DIVISION 16 - ELECTRICAL

PART 1 GENERAL

1.1 Related Sections

.1 This Section covers items common to Sections of Division 16.

1.2 Codes and Standards

.1 Do complete installation in accordance with the current edition of the Canadian Electrical Code (CSA C22.1) except where specified otherwise.

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

.3 Perform all work in accordance with local codes and bylaws.

1.3 Care, Operation and Start-up

.1 Instruct Contract Administrator and operating personnel in the 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 all aspects of its care and operation.

1.4 Voltage Ratings

.1 Operating voltages: to CAN3-C235-83.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 Permits, Fees and Inspection

.1 Submit to Electrical Safety Authority and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.

.2 Pay associated fees.

.3 Contract Administrator will provide drawings and specifications required by Electrical Safety Authority and Supply Authority at no cost.

.4 Notify Contract Administrator of changes required by Electrical Safety Authority prior to making changes.

.5 Furnish Certificates of Acceptance from Electrical Safety Authority on completion of work to Contract Administrator.

1.6 Measurement and Payment

.1 The lump sum price in Form B applies to all work listed within these specifications and on the drawings to provide a complete and operational electrical distribution and control system to meet the operational intent of the facility.

.2 The electrical portion of this contract shall be submitted on Form B as a lump sum. Payment for the work will be based on percentage estimation of progress. The Contract Administrator shall review the percentage of work complete and review the estimated Work with the Contractor prior to submitting the progress payment to the City. Progress estimates include time required for training.

1.7 Materials and Equipment

.1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

.2 Factory assemble control panels and component assemblies.

1.8 Electric Motors, Equipment and Controls

.1 Provide all power and control wiring and connections including mechanical control wiring as specified on mechanical and electrical drawings.

1.9 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 Y1-1-1955.

.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1-1958.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.10 Equipment Identification

.1 Identify electrical equipment with nameplates as follows:

.2 Nameplates:

.1 Lamicoid 3 mm thick plastic engraving sheet, white face, black core, mechanically attached with self tapping screws.

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 Utilize nameplate types as required to completely identify unit.

.3 Reduced Voltage Starter Units: Indicate RVS identification number, and fed from identification number "RVS-1/Fed from _____".

.4 RVS Feeder Units (eg. to motors): Indicate motor identification name and feeder "Pump P-1/Fed from RVS-1".

.5 Transformer: Indicate feeder circuit identification number, transformer identification number "TR-1/Fed from _____/Feeds _____".

.6 Lighting Panels, Power Panels, Instrument Power Panels and Feeder Units to Panels: Indicate panel identification name, and where fed from "Panel PP-1/Fed from TR-1".

.7 Field Operator Stations (eg. start/stop): Indicate station number, title, and where appropriate device controls.

.8 Control devices (eg. remote thermostats): Indicate equipment number of unit being controlled.

.9 Light switches and convenience receptacles: Indicate panel and circuit number.

.10 Co-ordinate names of equipment with Mechanical Division to ensure that identical names are used.

.11 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.12 Allow for average of twenty-five (25) letters per nameplate.

.13 Identification to be English.

.14 Identify equipment with Size 3 labels engraved with equipment tag.

1.11 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, using Electrovert Type Z cable markers (or equal) on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use number coded wires in control cables, matched throughout system. Identify conductors with permanent indelible identifying markings, numbered on both ends.

.5 Use number coded pairs in instrumentation cables, matched throughout system. Pairs shall be also color coded black and white for polarity indication. Identify conductor pairs with permanent indelible identifying markings, at both ends.

1.12 Wiring Terminations

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminium conductors.

1.13 Manufacturers and CSA Labels

.1 Visible and legible, after equipment is installed.

1.14 Warning Signs

.1 As specified and to meet requirements of The City and Contract Administrator.

.2 Decal signs, minimum size 175 x 250 mm.

1.15 Single Line Electrical Diagrams

.1 Provide single line electrical diagrams under plexiglass as follows:

.1 Electrical distribution system: locate in main electrical room.

.2 Drawings: 280 x 460 mm minimum size.

1.16 Location of Outlets

.1 Locate outlets in accordance with Section 16132 – Outlet Boxes, Conduit Boxes and Fittings, and as shown on the drawings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

1.17 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.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400 mm.

.2 Wall receptacles:

.1 General: 300 mm.

.2 In mechanical rooms: 600 mm.

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

.4 Telephone and interphone outlets: 300 mm.

.5 Wall mounted telephone and interphone outlets: 1500 mm.

