1 General

1.1 OVERVIEW

.1 Contractor must review these specifications alongside all other Contract documents, including design drawings and MMCD specifications as well as other discipline specifications such as civil, concrete, directional drilling, trenching, and backfilling.

.2 Seek clarifications from Consultant before submitting bids if any conflict or discrepancies arise in the Work documents that cast doubt on the intent or meaning of Work. If clarifications cannot be obtained before bid submission, allow for the most expensive alternative to complete the Work.

.3 The General Contractor bears sole responsibility for dividing the Work among subcontractors, suppliers, or others. The Consultant is not responsible for arbitrating subcontract scope or limits between sections or divisions of Work.

.4 Any mention of the 'Canadian Electrical Code' or 'CEC' refers to the edition of Canadian Electrical Code, Part I, CSA C22.1, and any local regulatory variations in force on the date of bid closing for the Contract.

.5 Electrical devices, equipment, cabling, and conduit locations indicated on drawings are approximate. Include allowance for relocation within 3 m of each indicated location in bid pricing.

.6 All electrical enclosure dimensions indicated on the drawings are approximate only. The Contractor is responsible for final sizing of the enclosure, suitable for housing all the components as well as 25% extra space for future additions. Allow in Bid pricing for at least 25% addition in size when basing pricing on drawing indicated dimensions.

.7 The conduit and cable routing indicated on the drawings is approximate only. The Contractor is responsible for determining the routing as well as the installation length of conduits, cables, and conductors. Allow in Bid pricing for at least 25% addition in length if basing pricing on scaling from the drawings.

1.2 SUMMARY OF ELECTRICAL WORK

.1 Provide all electrical Work, including supply, installation, wiring, configuration, programming, testing, commissioning, and operational training of electrical components, to activate all systems depicted in drawings and specified herein. Below is a non-exhaustive list, of major electrical systems within scope of construction for this project:

- .1 Existing electrical installation review and integration of new systems with existing electrical systems
- .2 Civil and concrete work related to electrical installations
- .3 Grounding systems
- .4 Power service and distribution
- .5 Controls cabling, and signals testing
- .6 Electrical Kiosk assembly c/w motor starters, drives and controls
- .7 Process controls and instrumentation
- .8 Programming of motor drives, controls and instrumentation systems

1.3 CONCRETE WORK RELATED TO ELECTRICAL INSTALLATIONS

.1 Design concrete foundations and housekeeping pads in accordance with CAN/CSA A23.1 standards.

.2 Size all pre-cast concrete structures as indicated on design drawings.

.3 Size cast-in-place concrete structures to accommodate electrical equipment, with a minimum 150mm concrete extension beyond all sides of the equipment. Provide chamfered edges and drainage slope away from the equipment for all foundations.

.4 The concrete foundation for electrical custom enclosures (Kiosk) must be a minimum of 150mm above the surrounding grade, unless otherwise noted on the drawings.

1.4 MATERIALS GENERAL REQUIREMENTS

.1 All electrical devices and components must use finger guards, to reduce the risk of contact with live terminals.

.2 All products, materials, equipment, and articles incorporated into the work must have a CSA rating, be new, and of the highest quality for industrial use purpose. Upon request, provide evidence to support the source and quality of products.

.3 For all reused or Owner-supplied electrical systems, remove and store materials at the site. Conduct a joint inspection with the Owner after removal to record any damaged or defective items. Upon clearance by the Owner's representative, take custody of the materials for further handling, storage, and integration into the work as necessary. Make any necessary repairs to damaged materials after taking custody.

.4 In the Contract documents, if the Consultant has specified a specific material name, manufacturer, catalogue number, model number, or similar reference, it must be used to establish the bid price unless written approval for an alternative material is obtained from the Consultant prior to bid submission. After bid submission, acceptance of alternate or substitute materials is at the sole discretion of the Consultant, whose decision is final. Due to time constraints during the tender period, it may not be feasible to review all requests for alternate or substitute materials. Therefore, bidders must submit all requests for alternate or substitute materials with a clear explanation of the benefits to the project in terms of cost, quality, safety, or schedule.

.5 Maintain uniformity of the manufacturer throughout the project materials to the extent possible.

.6 Extend all manufacturer warranty periods for materials to the Owner. Additionally, all materials and installations must be guaranteed for a minimum period of one (1) year from the date of substantial performance against any defects or performance failures. The warranty must be comprehensive and on-site, meaning no deductibles are allowed for travel time, service hours, repair parts costs, administration costs, etc.

