
PART 1. GENERAL

1.1 DESCRIPTION OF WORK

- .1 Supply and install new power feeds (including, but not limited to, circuit breakers, wiring, conduit, starters, and disconnect switches) for new mechanical equipment and systems as indicated under this contract.
- .2 Supply and install new 120 Volt power feeds (including, but not limited to, circuit breakers, wiring, and conduit) for new control panels, sensors, and devices as indicated under this contract.
- .3 Supply and install LED flood lighting and lighting contactor for new oil tank area as indicated.
- .4 Supply and install new underground duct, conduit under concrete tank slab, stub ups, junction boxes, vaults, conduit seals, supports, and equipment as indicated.
- .5 Install and mount three remote tank monitors as indicated (remote tank monitors shall be supplied by Division 33).

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23th Edition), Safety Standard for Electrical Installations.
 - .2 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 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.

1.3 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.

1.4 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 and French.
- .4 Use one nameplate for both languages.

1.5 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate details of construction, dimensions, capacities, weights, and electrical performance characteristics of equipment and material.
 - .3 Where applicable, include wiring, single line, and schematic diagrams.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Submit test results of installed electrical systems and instrumentation.
 - .2 Permits and fees: in accordance with General Conditions of contract.
 - .3 Submit, upon completion of work, load balance report as described in PART 3 - LOAD BALANCE.
 - .4 Submit certificate of acceptance from Electrical Inspection Department upon completion of work to Departmental Representative.

1.6 QUALITY ASSURANCE

- .1 Site Visit: Contractor to visit site and become familiar with the project and all conditions which may affect costs. Ignorance of existing conditions will not be considered as basis for extra claims.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

1.7 SYSTEM STARTUP

- .1 Instruct Departmental Representative and Operating Personnel in operation, care and maintenance of systems, system equipment and components.
- .2 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.

1.8 OPERATING INSTRUCTIONS

- .1 Provide operating instructions 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.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 22 - Construction/Demolition Waste Management And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring materials from landfill to metal recycling facility.

PART 2. PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from Electrical Inspection Department.
- .3 Factory assemble control panels and component assemblies.

2.2 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of Electrical Inspection Department.
- .2 Decal signs, 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 with nameplates as follows:
 - .1 Nameplates: 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core, permanently attached.
 - .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

NAMEPLATE SIZES

letters

- .2 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .3 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .4 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .5 Terminal cabinets and pull boxes: indicate system and voltage.
- .6 Transformers: indicate capacity, primary and secondary voltages.

2.5 WIRING IDENTIFICATION

- .1 Identify branch circuit wiring, including neutral conductors, at both ends, including all junction boxes located in between, with permanent indelible identifying markings indicating panel and circuit number (i.e. J-12).
- .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 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.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue

	Prime	Auxiliary
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

2.7 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 to EEMAC Y1-1.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

PART 3. EXECUTION

3.1 INSTALLATION

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

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install cables, conduits, and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 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.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.6 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 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centers, 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 distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .4 Insulation resistance testing:
 - Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - 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.

3.7 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

3.8 INCIDENTAL WORK REQUIREMENTS

- .1 All cutting and patching incidental to all electrical work shall be in accordance with Section 01 10 10 - General Instructions.
- .2 Firestopping as indicated in accordance with Section 07 84 00 - Firestopping.

END OF SECTION

PART 1. GENERAL

1.1 REFERENCES

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 All removal or modifications of electrical construction to be carried out in accordance with safety standards outlined in the Canadian Electrical Code 2015.

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 SP1122.

1.3 PROTECTION

- .1 Contractor shall be responsible for any damages to existing structure and equipment as a result of this work.

1.4 RE-USE OF MATERIALS

- .1 Materials and equipment identified on drawings as being re-used are to be taken down, reinstalled, etc. as required to allow for new construction.
- .2 Contractor must identify any damaged equipment or materials intended for re-use prior to demolition and point out deficiencies to Departmental Representative at that time.

1.5 DISPOSAL

- .1 Prior to demolition, Departmental Representative will identify any items of electrical equipment which are to be set aside as directed for future use by owner. Contractor shall provide a list of equipment being removed for Departmental Representative's review.
- .2 All other materials and equipment removed under work of this Section become property of the Contractor for disposal off site.
- .3 All electrical equipment determined to be environmentally hazardous shall be disposed of in accordance with NS Department of Environment instructions and guidelines and Environment Canada regulations. These guidelines must be

strictly adhered to. Contractor must obtain and familiarize themselves with proper disposal methods.

