1. GENERAL

1.1 References

.1 Canadian Standards Association Latest Edition (CSA)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CSA C22.3 No.7, Underground Systems.

.3 CAN/CSA-C22.3 No. 1, Overhead Systems.

.4 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE 100, The Authoritative Dictionary of IEEE Standards Terms.

1.2 Definitions

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these Specifications, and on Drawings, are those defined by IEEE 100.

1.3 Design Requirements

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.4 Submittals

.1 Submittals: in accordance with E4.

.2 Shop Drawings:

.1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.

.2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

.3 Indicate on Drawings clearances for operation, maintenance, and replacement of operating equipment devices.

.4 If changes are required, notify Contract Administrator of these changes before they are made.

.5 Contract Administrator will not assume the responsibility for searching out deviations in the Contractor’s drawings.

.3 Quality Control:

.1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special acceptance approval before delivery to Site.

.2 Submit test results of installed electrical systems and instrumentation.

.3 Permits and fees: in accordance with General Conditions of Contract.

.4 Upon completion of Work, submit and load balance report as described in Part 3.11.1 - Load Balance

.5 Upon completion of Work, submit certificate of acceptance from Authority Having Jurisdiction to Contract Administrator.

1.5 Quality Assurance

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid license in accordance with Authorities Having Jurisdiction.

1.6 System Start-up

.1 Instruct Contract Administrator and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of an instrumentation technician to check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.

1.7 Operating Instructions

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Other items of instruction as recommended by Manufacturer of each system or item of equipment.

.3 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.4 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

2. PRODUCTS

2.1 Materials and Equipment

.1 Material and equipment to be CSA Certified. Where CSA Certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in Paragraph 1.4 - Submittals.

.2 Factory assemble control panels and component assemblies.

2.2 Warning Signs

.1 Warning Signs: in accordance with requirements of Authority Having Jurisdiction, inspection authorities, and Contract Administrator.

.2 Lamacoid, red with white lettering, minimum size 175 x 250 mm.

2.3 Wiring Terminations

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.4 Equipment Identification

.1 Identify electrical equipment and devices with nameplates as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 All essential power labelling to be red face nameplate with white letters.

.3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Wording on nameplates and labels to be accepted by Contract Administrator prior to manufacture.

.5 Allow for minimum of twenty-five (25) letters per nameplate and label.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

.10 All distributions, panelboard, transfer switches, MCC's, Splitters, transformers, VFD's, reactors, filters, etc. provide circuit panel designations and where fed from.

.11 Confirm and coordinate all identification with Contract Administrator and the City prior to undertaking.

2.5 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders, branch circuit wiring and neutrals.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.6 Conduit and Cable Identification

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	**Auxiliary**
up to 600 V	Yellow	Green
up to 250 V	Yellow	
Other Communication Systems	Green	Blue

2.7 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.1 Paint outdoor electrical equipment "light gray" finish.

3. EXECUTION

3.1 Installation

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 Grounding

.1 All circuits shall be installed with dedicated green insulated ground wire.

3.3 Dedicated Neutrals

.1 Each circuit shall have its own dedicated neutral wire. Shared neutral for more than 1 circuit shall not be permitted.

3.4 Area Category and Classifications

.1 Enclosures

.1 All enclosures are to be NEMA 4X rated.

.1 NEMA 3R only acceptable for the Customer Service Termination Enclosure and Metering enclosure.

3.5 Nameplates and Labels

.1 Ensure Manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.6 Conduit and Cable Installation

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.

.2 Do not mix wiring and/or cables from different panels within the same conduit runs or pull boxes. Provide equipment barriers where acceptable and where applicable.

3.7 Location of Equipment

.1 Electrical Drawings are, unless otherwise indicated, drawn to scale and approximate distances and dimensions may be obtained by scaling. Figured dimensions shall govern over scaled dimensions. Where exact dimensions and details are required, refer to Architectural and Structural Drawings.

.2 Equipment locations shown on the Drawings are approximate. Locations may be revised up to 3 m to suit construction and equipment arrangements without additional cost, provided that the Contractor is notified prior to the installation.

.3 Unless otherwise specified or shown, install products in accordance with recommendations and ratings of Manufacturer’s.

3.8 Mounting Heights

.1 If mounting height of equipment is not specified or indicated, verify before proceeding with installation. Install electrical equipment at following heights unless indicated otherwise.

.1 Panelboards: as required by Code or as indicated.

3.9 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 The space between the sleeve and the conduit shall be filled with Dow Corning silicone RTV foam for fire stop and caulked around the top and bottom with approved permanently resilient, non-flammable and weatherproof silicone base compound and ensure that the seal is compatible with the floor and ceiling finishes.

3.10 Coordination of Protective Devices

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.11 Field Quality Control

.1 Load Balance

.1 Measure phase current to panelboards with normal loads operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.2 Conduct following tests:

.1 Power generation and distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

END OF SECTION

1. GENERAL

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

1.1 Work Included

.1 General Requirements

.1 General clean-up.

.2 All inspections and obtaining all permits, licenses required by various Inspection Agencies and local regulations related to Electrical Trade.

.3 All necessary tools, equipment, and supplies.

.4 Shop Drawings.

.5 Project Record Documents (As-constructed Drawings).

.6 Operating and Maintenance Data, where specified.

.7 Take care in not damaging the surrounding trees and shrubbery.

.2 Provision of commissioning and start-up of all systems included in the Scope of Work as per Section.

.3 Supply and install electrical equipment as described and as shown on Drawings.

.4 Install and terminate cables; provide electrical connections and connect to all equiment including equipment supplied by other divisions.

.5 General

.1 Provide all cabling required making a complete and operational facility. Provide raceway systems to allow complete installation for all cables.

.2 Provide complete grounding as herein specified and indicated on the Drawings. All grounding shall comply with the Canadian Electrical Code and local amendments to this code.

.3 Provide electrical wiring, conduit and other appurtenances required to provide power connections as required from the Customer Service Termination Enclosure (CSTE) to panelboard.

.4 Provide power connections from the panelboards on the West and East side to the various items of electrical equipment, motors, instrumentation and control equipment.

1.2 Materials

.1 Bus systems including all forms of buses integral with the electrical power system, together with their associated insulation, supports, bus ducts and protective devices.

.2 Conductors, including all types of wires, conductors, cables, which form an integral part of the electrical power system.

.3 Circuit breakers of all types and for all applications associated with electrical equipment, which receives its power supply from the main, auxiliary or emergency (including battery) system.

.4 Grounding systems, as required by the Canadian Electrical Code, or as otherwise specified in the Contract.

.5 Control and instrumentation systems - electrical or electronic instrumentation systems, with auxiliary equipment and components, unless specified otherwise.

1.3 Units of Measure

.1 The following three (3) conversion methods were used in product and location dimensions:

.1 Hard Conversion: industry available products which are manufactured in metric measurements.

.2 Soft Conversion: products which are still manufactured in Imperial units and are converted in Specifications using arithmetic conversion factors.

.3 Rationalized Conversion: dimensions which are soft converted and rounded off for ease of measurements.

.2 In cases where measurements may be open for interpretation, dual dimensions have been incorporated until hard conversions can be used exclusively.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

1. PRODUCTS

1.1 Warning Tape

.1 Detectable by a pipe/cable locator or metal detector from above the undisturbed ground.

.2 Minimum 50mm wide with an aluminum foil core laminated between two (2) layers of 3.5 mil thickness polyester plastic.

.3 Plastic colour coding: red for electrical lines.

.4 A warning shall be imprinted continuously along the length, with message reading similar to: "CAUTION – BURIED ELECTRIC LINE BELOW".

.5 Typical material: Brady Detectable Identoline, Panduit Detectable Hazard Warning Tape.

2. EXECUTION

2.1 Direct Burial of Cables

.1 After sand bed specified is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable. Do not pull cable into trench.

.2 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Underground cable splices not acceptable.

