: _____

Part 1 General

1.1 REFERENCES - GENERAL

- .1 Suppliers, Equipment, Products, and Execution must meet all requirements detailed in Section 29 05 00.
- .2 Local control stations shall be supplied to house local control switches, push buttons and indicator lights associated with field devices (valves, drives etc). The control stations shall be located in close proximity to their associated devices. Where a group of devices are located within close proximity to each other, the local controls may be combined into a single common local control panel. Line of site must be maintained between all devices and the respective local controls.

Part 2 Products

2.1 GENERAL

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

2.2 ENCLOSURES

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

2.3 PANEL ENCLOSURES

- .1 Fabricate panel enclosures from 11 gauge steel panels complete with necessary stiffening to form a rigid free-standing lineup. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide removable top and bottom cable entry plates.
- .2 Provide panels with front access only. Doors shall be key lockable and fitted with 3-point heavy duty latching assemblies. Provide a continuous piano hinge and a pneumatic hold open device on each door.
- .3 Finish the interior of the enclosure with white paint. Provide a switched fluorescent light fixture and 120 VAC duplex convenience receptacle inside the enclosure.

2.4 MARSHALING AND CONTROL PANELS

- .1 Supply, fabricate, checkout, layout, document and deliver to Site fully equipped and functional panels.
- .2 Supply all components contained on or within the panels fully wired under this Section of the Specification.
- .3 The selection of all accessories, materials and methods for fabrication not covered by this Specification, but which are necessary to complete the fabrication of the control panels, is the responsibility of the panel fabricator.
- .4 Fans and filters shall be installed to pressurize all control panels thus discouraging dust accumulation and providing air purging for temperature and corrosion control.
- .5 Marshalling and control panels shall be adequately sized to facilitate a professional, uncluttered arrangement. Provide adequate internal and external space to accommodate a 20 percent increase in each type of component used.
- .6 Control and marshalling panel layouts and wiring diagrams are to be provided by the Contractor as Shop Drawings.

2.5 WIRING AND ACCESSORIES

- .1 Provide wiring inside the panels according to the following Specifications:
 - .1 Control wiring to be a minimum of #16 AWG tinned stranded copper; insulation rated at 600 V.
 - .2 Wiring for power distribution shall be a minimum of #14 AWG tinned stranded copper; insulation rated at 600 V.
 - .3 Install cables in accordance with the requirements of Division 16.
- .2 Tag each wire at both ends with a heat shrink sleeve that is machine printed. Allow approximately 20 mm of wire insulation between the tag and the bare wire.

- .3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.
- .4 Run all wiring in enclosed plastic wireways such as Panduit. Size all wireways so that the total cross sectional area of the insulated wire and cable does not exceed 40 percent of the cross sectional area of the wire way.
- .5 Provide a minimum clearance of 50 mm between wire ways and any point of wire termination.
- .6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, defined as follows:
 - .1 Wire identification to use the connected field device tag name with the wire's corresponding end device terminal number appended to it.
 - .2 Identify every joint and/or terminal of the above wire run with the same identifier until the wire meets another tagged device, at which point the wire identifier will change to use the new device name and terminal number.
 - .3 For example, pressure transmitter S740-FIT located in the field has a 1 PR-TPSH cable connected to it. The cable runs through a junction box to a marshaling panel. The wire identifiers for the pair of wires would be S740-FIT all the way to the marshaling panel.
 - .4 Identify spare wires by using the cable tag, wire number and an "-SP" suffix.
 - .5 Arrange wiring on terminal blocks such that all internal panel wiring terminates on the inboard side of the terminal blocks and all external wiring terminates on the outboard side.
- .7 Provide a 120 VAC panel power distribution system and a 24 VDC power distribution system in each panel. Provide 12 VAC power for the CCTV fiber converters as required. Provide a thermal magnetic circuit breaker on each main power circuit and a fused terminal block for each branched circuit off the main.
- .8 Provide disconnect type terminal blocks Weidmuller WTR 4 series to isolate field wiring that is powered sourced from the panel. Provide a dedicated fused disconnect type terminal block to isolate each individual DCS input and output.
- .9 Provide sufficient terminals so that not more than two wires are connected under the same terminal. Provide 20 percent spare terminal capacity at each terminal block assembly.
- .10 Terminals shall be Weidmuller W Series color coded as follows:
 - Red = positive 24 VDC
 - Black = analog signal plus
 - White = analog signal common and VAC neutral
 - Grey = 120 VAC
 - Green = ground

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

2.6 PANEL GROUNDING

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

Part 3 Execution

3.1 MOUNTING HEIGHTS

- .1 Unless otherwise specified or a conflict exists, mount all panels, starters and disconnects 2000 mm to top of cover.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Division 1 and Division 26.