1.6 SCHEDULING

- .1 Contractor must note that normal operations are to be maintained and work activities must be coordinated to maintain electrical services in occupied areas. Contractor shall provide any temporary work.
- .2 Overtime work and work outside normal work hours as deemed necessary to accomplish this scheduling are the responsibility of the Contractor and must meet the requirements of the Department of Labour. All costs from such overtime must be included in the Contractor's Estimated Total Tender Price.
- .3 Essential services including, but not limited to, Fire Alarm, security, emergency and exit lighting, telephone and data systems must be maintained in operation at all times. All shutdowns required for this work must be minimized and planned and coordinated with schedules provided by Departmental Representative.

PART 2. PRODUCTS - NOT APPLICABLE

PART 3. EXECUTION

3.1 GENERAL REMOVALS

- .1 Schedule all removal work with Departmental Representative. Do not disrupt operations except as permitted by schedule.
- .2 Contractor shall be responsible for re-energizing, terminating, and verifying functionality of all existing circuitry disabled by work carried out under this contract.

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

- .1 Section 26 05 21 - Wire and Cables.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2 No.18-98, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2 No.65-93 (R1999), Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

PART 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, as required to: CAN/CSA-C22.2 No.18.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:

- .1 Install mechanical pressure type connectors and tighten screws. 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

PART 1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 20 - Wire and Box Connectors.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

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 min. insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.

2.3 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Type: ethylene propylene rubber.
 - .2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.

- .4 Inner jacket: polyvinyl chloride material.
- .5 Overall covering: thermoplastic material.
- .6 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
- .7 Connectors:
 - .1 Watertight approved for TECK cable.

PART 3. EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.2 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

3.3 INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0 - 1000 V.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 20 - Wire and Box Connectors (0-1000V).

1.2 SUBMITTALS

- .1 Submit shop drawings for buried vaults in accordance with Section 01 33 00 - Submittal Procedures.

PART 2. PRODUCTS

2.1 JUNCTION AND PULLBOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Weatherproof complete with gasketing and watertight conduit and cable fittings where indicated.

2.2 STEEL WIRING VAULTS

- .1 Heavy duty weatherproof, watertight junction box, sizes as indicated to CSA C22.2 No.25.
- .2 Heavy duty cover rated for vehicular traffic to AASTO H-20 (7258 kg wheel load).
- .3 Hot dipped galvanized steel body, dimensions as indicated.
- .4 Hot dipped galvanized steel checkered cover with external flange for flush mounting, complete with neoprene gasket cemented to cover.
- .5 Stainless steel tamper proof cover screws.

2.3 HDPE WIRING VAULTS

- .1 CSA listed high density polyethylene (HDPE) pull box vault, suitable for direct burial, dimensions as indicated.
- .2 Weatherproof, water tight, HDPE bolted lid rated 5 kN, for flush mounting with grade.
- .3 Stainless steel tamper proof cover screws.

PART 3. EXECUTION

3.1 JUNCTION, PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install pull boxes so as not to exceed 30m of conduit run between pull boxes.
- .3 Install weatherproof junction boxes for stub ups, in electrical vaults, and in transition sump pits with adequate conduit and cable outlets as indicated.

3.2 STEEL WIRING VAULT INSTALLATION

- .1 Install as per manufacturer's instructions and in accordance with other trades.
- .2 Install boxes such that covers are flush with finished grade of concrete slab.
- .3 Fully seal joint between boxes and concrete slab.
- .4 Make watertight all conduit penetrations.

3.3 ELECTRICAL VAULT INSTALLATION

- .1 Install as per manufacturer's instructions and in accordance with other trades.
- .2 Install boxes such that covers are flush with finished grade.
- .3 Install complete with internal vertical separator for isolation of controls and instrumentation and power wiring.
- .4 Make watertight all conduit penetrations.

3.4 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.