1.5 SHOP DRAWINGS

.1 Provide equipment information in electronic '.pdf' format containing relevant details such as layout with physical dimensions, electrical ratings, labeling details, wiring schematics, and termination details. Additionally, furnish any additional information requested by the Consultant to ensure satisfactory review of submittals.

2 Products

2.1 UNDERGROUND ELECTRICAL

.1 Underground Electrical Pull Box

- .1 Pre-cast concrete pull box with cast-iron flush cover
- .2 Approved product
  - Langley Concrete 1.5 m telecom vault or pre-approved equal

2.2 ELECTRICAL ENCLOSURES PROTECTION RATING AND MATERIALS

.1 The electrical enclosures shall have the following minimum protection rating, materials and quality of construction.

- .1 Mounted in Class 1 Zone 2 hazardous area – NEMA 4X, Stainless Steel
- .2 Mounted outdoor, wall or freestanding frame – NEMA 4X, Stainless Steel
- .3 Mounted outdoor, concrete pad – NEMA 3R, Aluminum
- .4 Mounted in outdoor Kiosk – NEMA 3R, Aluminum
- .5 Mounted outdoor, embedded in concrete or ground – NEMA 6P, Fiberglass or PVC

.2 All electrical enclosures shall have,

- .1 a factory standard finish, unless noted otherwise
- .2 piano hinged doors, except enclosures embedded in concrete or ground
- .3 full size metal backpan with matte-white finish
- .4 a clear plastic sleeve for shop drawings / documentation

.3 Pad mounted electrical enclosures shall have vapor-tight LED lighting activated by a door switch.
.4 All outdoor electrical enclosures shall have key-locking mechanisms. Electrical enclosures embedded in concrete or ground are acceptable without key lock, provided use of special tool is required for opening these enclosures.
.5 All surface mount 1-gang, 2-gang or round electrical boxes shall be die-cast aluminum with stainless steel cover plates to suit device or a blank cover plate.
.6 The selected factory-standard electrical enclosures shall be stocked locally by a large electrical distributor.

2.3 PAD-MOUNTED CUSTOM KIOSK

.1 Protection rating and materials – NEMA 3R, Aluminum.
.2 Welded joints continuous seam welded, free of slag and grounded for smooth finish.
.3 Finish: Sandblasting, followed by 2 – 3 mils of zinc rich powder primer-coat, followed by 3 – 4 mils of powder topcoat (Forest Green color).
.4 Finish free of all defects such as thickness variations, peeling, blistering, pinholes, craters, drips, color variations etc.
.5 Fully gasketed doors w/ hold open brackets and interior stiffening panels, bullet style hinges complete with grease nipples.
.6 Full length doors for all compartments, and removable door support, if necessary, to allow obstruction-free access to entire compartment from outside.
.7 Open bottom complete with 80 mm reinforced C-channel to allow enclosure to be lifted with forklift.
.8 Creased roof complete with 50 mm overhang and 25 mm rain-gutter all around.
.9 Heavy duty 3-point latching handle locking mechanism suitable for padlocks, complete with chrome plated handle.
.10 Full size removable metal back-panel for mounting equipment w/ matte white finish in each compartment.
.11 50 mm high density polystyrene board with foil facing thermal insulation inside enclosure walls and ceiling, all insulation joints and exposed edges covered with foil tape.
.12 Factory welded lifting eyes to support enclosure plus all equipment weight.
.13 Heating and mechanical ventilation to prevent condensation and maintain equipment operating temperature within range as recommended by respective equipment manufacturers.
.14 Vapor tight LED lighting controlled by compartment door switch.
.15 Folding laptop shelf mounted at 1 m height on the Kiosk door, closest to the PLC panel.
.16 Approved manufacturers
  .1 Valid Manufacturing
  .2 A.C. Dandy
  .3 Code Electric

2.4 SURGE PROTECTION

.1 Surge Protection Device
  .1 Compliant with UL 1449, 3rd Edition
  .2 120/208V, 3Ph4W grounded
  .3 160 kA rating per phase
  .4 LED indicators to indicate normal and fault states for each phase
  .5 Relay output for providing alarm indication
  .6 Approved products
    - Schneider Electric ASCO 330 series or pre-approved equal