.4 Maintain 75 mm minimum separation between cables of different circuits. Maintain 300 mm horizontal separation between low and high voltage cables. When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position. At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables. Maintain 300 mm minimum lateral and vertical separation for fire alarm and control, cables when crossing other cables, with control cables in upper position. Install treated planks on lower cables 0.6 m in each direction at crossings. All weather wood is not acceptable.

2.2 Field Quality Control

.1 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.2 Check each cable for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.3 Pre-acceptance tests

.1 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.4 Acceptance tests

.1 Ensure that the terminations and accessory equipment are disconnected.

.2 Ground shields, ground wires, metallic armour and conductors not under test.

.3 Leakage Current Testing

.1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.

.2 Hold maximum voltage for as specified time period by manufacturer.

.3 Record leakage current at each step.

.5 Provide the City with list of test results showing location at which each test was made, circuit tested and result of each test.

.6 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

1. PRODUCTS

1.1 Conduits

.1 Polyvinyl chloride (PVC) conduit: to CSA C22.2 schedule 40.

1.2 Conduit Fastenings

.1 One hole stainless steel straps to secure surface conduits 50 mm and smaller.

.1 Two hole stainless steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1 m on centre.

.4 Threaded stainless steel rods, 9 mm diameter, to support suspended channels.

1.3 Conduit Fittings

.1 Fittings: to CSA C22.2 No. 18.3, No. 18.4, and No. 18.5, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

1.4 Fish Cord

.1 Polypropylene.

2. EXECUTION

2.1 Conduits Underground

.1 Slope conduits to provide drainage.

.2 Waterproof joints.

1. GENERAL

1.1 References, Codes, and Standards

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables

.2 CSA-C22.2 No. 131, Type TECK 90 Cable

2. PRODUCTS

2.1 Teck Cable

.1 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, minimum size #12 AWG or as indicated.

.3 Wiring shall be 1000V insulated.

.2 Armour: interlocking aluminum.

.3 Inner jacket thermosetting PVC compound.

.4 Outer jacket of PVC material, rated -40 degrees Celsius and meeting low gas emission and FT 4 flame test requirements set forth in CSA C22.2 - No. 0.3 and IEEE 383.

.5 Fastenings:

.1 One-hole malleable iron straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables at 1,500 mm centers.

.3 Six (6) mm diameter threaded rods to support suspended channels.

.6 Connectors:

.1 Watertight, approved for TECK cable.

3. EXECUTION

3.1 General

.1 Install and rate power cables in accordance with the Canadian Electrical Code requirements.

3.2 Testing

.1 All power and control wiring shall be tested for insulation resistance value with a megger. Resistance values shall be as recommended by the cable manufacturer.

.2 All wire test results shall be properly tabulated, signed, dated, and submitted to the Contract Administrator.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide a complete system of splitters boxes and cabinets for the installation of wiring and equipment.

1.2 Shop Drawings and Product Data

.1 Submit Shop Drawings and product data for cabinets.

.2 Provide Manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

2. PRODUCTS

2.1 Splitters

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A

2.2 Splitters, Junction Boxes, Cabinets, and Pull Boxes – Wet locations, Category 2 or Weatherproof

.1 NEMA 4X Rated.

.2 Materials:

.1 Stainless steel.

2.3 Splitters, Junction Boxes, Cabinets, and Pull Boxes – Indoor Dry Locations, Category 1

.1 NEMA 1

.2 Materials:

.1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.

.3 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes.

.4 Junction boxes mounted in exterior walls shall be complete with box vapour barriers.

2.4 Cabinets

.1 Materials:

.1 Locks: to match panelboards.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.

.2 Install a back mounting plate for DIN rail mounted terminal blocks. Plate to be painted white enamel.

.3 Install metal divider in cabinets with more than one voltage.

.4 Surface or flush with trim and hinged door, latch and lock and two (2) keys, size as indicated or to suit. Keyed to match panelboard keys 19 mm.

3. EXECUTION

3.1 Splitter Installation

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction Boxes and Pull Box Installation:

.1 Supply all pull boxes and junction boxes shown on the Drawings or required for the installation.

.2 Boxes installed in party walls to be offset by a minimum of one stud space.

.3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

.4 Identify with system name and circuit designation as applicable.

.5 Size in accordance with the Canadian Electrical Code, as a minimum.

.6 Terminate cables and conductors as required and use water tight connectors where necessary.

.7 Make all necessary cable entry holes in junction boxes supplied by Contractor or others, regardless of material.

3.3 Cabinet Installation:

.1 Mount cabinets with top not greater than 1,980 mm above ground.

.2 Install terminal block where indicated.

3.4 Identification

.1 Provide equipment identification in accordance with Section 16010 Common Work Results for Electrical.

END OF SECTION

1. GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.65, Wire Connectors.

1.2 Classification and Category

.1 Refer to Section 16010.

2. PRODUCTS

2.1 Materials

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable, aluminum sheathed cable, flexible conduit, non-metallic sheathed cable as required to: CSA-C22.2 No.18.3, 18.4 and 18.5.

3. EXECUTION

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by Manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide disconnect switches for 120/240V and 120/208 V distribution as indicated on the Drawings.

1.2 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6, Industrial Control and Systems: Enclosures

1.3 Classification and Category

.1 NEMA 4X.

2. PRODUCTS

2.1 Disconnect Switches

.1 Ratings: 240 V for 120/240V and 120/208V distribution. 3 pole, and solid neutral for 3-phase 4 wire distribution. Ampere ratings as shown on the Drawings.

.2 Enclosures: hinged doors, external operating handles. Provide ON-OFF switch position indication on switch enclosure cover.

.3 Finish: one (1) primer coat and one (1) finish coat on all metal surfaces, colours as per Section 16010.

.4 Switch mechanisms: quick-make and quick-break action with self-wiping contacts, solderless pressure lug connectors. Provide for padlocking disconnect switches in OFF position. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle in ON position.

.5 Neutral Bars: where distribution system has grounded neutral conductor, provide neutral bar where required with ampere rating equal to switch rating, in enclosure. Provide ground bar for terminating ground conductors.

.6 Fuse Holders: provide fuse holders (relocatable and suitable without adapters) on load side of switches, ampere rating equal to switch ratings, suitable for fuses specified.

.7 Approved Manufacturers:

.1 Eaton

.2 Schneider Electric

.3 Siemens

2.2 Fuses

.1 All fuses to be 100,000A (minimum) interrupting capacity of the current limited type. In addition, fuses feeding motors to be of the time delay type. Provide one (1) full set of spare fuses, three (3) for each different ampere rating used, stored in suitable enclosure.

3. EXECUTION

3.1 Disconnect Switches

.1 Mounting: provide supports independent of conduits. Wall-mount where possible, otherwise provided 41 mm square strut channel frame support. Where switches are grouped mount in uniform arrangement.

.2 Wiring: connect line and load cable to all switches.

.3 Fuse Rating: install so that rating is visible.

.4 Identification: provide lamacoid plate in accordance with Section 16010, on each switch showing voltage, source of supply and load being fed, for example:

.1 Door Controller

.2 120/208 V

.3 Fed from PPA

.5 Nameplate: Size 3

END OF SECTION

1. GENERAL

1.1 Description

.1 Supply and install a complete grounding systems shown in the Drawings. Securely and adequately ground all components of the electrical system in accordance with the requirements of the latest edition of the Canadian Electrical Code and amendments in the Manitoba Electrical Code.

.2 The system is to consist of cables, supports, and all necessary materials and inter-connections to provide a complete system. Measured resistance to ground of the network shall not exceed 5 ohms.

1.2 References

.1 American National Standard Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding

2. PRODUCTS

2.1 Equipment

.1 Rod electrodes: copper clad steel, 19 mm dia by 3 m long.

.2 Plate electrode: copper surface area 2 m^2, 2 mm thick.

.3 Cables 2/0 and smaller to be connected to ground bars via Type QA-2B. Connections for cables larger than 3/0 shall be brazed.

.4 All ground wires to be stranded copper TWH complete with a green jacket unless otherwise shown.