PART 2. PRODUCTS

2.1 SUPPORT CHANNELS

- .1 Galvanized, U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted unless otherwise indicated.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Support equipment, conduit, or cables using clips, spring loaded bolts, cable clamps, u-bolts, 6 mm threaded rod, designed as accessories to basic channel members.
- .2 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .3 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .4 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 46 - Underground Cable Ducts.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No.83-M1985(R2003), Electrical Metallic Tubing.

1.3 SUBMITTALS

- .1 Product data: submit manufacturer's printed product literature, specifications and datasheets.

PART 2. PRODUCTS

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid PVC conduit: to CSA C22.2 No. 211.2.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
- .2 Two hole steel straps for conduits larger than 50 mm.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

2.4 CONDUITS IN HAZARDOUS LOCATIONS

- .1 Install explosion proof, threaded conduit sealing fittings, rated Class 1, Zone 2 where indicated.
- .2 Fittings shall be CEC Class I, Div 2 compliant, suitable for horizontal or vertical installation.
- .3 Fitting shall have threaded hubs to match conduit c/w integral bushings, and threaded sealing compound opening.
- .4 Sealing compound shall be CEC Class I, Div 2 compliant, cUL listed, rated for -40 to 165 F.
- .5 Install sealing compound to form complete seal between fitting bushings and conduit and conductors entering hub.

2.5 FISH CORD

- .1 Polypropylene.

PART 3. EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 All conduit penetrations as indicated shall be sealed and firestopped as per Section 07 84 00 - Firestopping.
- .3 Install conduit sealing fittings in hazardous areas, fill with compound.
- .4 Conceal conduits except in mechanical and electrical service rooms, attic, and crawlspace.
- .5 Surface mount conduits.

- .6 Minimum conduit size for lighting and power circuits: NPS $\frac{3}{4}$ " (19 mm).
- .7 Bend conduit cold: Replace conduit if kinky or flattened more than $\frac{1}{10}$ th of its original diameter.
- .8 Mechanically bend steel conduit over 19 mm diameter.
- .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .10 Maximum conduit support spacing:
 - .1 1.5m for 21mm trade size conduit.
 - .2 2m for 27mm and 35mm trade size conduit.
 - .3 3m for 41mm and larger.
- .11 Install fish cord in empty conduits.
- .12 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Do not pass conduits through structural members except as indicated. Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 05 21 - Wires and Cables (0-1000 V).
- .3 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings.
- .4 Section 26 05 46 - Underground Concrete Encased Duct Banks.
- .5 Section 31 23 10 - Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)

PART 2. PRODUCTS

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC ducts and fittings type DB2 for direct burial.
- .2 Rigid PVC couplings, reducers, bell end fittings, plugs, caps, adaptors, conduit, and junction boxes, as required to make complete installation.
- .3 Rigid PVC 90° and 45° bends as required.
- .4 Rigid PVC 5° angle couplings as required.
- .5 Expansion joints as recommended by manufacturer.
- .6 Waterproof fittings, seals, and cable glands for connection to sump pits, electrical vaults, and equipment stub ups. Install as per manufacturer's instructions.

2.2 WIRING

- .1 As indicated by the contract drawings and specifications.

2.3 MARKERS

- .1 Marker Tape: Red polyethylene marker type 75 mm wide with labeled black lettering "Warning - Electrical Power Cable Below".

PART 3. EXECUTION

3.1 DUCT INSTALLATION

- .1 Install duct in accordance with manufacturer's instructions.
- .2 Clean inside of ducts before installation.
- .3 Ensure full, even support every 1.5 m throughout duct length.
- .4 Slope ducts with 1 to 400 minimum slope.
- .5 During construction, cap ends of ducts to prevent entrance to foreign materials.
- .6 Pull through each duct wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 In each duct install pull rope continuous throughout each duct run with 3m spare rope at each end.
- .8 Install markers as required.
- .9 Install expansion joints in conduit systems in all rises above grade and in all connections to fixed equipment.

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 multi-conductor control cables reel off in same direction during installation.