1.2 RELATED WORK

- .1 Refer to Division 26

1.3 INSPECTION

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

1.4 STANDARDS

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

Part 2 Products

2.1 TWISTED PAIR SHIELED CABLES (TPSH)

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

2.2 RTD AND MULTI CONDUCTOR SHIELED CABLE

- .1 RTD cables shall be CSA approved and shall be constructed as follows:
 - .1 Three or more copper conductors, stranded, minimum # 18 AWG
 - .2 PVC insulated for 600 V

- .3 100 percent coverage aluminum foil or tape shield
- .4 Separate bare stranded copper drain wire
- .5 Overall flame retardant PVC jacket to CSA-C22.2

2.3 TECK CABLES

- .1 As per Division 26

2.4 WIRE

- .1 As per Division 26

Part 3 Execution

3.1 ANALOG SIGNALS

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

3.2 DIGITAL SIGNALS

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

3.3 INSTRUMENT POWER

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

3.4 INSTALLATION

- .1 Install instrumentation cables in conduit systems or in cable trays. Use a minimum of 300 mm and a maximum of 1000 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.
- .2 Where non-armoured instrumentation cables are installed in cable trays, provide barriers in the tray to separate instrumentation cables from power cables.
- .3 At each end of the run leave sufficient cable length for termination.
- .4 Do not make splices in any of the instrumentation cable runs.

- .5 Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.
- .6 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the marshalling panel.
- .7 Protect all conductors against moisture during and after installation.

3.5 CONDUCTOR TERMINATIONS

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

3.6 TESTING

- .1 Test all conductors for opens, shorts, or grounds. Resistance values shall not be less than those recommended by the cable manufacturer.
- .2 Test all fiber optic cables and terminations for signal integrity and conformity to manufacturer's specifications. Submit results to the City.

3.7 IDENTIFICATION

- .1 Identify all instrumentation cables.
- .2 Identify each conductor with wire numbers using a machine printed Raychem TMS heat shrink wire marker or approved equal in accordance with B6.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 The Work includes the provision of all instrument air supply and transmission devices.
- .2 Refer to Section 290500 for general instrumentation and control requirements related to instrument air supply and transmission.

Part 2 Products

2.1 PNEUMATIC AND PROCESS CONNECTIONS

- .1 Pipe, fittings, valves, tubing, tube fittings, etc. required under this Section of the Contract to be Swagelok and rated for the service in which they are to be employed.
- .2 Except for the last 300 mm, tubing and fittings to be made of stainless steel. For the last 300 mm (nominal), use reinforced neoprene tubing with a pressure rating of at least 1000 kPa.
- .3 Dimensions:
 - .1 Process connections - 12 mm (nominal) O.D. tubing
 - .2 Output/signal - 10 mm (nominal) O.D. tubing
 - .3 Air supply - 12 mm pipe (nominal) to isolation valves and 10 mm O.D. tubing (nominal) from isolation valves to end devices (e.g. valves).
 - .4 Provide a continuous support channel or raceway for all tubing.

2.2 AIR SETS

- .1 Provide all pneumatic actuator assemblies with an air set.
- .2 Provide Fisher 67FR air sets unless specified otherwise in the Instrument Specification Sheets of Section 17701.
- .3 Air set to be complete with filter regulator and output pressure gauge.
- .4 Filter rating shall be 40 um or less as called for in actuator manufacturer's specification.

2.3 SOLENOID VALVES

- .1 Provide Asco Redhat type solenoid valves unless specified otherwise in the Instrument Specification Sheets of Section 17701.
- .2 Solenoid enclosures to be minimum EEMAC 4; corrosive areas require EEMAC 4X and hazardous areas require EEMAC Type 9. Refer to Division 16 for area classifications.