2.5 POWER SERVICE AND DISTRIBUTION

.1 Panelboard
  .1 Surface mounting trim
  .2 Rated for service entrance
  .3 Bolt-on MCCB circuit breakers

.4 Bus rating – 120/240V, 3PH4W, 200 Amp tin-plated copper
.5 Main breaker rating – 90 Amp thermal-mag
.6 S.C. rating – 18kA RMS SYM. I.C.
.7 18 branch circuits minimum, branch circuit ratings as shown on drawings
.8 Accessories – neutral and ground bus kits
.9 Approved products
- Schneider Electric NQ Series or pre-approved equal

2.6 MOTOR STARTERS AND DRIVES

.1 Variable Frequency Drive (VFD) Assembly
.1 Variable torque rated, V/Hz control, 4kHz switching frequency minimum
.2 Suitable for 208V, 15 HP motor
.3 5% impedance DC link choke or line reactor
.4 EMI / RFI line side filter
.5 5% load reactor or dV / dT load filter
.6 LCD display
.7 Minimum IO: 3 relay outputs, 6 discrete inputs, 2 analog inputs, 1 analog output
.8 Accessories – pilot lights, hand switches as shown on drawings
.9 Approved products
- Toshiba AS Series
- Siemens G120 Series

2.7 ALARM NOTIFICATION

.1 Visual Alarm Annunciator
.1 Marine grade
.2 Configurable steady or flashing LED, 120V powered, lens color as shown on drawings
.3 Round electrical box mounted 1 m above the Kiosk roofline
.4 GE Edwards 105LED series or pre-approved equal

2.8 CONTROL PANEL ASSEMBLY

.1 Assembly
.1 Provide a scaled layout for control panel back-pan and door for Consultant's review and approval.
.2 The layout shall include the actual size of equipment supplied under this contract and shall include complete details such as equipment bill of materials, tags, labels, warning labels etc.
.3 Layout instructions:
- Minimum spacing between terminals and wire-duct – 75 mm
- Minimum spacing between door cutouts – 50 mm

.4 Provide full panel wiring schematics showing details including but not limited to wire labels, terminal block labels, fuse block labels, fuse or breaker sizes, relay labels etc.
.5 Wiring instructions:
- Terminate all PLC IO, including spare IO, at terminal blocks and / or output relays
- DC wiring color code: 24 VDC(+) – BLUE, 24 VDC(-) – YELLOW

.6 Provide 25% spare space on DIN RAIL for future capacity.
.7 Completed assembly shall be CSA or equivalent authorized agency approved.
.2 PLC, HMI, and Communications Equipment (NO SUBSTITUTIONS ALLOWED)
.1 Micro Processor– Allen Bradley 2080-LC20-20QBB
.2 4-channel current Analog Input Plug-in Module – Allen Bradley 2080-IF4
.3 Graphic terminal, touchscreen, color, DC, Ethernet – Automation Direct C-more CM5-T7W

.3 Terminal-Rail Components including feed-thru terminal blocks, fused terminal blocks (must have LED blown-fuse indicator), ground blocks, strip marker carriers, end brackets, jumper bars – Allen Bradley 1492 series or pre-approved equal
.4 Supplementary circuit breakers – Allen Bradley 1489 series or pre-approved equal
.5 Control relays – Allen Bradley 700-HL series or pre-approved equal
.6 Intrinsically Safe Barriers – Allen Bradley 937TH series or pre-approved equal
.7 Pilot lights (must have push-to-test assembly), push buttons, selector switches (illuminated if noted on drawings) – 30 mm, Allen Bradley 800T series or pre-approved equal
.8 DC Power Supply – Allen Bradley 1606-XLB series or pre-approved equal
.9 Ethernet switch – Allen Bradley Stratix 2000 series or pre-approved equal

2.9 INSTRUMENTATION

.1 Level Switch
  .1 Process conditions: media – stormwater, temperature – 0 to 40 °C, pressure – atmospheric
  .2 Rating / approval: CSA Class 1 Zone 2, Intrinsically safe circuit
  .3 DPDT, mercury free switch, contacts rated for 250V, 10A
  .4 Factory integral cable with special compound PVC sheathing, length to suit project requirements
  .5 Accessories: wall mount bracket
  .6 Approved products
    - Xylem ENM-10
.2 Primary Level Sensor
  .1 Process conditions: media – stormwater, temperature – 0 to 40 °C, pressure – atmospheric
  .2 Rating / approval: CSA Class 1 Zone 2, Intrinsically safe circuit
  .3 Radar level sensor
  .4 Sensor with factory integral cable with special compound PVC sheathing, length to suit project requirements
  .5 Signals output – 4–20 mA loop powered analog output
  .6 Accessories: Suspension clamp
  .7 Approved product
    - VEGA PULS C23 sensor