- .6 Before pulling cable into ducts and until cables are properly terminated, 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 as follows:
 - .1 Perform tests using qualified personnel. Provide necessary instruments and equipment.
 - .2 Check phase rotation and identify each phase conductor of each feeder.
 - .3 Check each feeder for continuity, short circuits, and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .2 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.
- .3 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing:
 - .1 Conduct hipot testing to IEEE 400 and in accordance with manufacturer's recommendations.
- .4 Provide Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.
- .5 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

PART 1. GENERAL

1.1 GENERAL

- .1 The contractor shall verify locations of all existing underground obstructions and services prior to digging trenches.
- .2 The contractor shall coordinate with other trades and become familiar with all other discipline's contract documents and proposed equipment installations prior to digging trenches. All conflicts shall be reported prior to commencing work.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast in Place Concrete.
- .2 Section 26 05 00 - Common Work Results - Electrical.
- .3 Section 26 05 21 - Wires and Cables (0-1000 V).
- .4 Section 26 05 23 - Splitters, Junction, Pull Boxes, and Cabinets.
- .5 Section 26 05 34 - Conduits, Conduit Fastenings, and Conduit Fittings.
- .6 Section 26 05 45 - Buried Cable and Ducts.
- .7 Section 31 23 10 - Excavating, Trenching and Backfilling.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)

PART 2. PRODUCTS

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC ducts and fittings type DB2 for direct burial.
- .2 Rigid PVC split ducts.
- .3 Rigid PVC couplings, reducers, bell end fittings, plugs, caps, and adaptors as required to make complete installation.
- .4 Rigid PVC 90° and 45° bends as required.

- .5 Rigid PVC 5° angle couplings as required.
- .6 Expansion joints as recommended by manufacturer.
- .7 Waterproof fittings, seals, and cable glands for connection to electrical vaults. Install as per manufacturer's instructions.

2.2 SOLVENT WELD COMPOUND

- .1 Solvent weld compound for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT

- .1 Continuous 6mm stranded nylon pull rope, tensile strength 5 kN, in each conduit

2.4 MARKERS

- .1 Marker Tape: Red polyethylene marker type 75 mm wide with labeled black lettering "Warning - Electrical Power Cable Below".

PART 3. EXECUTION

3.1 DUCT BANK INSTALLATION

- .1 Install reinforced concrete encased underground duct banks, including form work.
- .2 Build duct bank on undisturbed soil or on well-compacted granular fill not less than 150mm thick, compacted to 95% of maximum proctor dry density.
- .3 Open trench completely before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .4 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .5 Install base spacers at maximum intervals of 1.5m levelled to grades indicated for bottom layer of ducts.
- .6 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain horizontal spacing between ducts as indicated. Stagger joints in adjacent layers at

- least 150mm and make joints watertight. Encase duct bank with 50mm thick concrete cover.
- .7 Use galvanized steel conduit for sections extending above finished grade level.
 - .8 Make transpositions, offsets, and changes in direction using 5 degree bends sections, do not exceed a total of 20 degrees with duct offset.
 - .9 Terminate duct runs with a duct coupling set flush with the end of the concrete envelope when dead ending duct bank for future extension.
 - .10 Cut, ream, and taper end of ducts infield to manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
 - .11 Allow concrete to attain 50% of its specified strength before backfilling.
 - .12 Use anchors, ties, and trench jacks as required to secure ducts and prevent moving during pouring of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
 - .13 Clean ducts before laying. Cap ends during construction and after installation to prevent entrance of foreign materials.
 - .14 In each duct install pull rope continuous throughout each duct run with 3m spare rope at each end.
 - .15 Immediately after pouring of concrete, pull through each duct a mandrel followed by a stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling in cables.
 - .16 Install four 3m lengths of 15m reinforcing rods, one in each corner of duct bank when connecting duct to buildings.
 - .17 Install markers as required.
 - .18 Install expansion joints in conduit systems in all rises above grade and in all connections to fixed equipment.
 - .19 Concrete for encasement of electrical ducts shall be in accordance with CSA Standards (minimum concrete strength of 32MPa).

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 29 10 - Combination Motor Starters to 600V.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.248.12-94. Low Voltage Fuses Part 12: Class R (Bi-National Standards with, UL 248-12 (first Edition).

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals
- .2 Six spare fuses of each type and size installed up to and including 600 A.

PART 2. PRODUCTS

2.1 FUSES GENERAL

- .1 Fuse type reference L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer for entire project.