- .3 Provide manual overrides on coils when solenoid is used to actuate a valve.
- .4 Standard coil voltage: 120 VAC
- .5 Pipe size: 3-way valve - 6mm; 4-way valve – 10 mm
- .6 Maximum operating pressure: 850 kPa instrument air
- .7 Minimum operating pressure: 20 kPa instrument air

Part 3 Execution

3.1 TUBING AND FITTING INSTALLATION

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

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

- .1 Equipment, products and execution must meet all requirements detailed in Section 29 50 00.

Part 2 Products

2.1 TRANSMITTERS AND INDICATORS

- .1 Provide transmitters and indicators.
- .2 Transmitters shall have adequate power output to drive all devices associated with the signal loop. Provide signal boosters as required to achieve adequate signal strength or to isolate the signal.
- .3 All transmitters to have local indication scaled in engineering units as specified in the engineering Specifications. Provide a lamicoïd label indicating the calibrated range and engineering units and mount adjacent to the transmitter. Mount the transmitter so the indicator is visible by operations personnel.
- .4 Provide remote indicators similar to Action Instruments model V560 for use in unclassified areas. Action Instruments model V560-EP for use in Class 1 areas is acceptable.
- .5 Where the loop specification calls for a transmitter and an indicator to be mounted in the same panel, an indicating transmitter may be considered acceptable, provided the indicator is normally visible from outside the enclosure.
- .6 Where available as an option, the transmitter shall be supplied with an isolated fault contact.
- .7 Standard of acceptance for instrumentation shall be as follows:
 - .1 Pressure Transmitters: Rosemount Model 3051, ABB, or Foxboro complete with stainless steel two and three-valve manifolds as manufactured by Anderson Greenwood
 - .2 Pressure Gauges: Ashcroft, H.O. Trerice, Budenberg.
 - .3 Temperature Transmitters (RTD): Rosemount, ABB, Foxboro

Part 3 EXECUTION

3.1 References - General

- .1 Refer to Section 29 05 00.

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

- .1 Refer to Section 29 05 00

Part 2 Products

2.1 GENERAL

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

2.2 INDICATORS, PUSHBUTTONS AND SELECTOR SWITCHES

- .1 All control indicator lamps, pushbutton switches, and selector switches in unclassified or non-corrosive areas to be Allen Bradley 800T or 800E series.
- .2 All control indicator lamps, pushbutton switches, and selector switches in classified or corrosive (includes outdoors) areas to be Allen Bradley 800H series.
- .3 All control indicator lamps shall be push-to-test type.

2.3 RELAYS

- .1 The Quality and type of relays shall be based on Omron relays.
- .2 120 VAC relays to be Model LY 4PDT, plug-in, complete with test button and operation indicator, and surge suppressor.

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

2.4 PROCESS SWITCHES

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

Part 3 Execution

3.1 REFERENCES - GENERAL

- .1 Refer to Section 29 05 00

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

- .1 Equipment, Products and Execution must meet all requirements detailed in Section 29 05 00.

Part 2 Products

2.1 MISCELLANEOUS PANEL DEVICES

- .1 Pilot Lights
 - .1 Provide LED transformer type pilot lights for extended lamp life, oil tight, push to test, complete with appropriate colour lenses. Normal colours used are run=red, stop=green. Refer to Division 26 for additional information
- .2 Terminals
 - .1 Provide strap screw type terminal blocks rated for 600 V.
 - .2 Identify each terminal block within an enclosure with a unique machine printed terminal block number. Cabinet chassis grounding terminal blocks to be identified by the electrical ground symbol.
 - .3 Connections to screw terminals to be locking fork tongue insulated crimp type wire connectors.
 - .4 Terminals to be Weidmuller or approved equal in accordance with B6.
 - .5 Provide a group of terminals for each of 120 VAC hot and neutral and 24 VDC positive and negative power. Distribution wiring to have a thermal magnetic circuit breaker upstream of all major blocks of loads, adequately sized to protect the connected load while not causing nuisance tripping.
 - .6 Provide Weidmuller disconnect type terminal blocks for each load or loop powered from the marshalling panels.
- .3 Nameplates
 - .1 Refer to Section 29 05 00

2.2 SIGNAL CURRENT ISOLATOR

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

- .4 Approved manufacturers are Moore Industries, Weidmuller or Phoenix.

