

**Part 1 General**

**1.1 REFERENCES**

- .1 Definitions:
  - .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
  - .2 The words provide and provision shall be taken to mean *supply*, *install*, *connect*, *test* and *commission*.
- .2 Reference Standards:
  - .1 CSA Group
    - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
    - .2 CAN/CSA-C22.3 No.1-10, Overhead Systems.
    - .3 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
  - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
    - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

**1.2 SUMMARY OF WORK**

- .1 Work includes, but is not limited to:
  - .1 Provision of roadway and architectural site lighting systems including luminaires, steel shafts, concrete bases, pull boxes, conduits, wiring, and all other related materials as indicated on the drawings and within these specifications.
  - .2 Provision of CCTV Camera system for site and within the prefabricated building refer to Appendix for equipment locations including cameras, steel shafts, concrete bases, pull boxes, conduits, wiring, and all other related materials as indicated on the drawings and within these specifications.
  - .3 Provision of security system within prefabricated building refer to Appendix for locations.
  - .4 Provision of mechanical piping heat tracing including heat trace cable, thermostat control, and all other related materials as indicated on the drawings and within these specifications.
  - .5 Provision of automobile block heater receptacles including concrete bases, pull boxes, conduits, wiring, and all other related materials as indicated on the drawings and within these specifications.
  - .6 Provision of diesel standby generator complete with sound attenuated weatherproof enclosure.
  - .7 Provision of weatherproof distribution panels for BC MoTI and CBSA site electrical loads.

- .8 Disconnection and removal of the existing standby generator and enclosure and disposal off site.
- .9 Disconnection and removal of the existing roadway lighting lamp standards and concrete bases and disposal off site.
- .2 The Stewart CBSA Port of Entry must remain **OPERATIONAL** throughout the construction process.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets as indicated in technical sections and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada.
  - .2 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 co-ordinated installation.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5 Submit one copy of shop drawings and product data in PDF format.
  - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .4 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
  - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .5 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

- .6 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan in accordance with Section 01 74 19 Waste Management and Disposal.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .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 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
  - .4 Post instructions where directed.
  - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
  - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 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.
- .3 Language operating requirements: provide identification nameplates for control items in English.
- .4 Use one nameplate label.

**2.2 MATERIALS AND EQUIPMENT**

- .1 Provide material and equipment in accordance with Section 01 61 10 - Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

**2.3 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Departmental Representative.
- .2 Decal signs, minimum size 175 x 250 mm.

**2.4 WIRING TERMINATIONS**

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

**2.5 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates: lamicoïd 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 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

**2.6 WIRING IDENTIFICATION**

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

**2.7 CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

SYSTEM	PRIME	AUXILLIARY
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

**2.8 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green" finish.
  - .2 Paint indoor switchgear and distribution enclosures light gray.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for electrical installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

**3.3 NAMEPLATES AND LABELS**

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

**3.4 CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.

**3.5 MOUNTING HEIGHTS**

- .1 Refer to individual technical specification sections for equipment mounting heights.

**3.6 CO-ORDINATION OF PROTECTIVE DEVICES**

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

**3.7 FIELD QUALITY CONTROL**

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) 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.
  - .3 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents

on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: CCTV
  - .6 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 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.8 SYSTEM STARTUP**

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, 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 with aspects of its care and operation.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1            General**

**1.1                PRODUCT DATA**

- .1        Provide product data in accordance with Section 01 33 00 – Shop Drawings, Product Data and Samples.

**1.2                DELIVERY, STORAGE AND HANDLING**

- .1        Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2            Products**

**2.1                BUILDING WIRES**

- .1        Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2        Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

**Part 3            Execution**

**3.1                FIELD QUALITY CONTROL**

- .1        Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2        Perform resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3        Perform tests before energizing electrical system.