2.2 FUSE TYPES

- .1 Class J Fuses (formerly HRCI-J).
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
 - .2 Type J2, fast acting.
 - .3 200kA interrupting rating, 600 volt, rating as indicated.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting device immediately before energizing circuit.
- .2 Ensure correct fusing fitted to physically match mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for moulded case circuit breakers.

1.2 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

PART 2. PRODUCTS

2.1 BREAKERS GENERAL

- .1 Moulded case circuit breakers and circuit breakers to CSA C22.2 No. 5.
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .6 Circuit breakers to have minimum 10kA symmetrical rms interrupting capacity rating.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Install circuit breaker in existing spare bucket in existing MCC as per manufacturer's instructions, size and rating as indicated. Install mounting equipment, door handle, and make door modifications as required.
- .2 Install circuit breakers compatible with existing panel board as per manufacturer's instructions as required, size and rating as indicated.

END OF SECTION

PART 1. GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.
- .2 Section 26 28 14 - Fuses Low Voltage.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
 - .2 CSA C22.2 No.39-M89 9R2003), Fuseholder Assemblies.
- .2 International Electrotechnical Commission (IEC)
 - .1 IEC 947-4-1-1990, Part 4: Contactors and Motor Starters.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter type and size.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure type and dimensions.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.
- .3 Provide operations and maintenance data for each type and style of motor starter for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

PART 2. PRODUCTS

2.1 COMBINATION STARTERS

- .1 Combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure with front door closed.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.

- .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect as follows:
 - .1 Fusible disconnect switch complete with fusing in enclosure to CSA C22.2 No.4. Size, rating, and enclosure as indicated
 - .2 Provision for padlocking in ON/OFF switch position by multiple padlocks.
 - .3 Mechanically interlocked door to prevent opening when handle in ON position.
 - .4 Quick make - quick break action.
 - .5 ON-OFF switch position indication on enclosure cover.
 - .6 Fuseholder: to CSA C22.2 No 39, suitable without adaptors, for type and size of fuse indicated
- .3 Accessories:
 - .1 Hand/Off/Auto standard, labelled as indicated.
 - .2 Overload relays manually reset from front with door closed.
 - .3 Indication lamp.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Indicate name of load controlled on Size 2 nameplate.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results Electrical General Requirements, and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functionality.

- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for exterior site and tank area lighting.

1.2 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.137-M1981 (R2009), Electric Luminaires for Use in Hazardous Locations.

1.4 SUBMITTALS

- .1 Submit complete shop drawings for luminaires, driver, and mounting equipment in accordance with Section 01 33 00 - Submittal Procedures.

PART 2. PRODUCTS

2.1 LED FLOOD LIGHTS

- .1 CSA certified C22.2 No. 137.
- .2 LEDs and Driver:
 - .1 High efficiency LEDs, 6300 lumen output, 5000k.
 - .2 347 volt AC, 126 nominal watts, 0.85 PF.
- .3 Luminaire:
 - .1 Copper free aluminum housing with epoxy powder coat.
 - .2 Silicone gaskets, shatter resistant glass lens, stainless steel external hardware, complete with pipe slip fitter mounting.
 - .3 Replaceable driver and LEDs.
 - .4 Operating temperature range: -40 to 50 degrees Celsius.
 - .5 Rated life: 60,000 hours.
 - .6 NEMA 4X rated, approved for wet locations.
 - .7 Approved for Class 1, Zone 2 Hazardous location.
- .4 Acceptable product or approved equal:
 - .1 Cooper Crouse-Hinds - Champ Series FMV9LCY/347-SFA6.

2.2 LIGHTING CONTACTOR

- .1 Contactors: to CSA C22.2 No.14.
- .2 Controlled as indicated and rated for load controlled.
- .3 Complete with 1 normally open and 1 normally closed auxiliary contacts unless indicated otherwise.
- .4 Mount in CSA Enclosure type 1.
- .5 Include following options in cover:
 - .1 Hand-Off-Auto selector switch.
- .6 Control transformer: in contactor enclosure.
- .7 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

PART 3. EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Connect luminaires to lighting circuits as indicated.
- .3 Verify final tilt and orientation upon final installation.
- .4 Install lighting contactor in enclosure in main electrical room as indicated.
- .5 Connect auxiliary connection controls wiring (by Division 25).

END OF SECTION