2.3 INTRINSIC SAFETY BARRIERS AND RELAYS

- .1 Provide intrinsic safety barriers where required for two-wire transmitters of the active, isolating, loop powered type; MTL Type MT3042, Stahl 9005/01-252/100/00, P+F ZG series, or approved equal in accordance with B6.
- .2 Provide dual type intrinsic safety barriers for process switches; MTL 787, Panalarm 201-BR2.
- .3 Intrinsic safety relays to be Stahl, Gems, or Warrick.

Part 3 Execution

3.1 REFERENCES - GENERAL

- .1 Refer to Section 29 05 00

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 Connection and termination of all new plant instrumentation, control system I/O, communications media and vendor packages to the existing Distributed Control System (DCS).
- .2 The City will supply all DCS hardware expansion of the DCS to meet the new I/O requirements. Assist the City in the installation of the new hardware.
- .3 Start-up and Commissioning of the complete control system and associated field devices and wiring.
- .4 Cooperate with Package Plant Vendors and City programming, maintenance and operations staff to interface, test and commission the interface between the DCS and the equipment installed under this Contract.

Part 2 Products

2.1 EXISTING DISTRIBUTED CONTROL SYSTEM

- .1 General
 - .1 All new DCS equipment will be supplied by the City..
 - .2 City personnel will provide the DCS logic configuration.

2.2 SYSTEM INTEGRATION REQUIREMENTS

- .1 Cooperate and coordinate activities with other Contractors, the City, and the Contract Administrator to facilitate installation, testing, validation, and Commissioning of all components and equipment required under the BNR upgrade.
- .2 Supply, install, test and commission control panels for local operator controls as specified in this Division.
- .3 The City will supply the required additional hardware components for the existing Bailey Infi-90 DCS system to meet the increased I/O requirements created under the plant expansion.
- .4 All equipment testing and commissioning responsibilities must be carried out while at the same time maintaining the Plant DCS. Any equipment outage requirements are to be kept to a minimum and are to be scheduled with the Contract Administrator prior to implementation.

- .5 Provide Contract Administrator minimum four (4) weeks notice of required DCS configuration for testing and commissioning.
- .6 The City will require a minimum of four (4) weeks to install, test, and commission configuration changes.

Part 3 Execution

3.1 Performance – General

- .1 Refer to Section 29 05 00

3.2 INSTALLATION

- .1 Provide hardware in accordance with the foregoing requirements in sufficient quantity to satisfy the performance requirements defined in this and other Divisions of the Specification.
- .2 Provide all necessary documentation to define the control system including details for all hardware.
- .3 Commission and start up the system as defined herein.
- .4 Provide all documentation and training as defined herein.
- .5 Maintain existing plant operation during entire Construction Period. Refer to the requirements of Division 1.

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

.1 Refer to Section 29 05 00

1.2 DCS I/O INDEX

.1 The following spreadsheet gives an itemized list of the new Distributed Control System inputs and outputs. It is intended to serve as an aid for determining the cabling requirements for the Work specified in this Division.