.5 Uninsulated ground wires shall be bare stranded copper, soft annealed. Size as indicated.

.6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps

.3 Bolted type conductor connectors

.4 Bonding jumpers, straps

.5 Pressure wire connectors

3. EXECUTION

3.1 General

.1 Install complete permanent, continuous grounding system, including conductors, accessories. All connectors shall be installed in accordance with Manufacturers' requirements. All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded via a ground wire.

.2 All bolted connections must be accessible.

.3 Use compression connectors for all grounding splices and terminations unless otherwise shown on the Drawings.

.4 Ground all utility services to the electrical system ground.

.5 Protect exposed grounding conductors from mechanical injury.

.6 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.7 Soldered joints shall not be permitted.

.8 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.9 Install electrical room ground bus to wall as indicated, utilizing insulated off sets.

3.2 System and Circuit Grounding

.1 Install system and circuit grounding connections to neutral of secondary systems.

3.3 Field Quality Control

.1 Perform tests in accordance with Section 16010.

.2 Perform ground continuity and resistance tests using method appropriate to Site conditions and to approval of Contract Administrator and local AHJ over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6, Industrial Control and Systems: Enclosures.

1.2 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 16010.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

2. PRODUCTS

2.1 Panelboards

.1 Panelboards: Product of one Manufacturer.

.1 Manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 Enclosure:

.1 NEMA 4X.

.3 Panelboards: bus and breakers rated for 250 V to be 18kA, (symmetrical interrupting capacity). Series rated breakers not acceptable.

.4 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.6 Two (2) keys for each panelboard and key panelboards alike

.7 Tin plated Copper bus with neutral of same ampere rating as mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked grey enamel.

.11 Transient voltage surge suppressor surge protection – bus connected.

.12 Lockable.

2.2 Breakers

.1 Breakers: refer to Section 16477.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.3 Equipment Identification

.1 Provide equipment identification in accordance with Section 16010.

.2 Nameplate for each panelboard Size 4 engraved as indicated.

.1 Panel on West side to be labelled as “Panel W”, along with the required voltage, amperage, etc. labelling.

.2 Panel on West side to be labelled as “Panel E”, along with the required voltage, amperage, etc. labelling.

.3 Nameplate for each circuit in distribution panelboards Size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit, include holder, clear protective cover and removable directory.

2.4 Acceptable Manufacturers

.1 Eaton

.2 Square D (Schneider Electric)

.3 Siemens

3. EXECUTION

3.1 Installation

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Mount panelboards to height specified in Section 16010.

.3 Connect loads to circuits.

.4 Connect neutral conductors to common neutral bus with respective neutral identified.

END OF SECTION

1. GENERAL

1.1 References

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6, Industrial Control and Systems: Enclosures

1.2 Product Data

.1 Submit product data in accordance with Section 16010.

.2 Include time-current characteristic curves for breakers with minimum symmetrical (rms) interrupting capacity as shown at system voltage.

2. PRODUCTS

2.1 Breakers General

.1 Bolt-On Moulded Case Circuit Breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.

.2 Common-Trip Breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from three (3) to eight (8) times current rating.

.4 Circuit breakers with interchangeable trips as indicated.

.5 Add Electronic trip unit with adjustable settings to meet co-ordination study requirements where applicable or as shown on the Drawings.

2.2 Thermal Magnetic Breakers

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 Magnetic Breakers

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 Moulded Case Switch

.1 Moulded case switch shall be complete with a high instantaneous magnetic fixed trip, factory set to trip at high fault currents.

2.5 Enclosure for Individually Mounted Breakers or Moulded Case Switch

.1 Enclosure shall be CSA code gauge galvanized steel, hinged door, front mounted external operating handle, lockable in “off” position.

.2 Where distribution system has grounded neutral conductor, provide neutral bar, with ampere rating equal to breaker/switch rating in enclosure.

.3 Classification and Category: Refer to Section 16010.

3. EXECUTION

3.1 Installation

.1 Install circuit breakers as indicated on Drawings and specified herein.

.2 Install circuit breakers in panelboards to satisfy branch circuit requirements under the Scope of Work of this Contract.

.3 Identification: Provide lamacoid plate on each breaker showing voltage, source of supply and load being fed - 120/208 V, 3-phase, 4W or 3W as appropriate.

END OF SECTION

1. GENERAL

1.1 Coordination

.1 Coordinate starting of electrical equipment and systems with testing, adjusting, and balancing, and demonstration and instruction of:

.1 Electrical equipment and systems specified in Division 16.

.2 Other equipment and systems specified in other Divisions.

.2 Where any equipment or system requires testing, adjusting or balancing prior to starting, ensure that such Work has been completed prior to starting of electrical equipment and systems.

2. PRODUCT (NOT USED)

3. EXECUTION

3.1 Energizing Electrical System

.1 Prior to energizing the new electrical system:

.1 Verify supply authority voltage and phase rotation.

.2 Close and open all devices to ensure proper mechanical operation.

3.2 Energizing Equipment

.1 Prior to energizing equipment provided under other Sections and equipment provided by the Contract Administrator, confirm equipment nameplate with characteristics of power supply.

END OF SECTION

1. GENERAL

1.1 Scope of Work

.1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.

1.2 Section Includes

.1 Commissioning of all electrical systems and component including:

.1 Testing and adjustment.

.2 Demonstrations and Instruction.

.3 Instructions of all procedures for City personnel.

.4 Updating as-built data.

.5 Co-ordination of Operation and Maintenance material.

1.3 Commissioning

.1 The purpose of the commissioning process is to fully test all systems, electrical components and operating procedures by challenging these systems to realistic operation conditions.

.2 The commissioning activities shall be co-ordinated by the Contractor.

.3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.

.4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the commissioning exercise.

.5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification.

1.4 Submittals

.1 A commissioning document shall be prepared by the Contractor and issued to Contract Administrator two weeks prior.

.2 The electrical Subcontractor shall be responsible for ensuring all activities are properly documented in this manual and coordinated through the Contractor.

.3 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the Contract Administrator prior to the start of the commissioning activities.

1.5 Preparation

.1 Provide test instruments required for all activities as defined in the commissioning documents.

.2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.

.3 Confirm all scheduled activities have identified personnel available.

.4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

1.6 System Description

.1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.

.2 The City will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

.3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.

.4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.5 Conduct presentation on the City's premises. The City will provide space.

1.7 Final Report

.1 This trade shall assemble all testing data and commissioning reports and submit them to the Contract Administrator.

.2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Supply and install a complete instrumentation and control system as shown on the drawings and as specified herein.

.2 Responsibility shall include supply and installation of all component sub-systems so as to provide a functioning system including supervision, calibration, checkout, start up, documentation and development of control diagrams.

.3 Component sub-systems shall include:

.1 Primary elements and transmitters

.2 Instrumentation and control field devices

.3 Supply, installation, and connection of the data logging devices, instrumentation components and related devices.

.4 Conduit, cabling, and interconnections

.5 Instrumentation power supplies.

.4 Provide complete and continuous perimeter metal construction fencing around each entire work sites at a minimum height of 4 feet for the duration of the construction and commissioning.

.1 Fence units shall be securely linked together to prevent unauthorized access.

.2 All fence doors shall be lockable. The site shall be locked when the contractor or authorized personnel by the contractor are not on the site.

.3 Fencing shall not be unnecessarily routed such as to cause minimal intrusion on the surrounding area.

.4 Repair any damage caused by the fencing within 10 business days of removing the fencing.

.5 Fencing shall not be removed until after commissioning and when only after direction by the City or the Contract Administrator. The Fencing shall be removed within 10 business days after given direction by the City or the Contract Administrator.

.5 Documentation referred to shall include:

.1 Equipment installation, operation/maintenance manuals, and recommended spare parts lists

.2 Schematics, interconnecting wiring diagrams (including conductor identification and field terminals) and motor control schematics where applicable

.3 Detailed instrument loop diagrams, including loop number, conductor and terminal identification, and PLC input/output addressing. The instrument loop diagrams shall be based on the typical diagrams in section 17702. The typical drawings provided are intended to show the quality and style of the work required, they are not to be considered as working drawings.