**3.2                GENERAL CABLE INSTALLATION**

- .1        Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .2        Conductor length for parallel feeders to be identical.
- .3        Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

**3.3                INSTALLATION OF BUILDING WIRES**

- .1        Install wiring as follows:
  - .1        In underground ducts in accordance with Section 33 65 76 Direct buried Underground Cable Ducts.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CSA Group
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
  - .3 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Shop Drawings, Product Data and Samples.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect connectors and terminations from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

- .4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 CONNECTORS AND TERMINATIONS**

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for connectors and terminations installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2 INSTALLATION**

- .1 Install terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED SECTIONS**

- .1        Section 01 33 00 – Shop Drawings, Product Data and Samples
- .2        Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .3        Section 26 05 00 - Common Work Results - Electrical

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submit in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2        Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Sustainable Design Submittals:
  - .1        Construction Waste Management:
    - .1        Submit project Waste Management Plan in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

**1.3                CLOSEOUT SUBMITTALS**

- .1        Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2        Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect connectors and terminations from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.
- .4        Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 PLASTIC JUNCTION BOXES (TYPE 10)**

- .1 Rigid polyethylene 2 section c/w galvanized steel lid, drain plate, 533mm-740mm diameter sections by 760mm depth (combined depth with 2 sections) as indicated.
- .2 Junction boxes shall be equipped with steel tamper proof locking cover, hot dipped galvanized to CSA G164, latest edition, complete with Burndy Type KC Servit post grounding lug.
- .3 Junction box and cover shall be fabricated to withstand 7350kg vertical loading.
- .4 Provide grounding in accordance with drawings.
- .5 Label coverplate with "POWER" or "COMM" using bead welded letters .

**2.2 PLASTIC JUNCTION BOXES (SMALL)**

- .1 Rigid polyethylene 2 section c/w galvanized steel lid, drain plate, 374mm-508mm diameter sections by 700mm depth (combined depth with 2 sections) as indicated.
- .2 Junction boxes shall be equipped with steel tamper proof locking cover, hot dipped galvanized to CSA G164, latest edition, complete with Burndy Type KC Servit post grounding lug.
- .3 Junction box and cover shall be fabricated to withstand 7350kg vertical loading.
- .4 Provide grounding in accordance with drawings.
- .5 Label coverplate with "POWER" or "COMM" using bead welded letters .

**2.3 CONCRETE JUNCTION BOXES**

- .1 Concrete 3 section as indicated.
- .2 Concrete junction boxes shall be equipped with steel tamper proof locking cover, hot dipped galvanized to CSA G164, latest edition, complete with Burndy Type KC Servit post grounding lug.
- .3 Label coverplate with "POWER" or "COMM" using bead welded letters.

**Part 3 EXECUTION**

**3.1 PLASTIC JUNCTION BOXES (TYPE 10)**

- .1 Installation of plastic junction boxes.
  - .1 Install at locations indicated.
  - .2 Excavate the size and depth indicated and place bedding material.
  - .3 Place so that cover is level with ground.
  - .4 Make holes in plastic junction box walls suitable for the ducting used.
  - .5 Backfill with common backfill material around plastic junction box and compact to same density as adjacent ground.

**3.2 CONCRETE JUNCTION BOXES**

- .1 Installation of concrete junction boxes.
  - .1 Install at locations indicated.
  - .2 Excavate the size and depth indicated and place bedding material
  - .3 Place so that cover is level with ground.
  - .4 Make holes in junction box walls suitable for the ducting used.
  - .5 Backfill with common backfill material around concrete junction box and compact to same density as adjacent ground.

**3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 26 05 00 Common Work Results for Electrical
- .2        Section 33 65 76 Direct Buried Underground Cable Ducts.

**1.2                REFERENCES**

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submit in accordance with Section 01 33 00 – Shop Drawings, Product Data and Samples.
- .2        Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for [cables] and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Sustainable Design Submittals:
  - .1        Construction Waste Management:
    - .1        Submit project Waste Management Plan in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect cables.
  - .3        Replace defective or damaged materials with new.
- .4        Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2            Products**

**2.1            Not Used.**

**Part 3            Execution**

**3.1            EXAMINATION**

.1            Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.

.1            Visually inspect substrate in presence of Departmental Representative.

.2            Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3            Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2            CABLE INSTALLATION IN DUCTS**

.1            Install cables as indicated in ducts.

.2            Do not pull spliced cables inside ducts.

.3            Install multiple cables in duct simultaneously.

.4            Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5            To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6            Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7            After installation of cables, seal duct ends with duct sealing compound.

**3.3            FIELD QUALITY CONTROL**

.1            Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2            Perform tests using qualified personnel.

.1            Include necessary instruments and equipment.

.3            Check phase rotation and identify each phase conductor of each feeder.

.4            Check each feeder for continuity, short circuits and grounds.

.1            Ensure resistance to ground of circuits is not less than 50 megohms.