3 Execution

3.1 UNDERGROUND OR CONCEALED ELECTRICAL CONSTRUCTION

.1 Provide digital pictures clearly illustrating underground or concealed work in '.JPEG' format with a minimum size of 2 megapixels, taken before burial or concealment. Do not bury or conceal the work until the Consultant has satisfactorily reviewed the pictures. The Contractor is responsible for all costs related to re-exposure of the work, including Consultant inspection costs, if satisfactory review of pictures is not obtained.

3.2 HANGERS AND SUPPORTS

.1 Do not attach any electrical system directly to wetwell wall. Provide steel channel supports to install electrical devices clear of the wall.
.2 Utilize CSA-approved channel/strut systems manufactured by UNISTRUT or equivalent. Use stainless steel in hazardous classified areas and hot-dipped galvanized finish in non-hazardous areas.

3.3 WIRING AND CABLING

.1 Adhere to following materials schedule for provision of conduit / cable system, unless specifically noted otherwise:
  .1 Hazardous Area: Rigid Metal conduit or Teck90 cable.

.2 Outdoor Below Grade and In-concrete Slab: RPVC conduit adapted to Rigid Metal conduit where transitioning to above grade. DB-II conduit, run in structurally sized cast-in-place concrete duct-bank, adapted to rigid PVC conduit where outside concrete duct bank shall be acceptable as an alternate. Direct buried Teck90 cable shall be acceptable with express pre-approval only. Rigid metal conduit shall be Rigid Galvanized Steel, Rigid Aluminum or Stainless Steel. Rigid Aluminum shall be acceptable only where the installed conduit does not have any contact with concrete.

.3 Outdoor Above Grade: Rigid Metal conduit or Teck90 cable. RPVC conduit shall be acceptable with express pre-approval only in a restricted access outdoor area. Rigid Aluminum shall be acceptable above grade where installed conduit does not have any contact with concrete.

.4 Equipment Terminations: Armored liquid-tight for connection to equipment, length no more than 3 m.

.5 Factory Cable Terminations: use of factory cable is permitted only for submersible equipment. Terminate factory cable at above grade junction box as noted on drawings.

.2 Install wiring in approved conduits or cables, ensuring mechanical protection for all wiring installations, unless otherwise approved.

.3 Adhere to color coding of conductors as per CEC section 4-038: (BLACK, RED, BLUE for AC phase conductors, WHITE for neutral, BLACK for DC+ and WHITE for DC-). In multi-conductor cables, each neutral conductor must be permanently marked at all accessible points where separate conductors are visible due to removal of outer covering.

.4 Do not install intrinsically safe circuit wiring in the same conduit/cable, compartment, outlet, or junction box with wiring of any other system unless separated by a suitable mechanical barrier.

.5 Splice and terminate all wiring at device terminals or terminal blocks within a rated hinged-door enclosure unless specific pre-approval is obtained from the Consultant. Do not use marretted splices.

.6 Do not group multiple power circuit wirings in the same conduit or pull box without the Consultant's pre-approval.

.7 Do not install more than one splice between a conductor's source and destination without the Consultant's pre-approval.

.8 Provide minimum size 35mm conduit for all buried installation. Provide conduit sized as per CEC Table 6 to fill installed conductors plus 25% spare conductors.

.9 Provide explosion-proof fittings in hazardous areas, wet-rated fittings in general equipment areas, compression type (set screw fittings not permissible) for EMT. Provide EYS seal for conduit leaving hazardous area.

.10 Multiple control circuit conductors can be grouped into an adequately sized conduit where applicable. Where multiple conductors are installed in the same conduit, all conductors shall be pulled simultaneously. Multiple conductors in conduit or cable shall be terminated within same box at each end.

.11 Provide a separate bonding wire in each conduit including EMT conduit.

.12 Do not pull spliced conductors inside conduits. All splices shall be accessible inside approved boxes.