.4 Instrumentation and Control Panels shop drawings, face layouts, schematics, point-to-point wiring diagrams, and related documents.

.5 As-built drawings of the complete instrumentation system

.6 Provide a list of suggested spare parts and where to purchase. Documentation shall be kept current throughout project up to and including "As-Built" stage. Documentation to be included in maintenance manual at "As-Built" stage.

1.2 Qualifications

.1 The instrumentation contractor shall be a firm normally engaged and fully competent in this type of work. The firm shall have been continuously engaged in this business for at least five years.

.2 The firm shall show that it maintains a fully equipped and qualified organization in Manitoba, capable of performing the present work and of providing prompt service to the system after installation.

.3 All instrument hook-ups, calibrations, verifications and checkouts shall be performed by qualified Journeymen Instrument Mechanics who are familiar with the devices being installed.

.4 120 Volt control wiring installation and connections shall be performed by qualified Journeymen Electricians.

1.3 Receiving, Storing and Protection During Construction

.1 Examine each component upon delivery to site. Report any damage to the Contract Administrator prior to accepting delivery. Receive all instrumentation primary elements and control components, panels, etc. into secure, dry, heated storage building. Maintain space temperature above 10°C.

.2 Keep covers properly installed on all equipment. Provide covers, padding, guards, etc. as required to guard against damage to finish, proper operation, or life expectancy.

.3 Any equipment damaged shall be returned to the factory for total corrective repairs. If deemed necessary by the Contract Administrator, the damaged equipment shall be replaced with a new product.

1.4 Inspection

.1 Demonstrate proper calibration and correct operation to the Contract Administrator.

.2 Upon completion of testing of each device, affix a tag to the instrument certifying that calibration and testing have been completed and specifying the calibration points.

2. PRODUCTS

2.1 Control Devices

.1 Push buttons, pilot lamps, and selector switches shall be heavy duty oil-tight, Allen Bradley 800T or approved equal.

.2 Pilot lights shall have long life LED lamps, complete with appropriate colour lenses, Allen Bradley 800T or approved equal.

.3 Elapsed time meters shall be non-reset, 5 significant figures.

.4 Control relays shall be Omron, Type MY, or approved alternate, 120 volt, 3 amp minimum, 4 pole double throw, plug-in complete with test button and neon indicator light. Where possible, all control relays shall be identical and interchangeable.

.5 Plug-in sockets shall be for track mounting, compact with stacked, screw clamp terminals.

.6 Time delay relays, Omron H3CA or approved alternate, 120 volt, plug-in, complete with adjustable time delay. Range shall be selected to best suit job requirement. Sockets shall be for track mounting, with screw clamp terminals.

.7 Alarm buzzers for control panels shall be Sonalert or equal, rated 120 VAC and 65-70 dBA.

2.2 Enclosures

.1 All enclosures for shall be EEMAC Type 4X, except where otherwise specified. Use prefabricated Hammond or Hoffman enclosures where possible.

.2 Wiring, ducting, instruments, and equipment must be arranged for convenience of maintenance. All terminals and calibration adjustments must be accessible.

.3 All incoming and outgoing instrument and control wiring shall be terminated on terminal blocks, Wiedmuller “Sak” series or equivalent. Provide 20% spares of each type of terminal block used.

.4 Insulation sleeves shall be used at connectors, sockets, and terminals where the possibility of “shorts” exist.

.5 25 mm lamacoid nameplates shall be provided, for each device on or within the panels.

.6 Nameplates shall include the device tag number, a description of the function of the device, the power circuit, and panel number.

.7 Nameplates shall be securely fastened to the panels with screws or rivets. All tags must be permanent and placed in a visible location within the panel.

.8 Wiring inside panels shall be a minimum of #18 AWG tinned stranded copper; insulation rated at 300 V.

.9 Wiring for power distribution shall be a minimum of #12 AWG tinned stranded copper; insulation rated at 600 V.

.10 Each wire must be tagged at both ends with a heat shrink sleeve or self-laminating adhesive marker that is machine printed with indelible ink.

.11 Wiring systems with different voltage levels or types must be suitably segregated within the panel.

.12 All wiring shall be run in enclosed plastic wireways such as Panduit. Wireways shall be sized so that the total cross sectional area of the insulated wire and cable does not exceed 40% of the cross sectional area of the wire.

.13 A minimum clearance of 50 mm shall be provided between wireways and any point of wire termination.

.14 Firmly bond all panel-mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

.15 The Contractor shall determine the power supply requirements of all instruments and provide power supplies as required with voltage and current ratings to suit the equipment and the circuit. Power supplies shall be dual-redundant type with failure indication and Form C trouble contacts. Trouble contacts shall be wired to a discrete input on the control device.

.16 Provide a dedicated ground conductor for the instrumentation circuits, connected directly to the point of neutral creation in the power system with an insulated grounding conductor.

.17 Provide a duplex convenience receptacle in each control panel.

.18 The panels must bear approval from the C.S.A. and/or local inspection authority.

.19 Layout and design the panels to provide a well organized, uncluttered arrangement. Size each control panel to accommodate all of the equipment and components referred to in the specifications and drawings, provide 20% spare capacity in each panel for future expansion unless otherwise specified.

3. EXECUTION

3.1 Equipment Mounting

.1 All mounting plates, junction boxes, pedestals, bolts, shims, angle iron and other miscellaneous steel or hardware items required for the securing of equipment shall be supplied by the Contractor unless specifically noted otherwise.

.2 Equipment locations shown on drawings are approximate. Actual location of equipment can vary up to 3 m to provide good access for inspection and maintenance.

.3 Where instruments are grouped, supply a 6 mm thick aluminum backplate, sized to provide adequate room for mounting of all accessories, i.e. disconnect switches, receptacles, etc. Rigidly mount from unistrut fabricated floor stands with additional wall or ceiling supports as required.

.4 Support instruments independent of process pipes and vessels, except where otherwise indicated.

.5 Orient all field indicators such that an operator standing on floor level may read them.

3.2 Wire and Cable

.1 Provide wire, cable, and conduit systems in compliance with Division 16 Electrical.

.2 For 120 VAC control and interlocking, use wire and conduit indoors and multi-conductor TECK cables outdoors or buried.

.3 For analog signals use armored instrumentation cables with twisted and shielded pairs of #18 stranded wire.

.4 Provide spare conductors/pairs in all TECK cables and instrumentation cables. Minimum of six (6) conductors / one (1) pair spares.

3.3 Tubing and Fitting Installation

.1 Tubing shall be installed to avoid interference with access to other equipment.

.2 Tubing installations shall slope 20 mm per 2 m of run down to process connection, unless otherwise indicated.

.3 The distance between tubing supports shall not exceed 1 m.

.4 All turns shall be field bent with minimum bending radius of 50 mm.

.5 Non-terminal connections in tubing runs shall generally be avoided.

.6 Teflon tape shall be used on all threaded fittings. Do not apply tape on the first two threads.

.7 Tubing shall terminate at devices with fittings or 90° bends, to allow removal of tubing without disturbing the device mounting.

3.4 Equipment Connections

.1 Prior to the connection of signal wiring to process control and instrumentation devices, the device voltage and current rating and polarity shall be checked for compatibility with the corresponding loop and/or schematic diagram. Where device and circuit characteristics are incompatible, the connection shall not be made and the condition shall immediately be reported to the Contract Administrator.

.2 All control wiring diagrams illustrate typical control circuits applicable to the equipment. Control circuits may vary with different manufacturers of equipment. Verify all control circuits with the suppliers of the equipment, and interposing relays and make any corrections that may be required.

.3 Drill all required holes through walls, floors, etc., as required to make connections to equipment and control panels.

3.5 Testing of Instrumentation Loops

.1 After all devices within a loop have been connected, the loop shall be checked for correct functioning and interaction with other loops.

.2 All test results shall be properly recorded on loop certification sheets and instrument test reports (copy supplied to successful bidder).