- .5 Pre-acceptance tests:
  - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
  - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests:
  - .1 Ensure that terminations and accessory equipment are disconnected.
  - .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.5 PROTECTION**

- .1 Repair damage to adjacent materials caused by cables installation.

**END OF SECTION**

**Part 1      General**

**1.1            ACTION AND INFORMATIONAL SUBMITTALS**

- .1      Submit in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2      Product Data:
  - .1          Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3      Sustainable Design Submittals:
  - .1          Construction Waste Management:
    - .1              Submit project Waste Management Plan in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

**1.2            CLOSEOUT SUBMITTALS**

- .1      Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2      Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

**1.3            DELIVERY, STORAGE AND HANDLING**

- .1      Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2      Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3      Storage and Handling Requirements:
  - .1          Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2          Store and protect connectors and terminations from nicks, scratches, and blemishes.
  - .3          Replace defective or damaged materials with new.
- .4      Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

**1.4            RELATED WORK**

- .1      This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

**1.5            REFERENCES**

- .1      Canadian Standards Association (CSA International) – most recent version
  - .1          CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.

- .2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .3 CSA-C22.2 No.55, Special Use Switches.
- .4 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

**Part 2 Products**

**2.1 VEHICLE RECEPTACLES**

- .1 Self-contained programmable receptacle.
  - .1 Single receptacle. 15A 120V
  - .2 704mm pedestal
  - .3 45° down mount
  - .4 Indicator lights: 2x green, 2x red LED c/w IR access port.
  - .5 Acceptable Product: IPLC manufacturing.

**Part 3 Execution**

**3.1 INSTALLATION GENERAL**

- .1 Install receptacle on concrete footing as indicated.

**END OF SECTION**

**Part 1        General**

**1.1            ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Submit in accordance with Section 01 33 00 - Shop Drawings, Product Data and Samples.
- .2        Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Sustainable Design Submittals:
  - .1        Construction Waste Management:
    - .1        Submit project Waste Management Plan in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

**1.2            CLOSEOUT SUBMITTALS**

- .1        Submit in accordance with Section 01 78 30 - Closeout Submittals.
- .2        Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

**1.3            DELIVERY, STORAGE AND HANDLING**

- .1        Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2        Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3        Storage and Handling Requirements:
  - .1        Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect connectors and terminations from nicks, scratches, and blemishes.
  - .3        Replace defective or damaged materials with new.
- .4        Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

**1.4            GENERAL REQUIREMENTS**

- .1        Provide an 80 kW standby power system to supply electrical power at 120/240 Volts, 60 Hertz.
  - .1        The generator shall consist of a liquid cooled diesel engine, a self-contained 'belly tank', a weatherproof enclosure, and system controls with all necessary

accessories for a complete operating system, including but not limited to the items as specified hereinafter.

- .2 The overall dimensions of the diesel engine generator set shall not exceed those indicated on the drawings.
- .3 The automatic transfer switch is provided by others as part of the prefabricated building work.
- .4 Provide and install remote annunciator panel within prefabricated building. Confirm exact location.
- .5 Standby generator shall be capable of accepting the entire rated load in one step.

### **1.5 WORK INCLUDED**

- .1 Provide a 300mm high steel reinforced concrete base as directed by the Structural Engineer. Base shall have 20mm chamfered edges.
- .2 Provide restraining bolts and encase in concrete bases as directed by the supplier and the Earthquake Restraint Design Engineer.
- .3 Equipment shall not be delivered until it can be located on exterior housekeeping pad.

### **1.6 SEQUENCE OF OPERATION**

- .1 Upon failure of normal power a signal (contact closing) shall be sent to the generator control panel from the transfer switch.
- .2 Engine shall crank, start and come up to operating speed. Time for generator engine to operate at full speed shall be less than 15 seconds.
- .3 When generator engine reaches stable voltage and frequency the transfer switch shall operate to the EMERGENCY position.
- .4 Return of normal power shall, after the appropriate time delay, cause the transfer switch to operate back to the NORMAL supply under the control of the transfer switch "in-phase" monitor. If normal power should fail during the "cool down" period, the transfer switch shall immediately re-transfer to the EMERGENCY source and the "cool down" timer shall be re-set.
- .5 After the appropriate "cool down" time delay after re-transfer, a signal will be sent to shut down the engine generator and to reset the entire system.