Part 2 Products

.1 Not used

Part 3 Execution

.1 Not used

NO.	REV. NO.	TAG NAME				DESCRIPTION			P&ID DRAWING	I/O SPECIFICATION					
		PCU	AREA	LOOP	DEVICE ID	FUNCTION	SERVICE	ENG. UNITS		SCALE LOW-HIGH	ALARMS		I/O POINT TYPE	I/O POINT NO.	PCU AREA
											LOW	HIGH			
001	00	MA	M	609	MN	Motor Start	M609 Air Handling Unit	A-D-P0004						DO	
002	00	MA	M	609	MM	Motor Running Status	M609 Air Handling Unit	A-D-P0004						DI	
003	00	MA	M	609	UF	VFD Fault	M609 Air Handling Unit	A-D-P0004						DI	
004	00	MA	M	609	YS	Computer Selected	M609 Air Handling Unit	A-D-P0004						DI	
005	00	MA	M	609	SC	Speed Control	M609 Air Handling Unit	A-D-P0004	%	0 to 100				AO	
006	00	MA	M	609	TC	Discharge Air Temperature	M609 Air Handling Unit	A-D-P0004	°C	-10 to 50				AO	
007	00	MA	M	609	DPT	Air Plenum Pressure	M609 Air Handling Unit	A-D-P0004	Pa	-50 to 50	20			AI	
008	00	MA	M	615	ZC	Position Control	Level 400 VAV Box	A-D-P0004	%	0 to 100				AO	
009	00	MA	M	615	ZT	Position Feedback	Level 400 VAV Box	A-D-P0004	%	0 to 100				AI	
010	00	MA	M	615	FT	Air Flow Transmitter	Level 400 VAV Box	A-D-P0004	lps					AI	
011	00	MA	M	616	ZC	Position Control	Dry Well Level 300 VAV Box	A-D-P0004	%	0 to 100				AO	
012	00	MA	M	616	ZT	Position Feedback	Dry Well Level 300 VAV Box	A-D-P0004	%	0 to 100				AI	
013	00	MA	M	616	FT	Air Flow Transmitter	Dry Well Level 300 VAV Box	A-D-P0004	lps					AI	
014	00	MA	M	617	ZC	Position Control	Dry Well Level 100 & 200 VAV Box	A-D-P0004	%	0 to 100				AO	
015	00	MA	M	617	ZT	Position Feedback	Dry Well Level 100 & 200 VAV Box	A-D-P0004	%	0 to 100				AI	
016	00	MA	M	617	FT	Air Flow Transmitter	Dry Well Level 100 & 200 VAV Box	A-D-P0004	lps					AI	
017	00	MA	M	618	TT	Space Temperature Transmitter	Electrical Room Level 400	A-D-P0004	°C	-10 to 50	5	38		AI	
018	00	MA	M	619	TT	Space Temperature Transmitter	Dry Well Level 300	A-D-P0004	°C	-10 to 50	5	38		AI	
019	00	MA	M	634	MN	Motor Start	L400 Supply Fan	A-D-P0004						DO	
020	00	MA	M	634	MM	Motor Running Status	L400 Supply Fan	A-D-P0004						DI	
021	00	MA	M	634	YS	Computer Selected	L400 Supply Fan	A-D-P0004						DI	
022	00	MA	M	635	ZSB	Position Close	L400 Supply Fan Inlet Damper	A-D-P0004						DI	
023	00	MA	M	606	MN	Motor Start	L300 Combustion Air Supply Fan	A-D-P0004						DO	
024	00	MA	M	606	MM	Motor Running Status	L300 Combustion Air Supply Fan	A-D-P0004						DI	
025	00	MA	M	606	YS	Computer Selected	L300 Comb. Air SF Inlet Damper	A-D-P0004						DI	
026	00	MA	M	606	ZSB	Position Close	L300 Comb. Air SF Inlet Damper	A-D-P0004						DI	
027	00	MA	M	632	ZC	Position Control	Building Pressure Relief	A-D-P0005	%	0 to 100				AO	
028	00	MA	M	632	ZT	Position Feedback	Building Pressure Relief	A-D-P0005	%	0 to 100				AI	
029	00	MA	M	613	PDT	Differential Pressure Transmitter	Dry Well Level 300 Pressure Control	A-D-P0005	Pa	-50 to 50	20			AI	
030	00	MA	M	610	MN	Motor Start	Wet Well Ventillation Exhaust Fan	A-D-P0005						DO	
031	00	MA	M	610	MM-1	Motor Running Status	Wet Well Ventillation Exhaust Fan	A-D-P0005						DI	
032	00	MA	M	610	MM-2	Motor Running Low Speed Light	Wet Well Ventillation Exhaust Fan	A-D-P0005						DO	
033	00	MA	M	610	MM-3	Motor Running High Speed Light	Wet Well Ventillation Exhaust Fan	A-D-P0005						DO	
034	00	MA	M	610	UF	VFD Fault	Wet Well Ventillation Exhaust Fan	A-D-P0005						DI	
035	00	MA	M	610	YS-1	Computer Selected	Wet Well Ventillation Exhaust Fan	A-D-P0005						DI	
036	00	MA	M	610	HS-2	Occupied Mode Selected	Wet Well Ventillation Exhaust Fan	A-D-P0005						DI	
037	00	MA	M	610	FS	Flow Switch	Wet Well Ventillation Exhaust Fan	A-D-P0005						DI	
038	00	MA	M	610	SC	Speed Control	Wet Well Ventillation Exhaust Fan	A-D-P0005	%	0 to 100				AO	
039	00	MA	M	636	TT	Temperature Transmitter	Wet Well Space Temperature	A-D-P0005	°C	-10 to 50	5	38		AI	
040	00	MA	M	620	MN	Motor Start	Generator Room Exhaust Fan	A-D-P0006						DO	
041	00	MA	M	620	MM	Motor Running Status	Generator Room Exhaust Fan	A-D-P0006						DI	
042	00	MA	M	620	UF	VFD Fault	Generator Room Exhaust Fan	A-D-P0006						DI	
043	00	MA	M	620	YS	Computer Selected	Generator Room Exhaust Fan	A-D-P0006						DI	
044	00	MA	M	620	SC	Speed Control	Generator Room Exhaust Fan	A-D-P0006	%	0 to 100				AO	
045	00	MA	M	621	ZSB	Position Close	Gen. Room Cooling Air Inlet Damper	A-D-P0006						DI	
046	00	MA	M	622	ZSB	Position Close	Gen. Room Cooling Air Outlet Damper	A-D-P0006						DI	
047	00	MA	M	002	MM	Generator Running Status	Standby Generator	A-D-P0006						DI	
048	00	MA	M	002	UF-1	Trouble Status	Standby Generator	A-D-P0006						DI	
049	00	MA	M	002	UF-2	Shutdown Alarm Status	Standby Generator	A-D-P0006						DI	
050	00	MA	M	623	ZC	Position Control	Gen. Cooling Exhaust Air Damper	A-D-P0006	%	0 to 100				AO	
051	00	MA	M	623	ZT	Position Feedback	Gen. Cooling Exhaust Air Damper	A-D-P0006	%	0 to 100				AI	
052	00	MA	M	624	ZC	Position Control	Gen. Cooling Recycle Air Damper	A-D-P0006	%	0 to 100				AO	
053	00	MA	M	624	ZT	Position Feedback	Gen. Cooling Recycle Air Damper	A-D-P0006	%	0 to 100				AI	
054	00	MA	M	625	ZD	Open Command	Gen. Cooling Inlet Air Damper	A-D-P0006						DO	
055	00	MA	M	625	ZSB	Position Close	Gen. Cooling Inlet Air Damper	A-D-P0006						DI	
056	00	MA	M	625	ZSD	Position Open	Gen. Cooling Inlet Air Damper	A-D-P0006						DI	