.13 Do not splice cables inside underground manholes or pull boxes, unless specifically noted on drawings or with express pre-approval of Consultant. Where conductors are spliced in underground manhole or pull boxes, provide submersible splicing joints, such as 3M Scotchcast 82F series or equal.

.14 For underground installation, seal conduit ends with duct sealing compound after installation of conductors.

.15 Provide necessary hardware for watertight joints where conduits pass through watertight membranes. Perform X-ray inspection prior to coring through existing concrete. Do not pass conduits through structural members, without express pre-approval of Consultant.

.16 Support all conduits and cables independently of equipment and piping. Each cable and conduit shall be supported within 300mm of each box / fitting and at intervals of not more than 1.5 m throughout the run.

.17 The bending radius for conduits and cables shall comply with CEC 12-614 and 12-924. Install no more than equivalent of three 90-degree conduit bends between boxes, including bends located at boxes.

.18 Install polypropylene fish cord in empty conduits. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

3.4 LABELING AND ELECTRICAL IDENTIFICATION

.1 Submit a list of all nameplates, labels, wire markers, and cable or conduit markers to the Consultant for review prior to installation. Allow the Consultant to markup any changes or updates to the list at no additional cost to the Owner. All electrical identification components must be printed in a sans-serif font; handwritten markers are not acceptable.

.2 Nameplates must be engraved three-layer laminated plastic with a white face and black core, mechanically attached with self-tapping screws. Minimum size: 20 mm x 90 mm.

.3 Labels must be embossed adhesive tape with 5 mm letters, used only for identifying individual wall switches, receptacles, and control device stations.

.4 Conduit or cable markers must be embossed adhesive tape with 50 mm bands and 12 mm letters.

.5 Wire markers must be heat shrink sleeve type with printed markers.

.6 Provide arc-flash labels, CSA labels, and panel directories as per Project requirements.

3.5 PRE-COMMISSIONING CHECKLIST

.1 The Contractor must adhere to the following checklist and submit the relevant documents. A minimum of two weeks should be allowed for successful review of the submission by the Consultant before scheduling the commissioning date.

- .1 Shop drawings for all shop-fabricated cabinets and junction boxes.
- .2 Shop drawings for all supports and foundations for electrical conduits, cable trays and equipment.
- .3 Each variable frequency drive vendor start-up and configuration report.
- .4 Each instrument start-up and configuration report.
- .5 Control narrative, operator interface graphics and complete alarms list.
- .6 Systems integrator start-up and IO testing report.
- .7 Red-line drawings and specifications.
- .8 Operation and maintenance manuals.
- .9 Spare parts list.
- .10 Conduit and cable labels list.
- .11 Equipment labels list.
- .12 Commissioning sequence including schedule.

3.6 CLOSE OUT DOCUMENTATION

.1 Provide redline markups for electrical design, including, but not limited to location and routing of concealed conduits, cabling and electrical work.

.2 The operations and maintenance manuals shall be organized as per following:

- .1 3rd party design, inspection and testing reports, such as,
  - Electrical inspector final inspection and occupancy approval
  - Vendor start-up reports, organized in order of power systems, control systems and instrumentation
  - Systems integrator test and commissioning report, including PLC / SCADA tag list and device / instrument parameters configuration sheets
- .2 Control narrative incorporating as-commissioned setpoints
- .3 Product information organized in order of specification sections with following sub-sections
  - Supplier
  - Shop drawings (with review stamp)
  - Manufacturer manuals and warranty information
- .4 Photos of concealed electrical work.

3.7 COMMISSIONING AND ACCEPTANCE

.1 Commission and activate all electrical systems included in this Contract at least 4 weeks prior to substantial completion.

.2 Upon successful commissioning of all electrical systems as a single final System, the complete functioning System shall undergo a 15-day acceptance test. During this period, all System functions shall be tested, and any interruptions shall be logged for the cause of failure. Failure will terminate the 15-day acceptance test, resulting in a corresponding delay in substantial completion. Once the cause of failure is corrected, a new 15-day acceptance test shall be repeated until a successful test without any failures.

3.8 DEMONSTRATION AND TRAINING

.1 Upon successful commissioning of all electrical systems, demonstrate scheduled operation and maintenance of equipment and systems to Owner's personnel, before the date of substantial performance.

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

END OF SECTION