### **1.7 WARRANTY AND GUARANTEE**

- .1 Engine generator set and installation shall be guaranteed by the system supplier for a period of three (3) years from the date of site test acceptance. Warranty shall include the costs of labour and materials on site.

**Part 2        Products**

**2.1        EQUIPMENT - GENERAL**

- .1        The generator set shall be applied at the listed ambient temperature and elevation. Bidders to submit the generators rated power output at ambient (°F) and elevation (Ft).
- .2        A radiator fan guard must be installed for personnel safety that meets UL and OSHA safety requirements.
- .3        The engine's cranking batteries shall be lead acid. The batteries shall be sized per the manufacturer's recommendations.
- .4        The generator set shall have an engine driven, battery charging alternator with integrated voltage. The battery charger is to be factory installed on the generator set.
- .5        The engine shall include a primary fuel filter, water separator, manual fuel priming pump, and engine flexible fuel lines must be installed at the point of manufacture. Element shall be replaceable paper type.
- .6        Engines that are equipped with an electronic engine control module (ECM) shall monitor and control engine functionality and seamlessly integrate with the generator set controller through digital communications. ECM monitored parameters shall be integrated into the generator set controllers NFPA 110 alarm and warning requirements.
- .7        The engine exhaust emissions shall meet the EPA emission requirements for standby power generation.
- .8        The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system. A rain cap will terminate the exhaust pipe after the silencer. All components must be properly sized to assure operation without excessive back pressure when installed.
- .9        The manufacturer shall supply a hospital grade exhaust silencer as minimum.
- .10        The generator sets' weather proof sound attenuated enclosure exhaust piping from the turbo-charged discharge to the silencer shall be thermally wrapped to minimize heat dissipation inside the enclosure.
- .11        The alternator shall meet temperature rise standards of UL2200 (120 degrees C). The insulation system material shall be class "H" capable of withstanding 150 degrees C temperature rise.
- .12        The generator control system shall be a fully integrated microprocessor based control system for standby emergency engine generators meeting all requirements of NFPA 110 level 1. The generator control system shall be a fully integrated control system enabling remote diagnostics and easy building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including: engine protection, alternator protection, speed governing, voltage regulation and all related generator operations.

- .13 Provide a remote annunciator panel indicating high and low battery voltage, generator running, normal Utility power, EPS supplying load, low and pre-low oil pressure, high and pre-high coolant temperature, over-speed, under-crank, not in automatic transfer, battery charger malfunction, low fuel, low oil pan temp, low battery temp, low coolant temp and fault.
- .14 Two thermal magnetic circuit breakers carrying the UL mark shall be factory installed. The breakers shall be rated as shown on the single line diagram. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.
- .15 The generator set shall be packaged with a sound attenuating enclosure. The enclosure shall be completely lined with sound deadening material. This material must be of a self-extinguishing design.
- .16 The generator set shall come with an oil pan heater, battery heater, water pump heater and coolant heater.
- .17 The packaging shall include a double wall, sub-base mounted, UL142 listed fuel tank. The tank shall be sized to provide 72 hours of run time.
- .18 The fuel tank shall use an electric fuel sensor to provide analog indication of fuel level. The controller shall have a warning indication on low fuel level and provide optional shutdown functionality for low, low fuel level. The fuel tank must be supplied by the engine-generator set manufacturer and be installed before shipment.

## 2.2 FACTORY TESTS

- .1 Before shipping, the generator set and control panel shall be fully assembled and set up for tests at the shop/factory.
- .2 The factory test shall include
  - .1 Testing of all shutdown and malfunction devices including but not limited to
    - .1 High water temperature switch. This test shall be performed by actually raising the water temperature to prove sensor operation as well as the shutdown.
    - .2 Low oil pressure switch. This test shall be performed by actually reducing the oil pressure to prove sensor operation as well as the shutdown.
    - .3 Over-cranking switch.
    - .4 Over-speed switch.
    - .5 Low water level. This test shall be performed by actually lowering the water level to prove sensor operation as well as the shutdown.
    - .6 Low fuel supply level main tank.
    - .7 Low fuel supply level day tank.
    - .8 Low battery voltage level. This test shall be performed by connecting an external load to the battery while recording the battery voltage and trigger point of the alarm.
  - .2 Governor response tests.
  - .3 Voltage regulator response tests.