NO.	REV. NO.	TAG NAME				DESCRIPTION		P&ID DRAWING	I/O SPECIFICATION						
		PCU	AREA	LOOP	DEVICE ID	FUNCTION	SERVICE		ENG. UNITS	SCALE LOW-HIGH	ALARMS		I/O POINT TYPE	I/O POINT NO.	PCU AREA
											LOW	HIGH			
057	00	MA	M	639	TT	Temperature Transmitter	Generator Room Space Temperature	A-D-P0006	°C	-10 to 50	5	38	AI		
058	00	MA	M	920	GT	Methane Gas Transmitter	Wet Well Level 200	A-D-P0005	% LEL	0 to 100			AI		
059	00	MA	M	921	GT	H2S Gas Transmitter	Wet Well Level 200	A-D-P0005	ppm	0 to 50		20	AI		
060	00	MA	M	930	GT	Methane Gas Transmitter	Wet Well Level 300	A-D-P0005	% LEL	0 to 100			AI		
061	00	MA	M	931	GT	H2S Gas Transmitter	Wet Well Level 300	A-D-P0005	ppm	0 to 50		20	AI		
062	00	MA	M	932	GT	Methane Gas Transmitter	Dry Well Level 300	A-D-P0004	% LEL	0 to 100			AI		

Part 1 General

1.1 REFERENCES - GENERAL

- .1 The Work includes the provision of all instrument specification sheets.
- .2 Refer to Section 29 05 00

1.2 INSTRUMENT SPECIFICATION SHEETS

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

Part 2 Products

- .1 Refer to the following specification sheets.

INSTRUMENT SPECIFICATION NUMBER:	I-101
DEVICE:	Level Switch
TAG:	Wet well, LSH and LSHH
TYPE:	Float Switch
SERVICE:	Waste water
ENCLOSURE:	Polypropylene float casing with preterminated signal cable
SIGNAL CABLE LENGTH:	20m
OUTPUT:	Relay contact resistive – 10A, 250V
MOUNTING:	Provide strain relief-type connectors to suspend float at desired location. Fabricate mounting brackets from 316 SS. Provide anti-sway rings to prevent sway in turbulent tanks.
MANUFACTURER AND MODEL:	Flygt ENM-10 Consolidated Electric Warwick Magnetrol
ACCESSORIES:	Supply and install intrinsically safe barrier in DCS cabinet

INSTRUMENT

SPECIFICATION NUMBER: I-102

DEVICE: Existing Liquid Level Transmitter

TAG: Wet well level

TYPE: Bubbler

SERVICE: Waste Water

ACCESSORIES: Stainless steel tubing and isolation ball valves.