.3 Operation of final control elements such as solenoid valves, actuators, etc. shall first be checked by manual control.

.4 All tubing shall be tested for leaks. Instruments shall be isolated when tubing is being tested to protect against over pressure.

.5 Test reports shall be signed and dated and shall be submitted to the Contract Administrator within five (5) working days of testing.

3.6 Calibration

.1 Instruments shall be set up, calibrated, and verified as installed by a certified Journeyman Industrial Instrument Mechanic.

.2 Calibrate and verify the installation all instrumentation.

.3 Calibrate and verify the installation of all flow meters by a verifying the level reading against a separate, reliable measurement and verifying the velocity profile against a separate, reliable measurement. Verify the flow calculation produced by the level and velocity profiles.

.4 Calibrate and verify the installation of all ultrasonic level detectors in place by actual variation of water levels.

.5 Calibrate and verify the installation of all panel indicators using an accurate current source.

.6 Position, calibrate, and verify the antenna installation to ensure a reliable reception and connection to the McPhillips SCADA.

.7 All instruments shall be calibrated to an accuracy of 0.5% of full range, or to the accuracy specified in the specification sheets included herein, whichever is greater.

.8 Instruments shall be factory pre-calibrated. Final calibration shall be verified in place. Allow for field recalibration of instruments (once only per instrument) to adjust instruments to optimum performance.

3.7 Commissioning

.1 Commissioning of the instrumentation and control system shall include but not be limited to the following:

.1 Installation of components, wiring connections and piping connections.

.2 Execute wiring continuity and pipe leak tests.

.3 Perform instrument calibrations and provide written reports.

.4 Demonstrate to the City and the Contract Administrator full functionality of the entire specified system including accurate instrument measurement, reliable communication to the McPhillips SCADA, and proper monitoring and alarming.

.5 Function check and adjust under operational conditions the Instruments and Control System.

.6 Coordinate Instrument and Control Equipment supplier's service personnel as required for complete system testing.

.7 Instruct plant personnel in correct method of operation of instruments and control equipment.

.8 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant.

.9 Ensure that the instrumentation and control equipment suppliers cooperate to complete the work of this section.

.10 Verify signal levels and wiring connections to all instrumentation and control equipment.

.11 Submit a "Loop Check Sheet" for each loop and an "Instrument Calibration Sheet" for each device. Include all completed forms in the O & M manuals.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 This Section describes the operation of the proposed process systems to be included in the work. The work consists of:

.1 Two new monitoring systems including flowmeter, controller and control panel, and antenna system.

2. PRODUCTS

2.1 Process Equipment Numbering

.1 The process equipment, piping, and valves have been numbered for identification, and are as shown in the specifications.

.2 All equipment shall be tagged accordingly.

3. EXECUTION

3.1 Monitoring Stations

.1 All process data, alarms, and derived alarms from both monitoring systems shall be communicated through the cellular antenna to the McPhillips collections SCADA system and verified with the City through I/O checks, simulating all scenarios, and testing all scenarios.

.2 All communication to the McPhillips collections SCADA system shall be with DNP3. Before commissioning provide a DNP3 map of all points (signals and internal states/alarms) being communicated.

.3 All signals out of operating ranges shall result in an alarm to the McPhillips collections SCADA system identifying the signal.

.4 All signal values shall be sent to the McPhillips collections SCADA system when the value changes by the threshold the City choses during commissioning. If any signal value does not change greater than this threshold in 1 minute, that signal shall be resent to the McPhillips collections SCADA system such that every signal is sent at least every minute at a minimum.

.5 Local indication should be programmed to read water level in meters, velocity in meters per second, and flow in cubic meters per second.

.6 The local controller shall alarm for reduced quality of data if:

.1 The Upstream East monitoring system shall create an alarm at water levels at and above 220.68 m indicating that the high water level may reduce the measurement quality.

.7 The local controller shall alarm for unreliable data if:

.1 The East monitoring level is at or above 221.27 m (approximate centerline depth of 1.5 m). Value to be confirmed at commissioning.

.2 The East monitoring level is at or below 220.07 m (approximate centerline depth of 0.3 m). Value to be confirmed at commissioning.

.3 The West monitoring level is at or above 218.45 m (approximate centerline depth of 1.75m) or the elevation where the slot opening in the crown of the pipe intersects the pipe wall, whichever is lower. Value to be confirmed at commissioning.

.8 The following is for reference only and to be programmed at the McPhillips SCADA by the City. All other programming to be done by the Contractor:

.1 After one (1) month of operation, provide AECOM with the collected data associated with the monitoring stations. This data will be used to adjust alarm conditions as needed.

.2 Measurement A is the real time total flow volume over the 24 hour period between 6 am to 6 am at the Upstream East monitoring station. Measurement B is the real time total flow volume over the 24 hour period between 6 am to 6 am at the Downstream West monitoring station.

.3 The McPhillips monitoring SCADA shall be programmed to alarm if measurement A and measurement B differ by more than 10%.

.1 If in the past 24 hours there is unreliable data as per 3.1.7, measurement times for that data should be omitted from the calculation of the total flow volume for both locations.

.1 The unreliable data should be maintained in the full time series of the collected data. This unreliable data alarm should be included in data dumps so reviewers know that the data at these times is unreliable.

END OF SECTION

1. GENERAL

1.1 Scope of Work

.1 This Section describes the requirement for field services required to place, install, wire, connect, test, verify and document the installation of all components and related training.

.2 Provide all labour, equipment and materials required for the installation, testing and commissioning, and start-up of the data logging systems.

.3 Cooperate and coordinate with the City, the SCADA system integrator, and other contractors to fully test and commission all components of the SCADA system complete back to the McPhillips collections monitoring station.

.4 Provide network connections and power supply connections, from the electrical distribution panels for all equipment requiring power.

.5 West of the Red River monitoring:

.1 Supply, install, connect, and commission a flowmeter located in the NE Interceptor line. The flowmeter is to be connected to the control panel for monitoring.

.2 Supply, install, connect, and commission a heated power and control panel on cement pads for monitoring the flow.

.3 Supply, install, connect, and commission acellular antenna system, including an external antenna and antenna surge protector, for transmitting data to the McPhillips collections monitoring station.

.4 All signals, alarms, and derived alarms shall be communicated to the McPhillips collections monitoring station.

.5 Provide and install all required components required to make a complete functional system.

.6 East of the Red River Monitoring:

.1 Supply, install, connect, and commission a flowmeter located in the NE Interceptor line. The flowmeter is to be connected to the control panel for monitoring.

.2 Supply, install, connect, and commission a heated power and control panel on cement pads for monitoring the flow.

.3 Supply, install, connect, and commission a cellular antenna system, including an external antenna and antenna surge protector, for transmitting data to the McPhillips collections monitoring station.

.4 All signals, alarms, and derived alarms shall be communicated to the McPhillips collections monitoring station.

.5 Provide and install all required components required to make a complete functional system.

.7 All work shall meet the Canadian Electrical Code.

.8 Coordinate the installation of equipment with the Division 16.

.9 Coordinate the field instrumentation requirements with other Divisions.

1.2 Submittals

.1 Submit the proposed forms for documenting the checkout and verification phases of all of the work.

1.3 Qualifications

.1 Provide a qualified factory authorized field-service representative for the installation and set-up of new equipment.

.2 For installation of field raceways and wiring use qualified trades people.

2. PRODUCTS

2.1 Equipment and Materials

.1 Provide all equipment and materials necessary for the un-loading, handling, placement, installation and testing of all control system equipment.

3. EXECUTION

3.1 Installation

.1 Provide for the off-loading and placement of all equipment in the field.

.2 Inspect equipment for mechanical and electrical damage prior to shipping, arrival at Site, during unpacking and after final placement of equipment. Replace or repair any damaged equipment to the satisfaction of the Contract Administrator.

.3 Prepare damage reports and make all claims against the carrier.

.4 Provide adequate protection for the equipment after installation. Do not install equipment in locations that are not sufficiently complete to maintain the proper environmental conditions for the equipment.