- .4 Vibration levels measured against factory limits.
- .5 3-hour full-load test (resistance load acceptable) at rated speed and voltage.
- .6 Readings at quarter-hour intervals during full-load tests shall be taken for the following
  - .1 Exhaust temperatures (before turbo-charger)
  - .2 Water temperature
  - .3 Lubrication oil temperature
  - .4 Lubrication oil pressure
  - .5 Voltage, current and frequency
  - .6 Kilowatts
- .3 Electronic copies of all test results shall be submitted to the Consultant for review.

### **Part 3 Execution**

#### **3.1 INSTALLATION - GENERAL**

- .1 Uncrate, unload, hoist, and install in place the engine generator, remote annunciator panel, and all equipment as specified herein.
- .2 Coordinate the installation fully with the supplier, mechanical sub-trade, and the manufacturer of the low voltage switchboard to ensure that all wiring and electrical devices, fuel, air, and exhaust requirements are met and that the system operates as described under "Sequence of Operation".
- .3 Provide all power wiring and connections from generator engine set to transfer switch.
- .4 Provide all power wiring and connections to engine auxiliary heaters..
- .5 Provide separate power supply to battery charger.
- .6 Provide all required equipment and system ground connections.
- .7 Provide all required control and annunciator wiring and connections.
- .8 All wiring connections shall be with liquid seal-tight flexible conduit.
- .9 Provide flexible connectors (min. 450mm) at all connections to the diesel engine generator set (fuel, electrical, coolant, exhaust, etc.).

#### **3.2 SERVICE START-UP**

- .1 The supplier shall provide supervision, assistance and instructions during installation and initial start-up and prior to site acceptance tests.
- .2 Any malfunctions occurring prior to final acceptance tests shall be corrected.
- .3 A mechanical inspection of the unit shall be made to ensure all fluid seals are properly installed and no leakage occurs.

- .4 After installation is complete and at a time when the unit is at normal operating temperature, the unit shall be stopped and clearances between the faces of any flexible couplings between engine and alternator shall be immediately checked. Adjustments shall be made as required to effect minimum eccentricity.
- .5 Installation of the engine generator set, control panel, and all auxiliary equipment including mechanical and electrical services to same shall be checked for conformity to the manufacturer's recommendations and upon completion of installation, a written acceptance statement shall be provided to the Consultant.
- .6 A list of deficiencies, if any, shall be submitted to the Consultant immediately after inspection has been completed.

### **3.3 SITE ACCEPTANCE TEST**

- .1 The supplier shall carry out all tests as outlined in the following. A time of test shall be agreed upon with the General Contractor, Electrical Sub-Contractor, and Consultant.
- .2 A continuous, full-load test on the diesel-engine generator shall be run for four (4) hours. The Generator supplier is responsible to provide suitable resistive type load banks and all required cabling at the site to carry out the load test.
- .3 The following data shall be taken at the start of the test and at half-hour intervals thereafter
  - .1 Frequency (not to be changed)
  - .2 Voltage (not to be changed)
  - .3 Load (Ampere)
  - .4 Kilowatts
  - .5 Water temperature
  - .6 Lubricating oil temperature
  - .7 Lubricating oil pressure
  - .8 Ambient temperature
- .4 On completion of the site acceptance test, the equipment supplier shall perform the following tests and demonstrate the satisfactory operation of the following devices
  - .1 High water temperature switch
  - .2 Low oil pressure switch
  - .3 Over-cranking switch
  - .4 Over-speed switch
  - .5 Low water level
  - .6 Low fuel supply level main tank
  - .7 Low fuel supply level day tank
  - .8 Low battery voltage level
  - .9 Main fuel tank leak
  - .10 Provide alignment of any flexible couplings
- .5 Electronic copies of all test results shall be submitted to the Consultant.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED WORK**

- .1        This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

**1.2                REFERENCES**

- .1        CAN/CSA C22.1, Canadian Electrical Code, Part I - most recent version
- .2        CAN/CSA C22.2 No.9.0, General Requirements for Luminaires.
- .3        IESNA Illuminating Engineering Society of North America - Lighting Handbook – most recent version
- .4        ASHRAE 90.1 – American Society of Heating, Refrigerating and Air-Conditioning Engineers – most recent version.