NOTES: Supply and install new tubing and isolation valves to allow manual selection between monitoring the level in the current chamber and monitoring the level in the second chamber.

INSTRUMENT SPECIFICATION NUMBER: I-103

DEVICE: Pressure Transmitter (Differential)

TAG: M609-DP, M613-PDT

SERVICE: M609-MAU discharge air pressure, LEVEL 300 air pressure

PROCESS CONNECTIONS: 1/8" NPT

RANGE: -10 mbar to 10 mbar

INACCURACY: ±0.25% of span

OUTPUT: 4 to 20 mA DC into 500 OHM

POWER SUPPLY: Loop powered 24 VDC

CONSTRUCTION: Stainless steel wetted parts

ELECTRONIC ENCLOSURE: EEMAC 4X

ACCESSORIES: mounting bracket

MANUFACTURER AND MODEL: Rosemount Type 951, or approved equal in accordance with B6

NOTES: Mount in MAU control panel or in separate enclosure

INSTRUMENT SPECIFICATION NUMBER: I-104

DEVICE: Temperature

TAG: M618-TT, M619-TT, M639-TT

SERVICE: Space temperature

SPAN: -10 to 50 degrees Celsius

SENSOR: 3 wire RTD, Pt 100

INACCURACY: $\pm 0.1\%$ of span

OUTPUT: 4 to 20 mA DC into 500 OHM

POWER SUPPLY: Loop powered 24 VDC

CONSTRUCTION: Stainless steel wetted parts

ELECTRONIC ENCLOSURE: Universal head, aluminum alloy

ACCESSORIES: mounting bracket

MANUFACTURER AND MODEL: Rosemount 144 c/w RDT sensor

INSTRUMENT SPECIFICATION NUMBER:	I-105
DEVICE:	Methane Gas Detector
TAG:	M920-GIT, M930-GIT, M932-GIT
SERVICE:	Wet well and gas engine monitoring
RANGE:	0 to 100% LEL
SENSOR:	Infrared Hydrocarbon Gas Detector
INACCURACY:	±3% from 0 to 50% LEL, ±5% from 50 to 100% LEL
OUTPUT:	4 to 20 mA DC into 500 OHM
POWER SUPPLY:	Loop powered 24 VDC
CONSTRUCTION:	Stainless steel wetted parts
ELECTRONIC ENCLOSURE:	Explosion proof, stainless steel
CERTIFICATIONS:	CSA Class 1, Div 1, Groups C & D
ACCESSORIES:	mounting bracket
MOUNTING:	Mount near ceiling
CALIBRATION:	include calibration kit with 2 gas bottles, carrying case, regulator, calibration tubing and hook-up to weather baffle. Provide remote switch and housing for calibration.
MANUFACTURER AND MODEL:	Det-Tronics Pointwatch Eclipse Model PIRECL or approved equal in accordance with B6

INSTRUMENT SPECIFICATION NUMBER:	I-106
DEVICE:	H2S Gas Detector
TAG:	M921-GIT, M931-GIT
SERVICE:	Wet well monitoring
RANGE:	0 to 50 ppm
SENSOR:	Electrochemical
INACCURACY:	±10% of span or ±3 PPM, whichever is greater
OUTPUT:	4 to 20 mA DC into 500 OHM
POWER SUPPLY:	Loop powered 24 VDC
CONSTRUCTION:	Stainless steel wetted parts
ELECTRONIC ENCLOSURE:	Explosion proof, stainless steel
CERTIFICATIONS:	CSA Class 1, Div 1, Groups C & D
ACCESSORIES:	mounting bracket, hydrophobic filter
MOUNTING:	Mount 600mm from floor on Level 300, 1500mm from floor on Level 200
CALIBRATION:	include calibration kit with 2 gas bottles, carrying case, regulator, calibration tubing and hook-up to weather baffle.
MANUFACTURER AND MODEL:	Det-Tronics Infiniti U9500 transmitter with C706E gas sensor, or approved equal in accordance with B6.