.5 Certify in writing that equipment has been installed as per Drawings and recommended installation procedures. Report any discrepancies to the Contract Administrator.

.6 Provide and install the AC power supply from the distribution panels and connect to systems ground for the equipment. Certify in writing that equipment power and grounding requirements have been satisfied. Report any discrepancies.

.7 Certify in writing that field wiring is properly installed and correctly identified. Report any discrepancies to the Contract Administrator.

.8 Make adjustments necessary to place equipment in trouble-free operation. Submit any amendments to calibration certificates to the Contract Administrator.

.9 Certify that the system is ready for field testing.

.10 Update and submit to the Contract Administrator the As-Built Drawings and CAD files for the installed systems.

END OF SECTION

1. GENERAL

1.1 General Requirements

.1 Design, supply, and installation of new programmable logic controller (PLC)-based control systems for the NE Interceptor East monitoring location and NE Interceptor West monitoring location in accordance with the requirements of these Specifications and associated Drawings.

.2 All control system equipment including PLCs, Input/output (I/O) sub-systems, network switches, media converters, power supplies, and related ancillary items shall be housed in control panels.

.3 Software programming and integration of new PLC systems with the McPhillips Monitoring Station are to be provided under this Contract.

.4 Cooperate with other contractor(s) and the Contract Administrator and provide start-up and commissioning services for the complete control system and associated field devices and wiring.

.5 All required software licenses and associated programs created or used for the work shall be provided to the City.

.6 Allow for one return trip, if required, to make adjustments to the PLC systems.

2. PRODUCTS

2.1 Programmable Logic Controllers

.1 General:

.1 All new PLC equipment shall be based on Schneider M580 family of products.

.2 All new processors are to be adequately sized to provide sufficient memory and processing capacity to handle the I/O, logic, communications, antenna requirements, and data requirements typical of a modern, fully automated facility and for the defined I/O mix.

.3 Communication for the PLC network is Ethernet over copper and/or Fiber as indicated on the Drawings.

.4 Provide at least 20% (minimum 10) spare I/O of each type to each panel assembly.

.5 Provide all necessary racks, power supplies, cables, communication cards, and accessories.

.1 Provide NOR communication card set up for DNP3.

.6 Each new PLC panel assembly is to include a constant voltage regulating transformer suitably sized for the panel load equal to Sola Hevi-Duty MCR series and incoming power transient surge suppression equal to Sola Hevi-Duty STV100K series. Connect the surge suppressor dry contacts to a PLC input at each panel and notify the control system integrator/programmer.

.7 Provide all run-time licenses necessary for the operation of the new PLC and HMI installations.

.2 Each PLC installation shall be accompanied by an Ethernet switch.

.1 Industrial Ethernet Switch 12 port RJ-45

2.2 PLC Programming Guidelines

.1 These programming guidelines exist for the purpose of allowing maintainable programs to be developed and to facilitate the implementation of reliable control systems. All applications have unique properties and all programs therefore cannot be identical. These guidelines are intended as an aid to keep program structure consistent throughout.

.2 The guideline in no way is to inhibit innovative ideas, new engineering applications or methods by the Vendors. Obtain approval from the Contract Administrator prior to deviations from the guidelines. Comprehend the requirements of all existing equipment and systems and the equipment and systems supplied under other contracts and ensure the programming design and concepts reflect the specifications.

.3 Break programs up into multiple program files to provide better program organization. Program file lengths will be determined by the individual process systems. Generally, program files should be less than fifty (50) rungs in length.

.4 Locate program file breaks at logical breaks in the process.

.5 Make use of standard function blocks for repetitive applications in the process (e.g., motor starters and valve controls).

.6 Non-control program files to reside as the last files and may including the following:

.1 Diagnostic Files: Network, Input/Output (I/O), debugging, and system health.

.2 Calculations

.3 Data Block Transfers.

.7 Schedule non-control program files on a time or event basis in order to minimize scan times, if they are not required to run continuously.

.8 Other control program files may include: Fault routine for orderly shutdown or power-up; Selectable Timed Interrupt file – use only when necessary and ensure the interrupt time selected is longer than the scan time of the interrupt file.

.9 Any parameter passing between program files shall be explicit in the logic.

.10 Avoid indirect and indexed addressing where possible.

.11 Avoid CMP, CPT, MCR and Zone control type instructions.

.12 “Most likely to be false” instructions should be left-most on rungs in order to minimize scan times.

.13 Do not use latched (OTL) instructions on output rungs except where status must be retained on power outage.

.14 Do not exceed display size for control rungs—with descriptors/symbols ON and rung comments OFF. Rungs must be printable on one page.

.15 Minimize the number of intermediary (store) points.

.16 Diagnostic rungs to be a minimum 10% of program size and include, but not be limited to, reporting of I/O rack status, I/O module status, communication status, communication faults and processor battery low indication.

3. EXECUTION

3.1 Performance – General

.1 Refer to Section 17010 and 17500.

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 configuration of the control system including details for all hardware.

.3 Program the new control system to provide all existing functionality and new functionality generally as described in the Process Control Narratives and to satisfy plant operations requirements. Demonstrate correct functioning of all new and modified PLC programs to the City and contract administrator. Progress payments will not be approved for programming work that has not been demonstrated and approved.

.4 Carefully coordinate all required plant shutdowns with the City and the contract administrator well in advance of the work and provide specified notifications.

.5 Commission and start up the system as defined herein.

.6 Provide all documentation and training as defined herein.

END OF SECTION

1. GENERAL

1.1 References

.1 Section 17010.

2. PRODUCTS

2.1 General

.1 Provide exterior finishes on all enclosures in ANSI 61 Gray. Interior shall be finished in white.

.2 The enclosures to be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warping, sagging, or distortion.

2.2 Enclosures

.1 All enclosures are to be NEMA 4X and include hazardous area approvals for classified areas.

.2 All enclosures shall be tamper proof.

.3 All enclosures shall have a heater controlled by a thermostat to keep the temperature in the enclosure above 10^{o} Celsius.

.4 All enclosures shall have cooling fans to prevent the internal equipment from overheating.

2.3 Panel Enclosures

.1 Fabricate panel enclosures from 11-gauge steel panels complete with necessary stiffening to form a rigid free-standing line-up. The structures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors. Provide back mounting plate or equivalent, removable top and bottom cable entry plates.

.2 Provide panels with front access only. Doors to be key lockable and fitted with 3-point heavy duty latching assemblies. Provide a continuous piano style hinge and a pneumatic hold open device on each door.

.3 Provide a switched fluorescent light fixture and 120 VAC duplex convenience receptacles inside the enclosure.

2.4 Marshalling and Control Panels

.1 Supply, fabricate, check out, document, and deliver to site fully equipped and functional panels.

.2 Supply all components contained on or within the panels fully wired.

.3 Provide all accessories, materials and methods for fabrication not covered by this Specification, but which are necessary to complete the fabrication of the control panels.

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 Refer to Division 16 for cable routing requirements.

.2 Tag each wire at both ends with machine printed heat shrink sleeves.

.3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, as per the CEC.

.4 Run all wiring in enclosed plastic ducts such as Panduit or approved equivalent. Size all ducts so that the total cross-sectional area of the insulated wire and cable does not exceed 40% of the cross-sectional area of the duct.

.5 Provide a minimum clearance of 40 mm between ducts 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 (1, 2, N, G), appended to it. Wires to be identified as follows:

.1 Wire identification to use the connected field device tag name with the wire's associated terminal number appended to it (e.g. LSH-3021-5).

.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 Identify spare wires by using the destination identifier, i.e. the location and terminal identifier of the opposite end of the wire are combined to form the wire tag.

.7 Provide a 120 VAC power distribution system and DC power distribution systems in each panel as required for installed equipment. 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 fused disconnect type terminal blocks Wiedmuller or equivalent to isolate field wiring that is powered from the panel.

.9 Provide sufficient terminals so that not more than 2 wires are connected under the same terminal. Provide 20% spare terminal capacity at each terminal block assembly.