**1.3                INTENT**

- .1        Provide lighting fixtures and accessories for all outlets as listed in the Fixture Schedule and as shown on drawings.
- .2        Lighting fixtures shall be structurally well designed and constructed, using new parts and materials of the highest commercial grade available.
- .3        Bond all lighting equipment to grounding system.
- .4        Verify all ceiling types and finishes before ordering fixtures and provide fixtures suitable for mounting in or on ceilings being installed in each area, as specified. Where fixture types specified are not suitable for ceiling being installed, obtain written instructions from the Consultant before ordering fixtures.
- .5        Fixtures of the same or similar type shall be supplied by the same manufacturer.
- .6        Electrical contractor shall supply and install all luminaires complete with lamps, mounting brackets, lenses, ballasts (dimming or otherwise), drivers and all necessary accessories in accordance with luminaire types shown on drawings and listed in luminaires schedule unless otherwise noted.
- .7        Supply and install complete and proper support and hangers for all luminaires in ceiling space where required for proper support of outlet boxes and luminaire hanger assemblies.

**Part 2            Products**

**2.1                FIXTURES**

- .1        Ground mounted LED flag pole floodlight.
  - .1        Housing: Die-Cast Aluminum c/w heat sink fins
  - .2        Finish: Powdercoat Black
  - .3        Voltage: 120V AC
  - .4        Source: LED, 8 Section Module 3000K colour temperature rated.
  - .5        Mounting: as indicated

**Part 3            Execution**

**3.1                VERIFICATION OF CONDITIONS**

- .1            Install luminaire as indicated.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Standard Specifications for Highway Construction British Columbia Ministry of Transportation and Infrastructure – SP635 (2012) and all related amendments. Reference: [http://www.th.gov.bc.ca/publications/const\\_maint/contract\\_serv/standardspecs.htm](http://www.th.gov.bc.ca/publications/const_maint/contract_serv/standardspecs.htm)

**1.2 REFERENCES**

- .1 CSA Group
  - .1 CAN/CSA-A14-07(R2012), Concrete Poles.
  - .2 CSA C22.2 No.206-13, Lighting Poles.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 10 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect roadway lighting from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 STEEL POLES**

- .1 Steel poles: to CSA C22.2 No.206, BCMoTI Acceptable Products list and BC Standard Specifications for Highway Construction Section 635 designed for underground wiring and:
  - .1 Mounting on concrete anchor base.
  - .2 Style: monotube, tapered octagonal.
  - .3 Access handhole to SP655.
  - .4 Anchor bolts: to SP635.
  - .5 Finish: galvanized.
  - .6 Grounding lug.

**2.2 LUMINAIRES**

- .1 BCMoTI Approved Product. No alternate products will be accepted.

- .2 Voltage: 120V
- .3 Photometric Type: Extra Narrow Asymmetric (Type 2) and Narrow Asymmetric (Type 3) as indicated.
- .4 Wattage: 75W, 6300 Lumens
- .5 Colour Temperature: 4000K
- .6 Product: GE Lighting "Evolve" series. Model ERS1-1-C3-A1-5-40.

**2.3 ELECTRICAL SERVICE PANEL No. 1**

- .1 BCMoTI Approved Product. No alternate products will be accepted.
- .2 Mounting: Pole
- .3 Voltage: 120/240V, 1Ø
- .4 Capacity: 100A
- .5 Enclosure: Stainless Steel, weatherproof, top feed
- .6 Lighting Contactor: 30A-4 Pole
- .7 Components: 100A-2P Main breaker, lighting contractors and 16 circuit distribution panel.
- .8 Product: Valid Manufacturing Model HWYSP16-10S

**2.4 ELECTRICAL SERVICE PANEL "X"**

- .1 Mounting: Pole
- .2 Voltage: 120/240V, 1Ø
- .3 Capacity: 100A
- .4 Enclosure: Stainless Steel, weatherproof, bottom feed
- .5 Lighting Contactor: 30A-4 Pole
- .6 Components: 100A-2P Main breaker, lighting contractors and 16 circuit distribution panel.
- .7 Product: Valid Manufacturing Model HWYSP16-10S-U

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roadway lighting installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 INSTALLATION**

- .1 Install poles true and plumb, in accordance with manufacturer's instructions.
- .2 Install luminaires on pole davits and install lamps.
- .3 Check luminaire orientation, level and tilt.
- .4 Connect lighting and non-lighting loads to electrical service panel circuits as indicated.
- .5 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**END OF SECTION**