.10 Terminals to be Wiedmuller or equivalent, colour coded to be consistent with existing.

.11 Provide nameplates for each device on or within the panels and enclosures. Nameplates to be white lamicoid with black lettering with a minimum size of 25 mm x 75 mm with up to

three lines of 3 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 marshalling panel.

.2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.

.3 Provide in each marshalling panel an isolated copper grounding busbar 6 x 25 x 600 mm, equipped with necessary lugs for accepting two #2 AWG grounding conductors.

.4 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

3. EXECUTION

3.1 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

1. GENERAL

1.1 Product Data

.1 Submit product data in accordance with Division 1.

1.2 Standards

.1 All wire and cable shall be UL approved and conform to CEC and IEC standards.

2. PRODUCTS

2.1 Shielded Twisted Pair Cables (STP)

.1 STP cables shall be constructed as follows:

.2 Single pair copper conductors, stranded, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm.

.3 Insulated for 300 V, 105°C.

.4 Shield to be aluminium foil or tape; 25% overlap providing 100% coverage when flexed.

.5 Separate bare stranded copper drain wire, minimum #22 AWG.

.6 Outer jacket shall be 90°C flame retardant and sunlight-resistant PVC.

.7 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.

.8 Aluminium Interlocking Armour or equivalent (where required).

.9 Thermo Electric Instrument cable, Belden cable or equivalent.

.10 Where multi-conductor STP 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 Shielded Cable

.1 RTD cables shall be UL approved and shall be constructed as follows:

.1 Single Triad copper conductors, stranded, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm.

.2 Insulated for 300 V, 105°C.

.3 Shield to be aluminium foil or tape; 25% overlap providing 100% coverage when flexed.

.4 Separate bare stranded copper drain wire, minimum #22 AWG.

.5 Outer jacket shall be 90°C flame retardant and sunlight-resistant PVC.

.6 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.

.7 Aluminium Interlocking Armour or equivalent (where required).

.8 Thermo Electric Instrument cable or equivalent.

2.3 Teck Cables

.1 As specified in Division 16.

2.4 Wire

.1 As specified in Division 16.

3. EXECUTION

3.1 Analog Signals

.1 Use STP cable for all low level analog signals such as 4-20 mA, 1-5 VDC, 0-10 VDC, pulse type circuits 24 VDC and under, and other signals of a similar nature.

.2 Use RTD cable for connections between RTDs and transmitters or PLC RTD inputs.

3.2 Digital Signals

.1 Use STP cable for all low level input (24 V and below) and output signals to the SCADA.

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

3.3 Installation

.1 Install instrumentation cables in conduit systems or in cable trays. Use a minimum of 300 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.

.1 Where instrumentation cables are to be installed in cable trays, armoured cables shall be used.

.2 All SCADA cable, Ethernet and other communication cables shall be non-armoured and run in Conduit.

.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. Where splices are required, obtain approval from the Contract Administrator prior to installing the cable.

.5 Where splices are necessary in instrumentation cables other than coaxial cables, perform such splices on terminal blocks in terminal boxes. Keep splices in instrumentation cable to a minimum and separated physically from power circuits. Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.

.6 Where splices are made to coaxial cables, use standard coaxial cable connectors.

.7 Instrument cable shields shall be grounded at one end only. Unless otherwise specified, ground the shields at the marshalling panel.

.8 Protect all conductors against moisture during and after installation.

3.4 Conductor Termination

.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, STA-KON or equivalent, self-insulated, locking type terminators, sized as required to fit conductors and screw terminals.

3.5 Testing

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

3.6 Identification

.1 Identify all cables.

.2 Identify each conductor with wire numbers using a machine printed heat shrink wire marker, similar to PANDUIT LS4H or equivalent.

END OF SECTION

1. GENERAL

1.1 Reference – General

.1 Section 17010.

2. PRODUCTS

2.1 Power Supply and Conditioning Equipment

.1 Provide all DC power supplies as required for all instrument circuits. Power all circuits from the local control panels or marshalling panels. Power supplies to be equal to Hammond or G.F.C., complete with an overvoltage protection module.

.2 Provide redundant configurations for power supply equipment serving more than one instrument loop, so that failure of a single unit will not disable all or any shared part of the instrumentation and communication system. Provide diode isolation for redundant direct current supply units and ground the negative terminal of the power supply.

.3 Power supplies and transmitters feeding circuits that run in non-armoured cable in cable tray shall meet the requirements for Class 2 circuits as defined under NEC Article 725.

.4 Unless otherwise required, all DC power supplies to be rated 28 VDC, adjustable plus or minus 5%, and set to provide 26.4 V on the panel direct current bus. Size the power supply for two times the connected load, minimum size is 2 A.

2.2 Noise Suppression

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

2.3 UPS Power Supply

.1 Provide an un-interruptible power supply (UPS) in each new control panel to power control system and SCADA equipment.

.2 Size UPS standby capacity for thirty (30) minutes at full load rating of the connected equipment.

.3 Provide on-line units from Exide, Oneac, Toshiba, Best or approved equal.

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 References – General

.1 Section 17010.

2. PRODUCTS

2.1 Transmitters and Indicators

.1 Provide transmitters and indicators where specified.

.2 Transmitters to have adequate power output to drive all devices associated with the loop. Provide signal boosters and/or isolators as required to achieve adequate signal strength and to isolate the signal.

.3 Provide current loop signal isolators where required to eliminate “ground loop” signal errors caused by mismatched transmitters and receivers.

.4 All transmitters shall have local display scaled in percent. Provide a laminated label indicating the calibrated range and engineering units and mount adjacent to the transmitter. Mount the transmitter so the indicator is easily visible.

.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.

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 References – General

.1 Section 17010.

2. PRODUCTS

2.1 General

.1 Use normally closed contacts for alarm actuation which 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 such as programmable controllers or annunciators to be hermetically sealed and designed for switching currents from 20 to 100 mA at 24 VDC.

.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 NEMA 4X, minimum.

2.2 Indicators, Pushbuttons and Selector Switches

.1 All control indicator lamps, pushbutton switches and selector switches in unclassified or non-corrosive areas to be Allen Bradley 800T or 800E series items or approved alternative.

.2 All control indicator lamps, pushbutton switches and selector switches in classified or corrosive (includes outdoors) areas to be Allen Bradley 800H series items or approved alternative.

.3 All control enclosures to be as specified under Section 17110.

2.3 Thermistor Relays

.1 ABB type CM or equal is the design standard for the quality and type of thermistor relays to be provided.

.2 Provide thermistor relays for monitoring multiple positive temperature coefficient (PTC) thermistor sensors embedded within motor windings. Output contacts shall be rated for 120 VAC, 3 A and wired to shut down the associated motor starting equipment and initiate an alarm signal to the control system.

.3 Install thermistor relays inside the respective motor starting equipment cabinet where possible or alternately, within the control system marshalling panel.

2.4 General Purpose Relays

.1 Omron is the design standard for the quality and type of relays to be provided.

.2 All 120 VAC relays to be Model LY 4PDT or acceptable alternative. Plug-in type complete with test button and operation indicator, and surge suppresser.

.3 24 VDC relays to be Model MY 2PDT or approved alternative. Plug-in type, complete with test button and operation indicator, and surge suppresser diode.

.4 Time delay relays for behind panel mounting to be Model H3BA, 2PDT or approved alternative. Provide plug-in type relays programmable for sixteen (16) timing 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 or acceptable alternative. Provide screw-in type relays programmable for five (5) timing ranges and eight (8) operation modes, complete with digital display module for time settings and flexible protective cover.

.6 Provide relay plug-in sockets for DIN mounting complete with stacked screw clamp terminals.

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 References - General

.1 Section 17010.

2. PRODUCTS

2.1 Signal Conditioning Modules

.1 Where required, provide signal conditioning modules which comply with the following requirements:

.1 Analog signal inputs: 4-20 mA DC into 500 ohms or less.

.2 Analog signal outputs: 4-20 mA DC into 500 ohms.

.3 Discrete output contacts: SPDT or DPDT rated 5A.

.4 Arrange electronic trips so that output contact opens in case of loss of signal or loss of power supply.

.5 Signal conditioning and isolating modules to be rated for continuous operation in an ambient temperature of 0 to 80°C. The ambient temperature effect on module accuracy is not to exceed plus or minus 0.01% per °C within that range.

.6 Span and zero adjustments to be made by front accessible multi-turn potentiometers.

.7 Provide electronic trip modules with LED indicators for relay status.

.8 Signal conditioning modules to withstand 30 V per meter radio frequency radiation between 200 and 500 MHz with not more than 0.25% calibration effect. Provide modules with traps on the terminals to shunt conducted radio frequency interference to ground.

.9 Provide effective isolation of signal and power supply terminals from the case.

.2 All modules specified in this section to be the product of a single Manufacturer.

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 References – General

.1 Section 17010.

2. PRODUCTS

2.1 Miscellaneous Panel Devices

.1 Pilot Lights:

.1 Provide pilot lights of the LED type, oil tight, push to test, complete with appropriate colour lenses.

.2 Terminals:

.1 Provide 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 Terminal blocks and accessories to be Wiedmuller or approved alternative.

.5 Provide a group of terminals for each of 120 VAC hot and neutral and 24 VDC positive and negative power supply. 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 Wiedmuller disconnect type terminal blocks or approved alternative for each load or loop powered from the control and marshalling panels.

.3 Nameplates:

.1 Section 17010.

2.2 Signal Current Isolator

.1 Provide current loop signal isolators as required to provide isolation of milliampere transmission signals to prevent “ground loop” signal errors caused by mismatched transmitters and receivers.

.2 Isolators are to be panel mounted or housed in a NEMA 250, Type 4/7 conduit body and derive its operating power from the signal input circuit.

.3 Isolator input and output signals to be 4 - 20 mA, with an error not exceeding 0.1% of span. Input resistance will not exceed 550 ohms with an output load of 250 ohms.

.4 Current loop signal isolators are to be manufactured by Action Instruments or approved alternative.

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 as manufactured by MTL, Phoenix, Stahl, P+F, or acceptable alternative.

.2 Provide dual type intrinsic safety barriers for process switches as manufactured by MTL, Phoenix, Stahl, P+F, or acceptable alternative.

.3 Intrinsic safety relays to be as manufactured by MTL, Phoenix, Stahl, P+F, or acceptable alternative.

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 References – General

.1 Section 17010.

1.2 SCADA I/O Index

.1 The SCADA I/O index included in this section has been provided for reference and includes all of the I/O points shown on the P&ID diagrams. This list shall be updated by the contractor based on the finalized I/O requirements for each system and piece of equipment obtained from the “Reviewed-No Comment” or “Reviewed-As Noted” shop drawings.

.2 The updated SCADA I/O index will be used by the system integrator to develop the control system application programs, and HMI graphics.

.3 At the completion of the work, prepare and submit an as-constructed SCADA I/O index for the project and submit the completed list to the Contract Administrator for review. The reviewed as-constructed SCADA I/O index shall be included in the project O&M manuals in both printed copy and soft copy on CD.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

INDEX No.	SCADA POINT NAME			POINT DESCRIPTION		SIGNAL TYPE						SOURCE DEVICE			P&ID DWG	REMARKS	REV CODE
				ASSOCIATED EQUIPMENT	FUNCTION/TYPE	DI	DO	AI	AO	COMM	PLC Panel						
1	01	FI	100	East Side Flowmeter	Flow Indicate			1			LCP-100	01	FIT	100		Allow for all I/Os from the FloDAR unit and integrate all FloDar I/Os to the SCADAPack. Confirm I/Os with Shop Drawings	0
2	01	LI	100	East Side Flowmeter	Level Indicate			1			LCP-100	01	FIT	100			0
3	01	UA	100	East Side Flowmeter	Transmitter Fault	1					LCP-100	01	FIT	100			0
4	01	FT	100	East Side Flowmeter	Transmitter Totalizer	1					LCP-100	01	FIT	100			0
5	01	UA	105	East Side - 24V Power	24V Power Fault	1					LCP-100	01	LCP	100			0
6	01	UA	110	East Side - 120V Power	120V Power Fault	1					LCP-100	01	LCP	100			0
7	01	FI	200	West Side Flowmeter	Flow Indicate			1			LCP-200	01	FIT	200		Allow for all I/Os from the FloDAR unit and integrate all FloDar I/Os to the SCADAPack. Confirm I/Os with Shop Drawings	0
8	01	LI	200	West Side Flowmeter	Level Indicate			1			LCP-200	01	FIT	200			0
9	01	UA	201	West Side Flowmeter	Transmitter Fault	1					LCP-200	01	FIT	200			0
10	01	UA	205	West Side - 24V Power	24V Power Fault	1					LCP-200	01	LCP	200			0
11	01	UA	210	West Side - 120V Power	120V Power Fault	1					LCP-200	01	LCP	200			0
																	0
				I/O count totals		7	0	4	0	0						*EXACT I/O COUNTS TO BE CONFIRMED FROM SHOP DRAWING AND AS-CONSTRUCTED DATA	

1. GENERAL

1.1 References - General

.1 Section 17010.

1.2 Instrument Index

.1 The Instrument index included in this section has been provided for reference and includes all of the tagged instrumentation devices shown on the P&ID diagrams. This list shall be updated by the contractor based on the finalized instrument data obtained from the “Reviewed” or “Reviewed as Modified” shop drawings.

.2 The updated instrument index will aid the control system integrator in development of the control system application programs and HMI graphics.

.3 At the completion of the work, prepare and submit an as-constructed instrument index for the project and submit the completed list to the Contract Administrator for review. The reviewed as-constructed instrument index shall be included in the project O&M manuals in both printed copy and soft copy on CD.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

Instrumentation Index

INSTRUMENT Tag No			INSTRUMENT DESCRIPTION		P&ID DWG	SPEC SECTION	INST. SPEC. SHEET (ISS)	LOOP WIRING DIAGRAM	INST. STANDARD DETAIL (ISD)	LOCATION DRAWING	REMARKS	REV CODE
AREA	TAG	No	ASSOCIATED EQUIPMENT	FUNCTION / TYPE								
08	FIT	100	East Side Flowmeter	Flow Transmitter		17701	I101	Dwg 12300	Mfr. Std.		Use weatherproof wiring methods	0
08	LCP	100	East Side Control Panel	Local Control Panel		17110	n/a	n/a	Mfr. Std.		Use weatherproof wiring methods	0
08	TIT	201	West Side Flowmeter	Flow Tranmitter		17701	I101	Dwg 12300	Mfr. Std.		Use weatherproof wiring methods	0
08	DL	200	West Side Control Panel	Local Control Panel		17110	n/a	n/a	Mfr. Std.		Use weatherproof wiring methods	0

INSTRUMENT SPECIFICATION NUMBER:	I-101
DEVICE:	Flow Transmitter – Liquid Service
TAG:	Refer to Instrument Index, Section 17700
TYPE:	Radar/Ultrasonic Combined Transmitter
SERVICE:	Waste Water
POWER SUPPLY:	120 VAC
RANGE:	-10°C to 50°C
ACCURACY:	±1%
OUTPUT:	4 to 20 mA DC
ENCLOSURE:	NEMA 4X
INDICATION:	LCD display scaled in engineering units
MOUNTING:	Manufacturer's standard; Mount to minimize obstruction and interference.
ACCESSORIES:	Flow Logger 1500; Intrinsically Safe Barrier and wiring; Stainless Steel; Extended Range Sensor; Flo-Dar Cables; All required mounting equipment for applications.
TRAINING:	Provide operation, calibration and maintenance training in person from a qualified manufacturer's representative. Allow for travel.
MANUFACTURER AND MODEL:	Hach Flo-Dar c/w FL1500

ILD NO.	TITLE
Dwg 12300	Flowmeter Transmitter

END OF SECTION