1.18 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 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.19 Conduit and Cable Installation

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

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

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

1.20 Field Quality Control

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.

.2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province of Manitoba. Submit test results to Contract Administrator.

.3 Conduct and pay for following tests:

.1 Point to Point wire continuity test for all conductors.

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

.3 Circuits originating from branch distribution panels.

.4 Lighting and its control.

.5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.6 Systems: fire alarm system

.7 Test resistance to ground of the completed grounding electrode.

.4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.5 Insulation resistance testing.

.1 Megger 600 V circuits, feeders and equipment with a 1000 V instrument.

.2 Check resistance to ground before energizing.

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

.7 Submit test results for Contract Administrator's review.

1.21 Co-ordination of Protective Devices

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

1.22 Instruction Manuals

.1 The Contractor shall provide the City of Winnipeg with four (4) copies of maintenance and operating manuals showing:

.1 Service Instructions: Including a list of spare parts and replacement parts and the names and addresses of all suppliers.

.2 Maintenance Instructions.

.3 Installation Instructions.

.4 Operating Instructions.

.5 Electrical Schematics.

1.23 As-Built Drawings

.1 The Contractor shall provide two sets of record drawings bearing notations of all changes and variations from the originals. One set shall remain on site to assist in operation until the final as-builts are available. One set shall be delivered to the Contract Administrator.

.1 The accuracy of these drawings shall be the responsibility of the Contractor, who shall bear all expenses of corrections thereto.

1.24 Training

.1 The Contractor shall provide two separate complete days of training on the operation of the electrical and control equipment. These training days are to be co-ordinated with the city a minimum of two weeks in advance.

1.25 Scope of Work

.1 Supply and install all lighting, conduit, receptacles, panels etc. as indicated on the drawings.

.2 Supply and Install electrical power and controls wiring as indicated on the drawings.

.3 Install electrical power/control cables from flood pumps to splitter boxes. Cable supplied by pump manufacturer.

.4 Supply and Install shop fabricated panels produced by a CSA certified panel shop for the Level Control Panel, Pump Field Junction Panels (JB-P1 & JB-P2) and Power Monitoring Panel (PL-CP).

.5 Provide pre-commissioning tests (in the dry) as follows:

.1 Pump rotation.

.2 Soft start setup.

.3 Arrange for City WWD to setup pump level controls.

.4 Test out all alarms locally and together with WWD alarms out to the City's SCADA.

.6 Commissioning tests (in the wet, Refer to Section 11000 for details)

.1 Provide all services required to prove out the pumping system in the wet.

1.26 Electrical Service

.1 The City will arrange and pay for Manitoba Hydro to provide electrical service up to hydro supplied pad mount transformer. All cabling from the secondary side terminals is the responsibility of the Contractor. A continuous wireway from the lockable metering enclosure to the CT's must be installed by the Contractor for Manitoba Hydro to install it's metering equipment. The Contractor is to coordinate with Manitoba Hydro for this work.

1.27 Telephone Service

.1 Telephone service is to be installed by MTS. Contractor is responsible for coordinating telephone service installation with MTS.

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Not Used

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 16010 - Electrical General Requirements.

PART 2 PRODUCTS

2.1 Markers

.1 Cable marker strip at depth indicated.

PART 3 EXECUTION

3.1 Direct Burial Of Cables

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

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

.3 Underground cable splices not acceptable.

.4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.5 Cable separation:

.1 Maintain 75 mm minimum separation between cables of different circuits.

.2 Maintain 300 mm horizontal separation between low and high voltage cables.

.3 Installation configuration as per Canadian Electrical Code (CSA C22.1).

3.2 Field Quality Control

.1 Perform tests in accordance with Section 16010 - Electrical General Requirements.

.2 Perform tests using qualified personnel. Provide 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. Ensure resistance to ground of circuits is not less than 50 megohms.

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

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

END OF SECTION

PART 1 GENERAL

1.1 Description

.1 Supply and install a complete grounding system. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the current edition of the Canadian Electrical Code (CSA C22.1) (as adopted by the Province of Manitoba).

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

PART 2 PRODUCTS

2.1 Equipment

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.

.2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, soft annealed, size as required.

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

.4 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

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

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

.7 Insulated grounding conductors to be stranded copper RW90 complete with a green jacket.

PART 3 EXECUTION

3.1 Installation General

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 All bolted connections must be accessible.

.7 Soldered joints not permitted.

.8 Include a separate green ground wire in all power conduits including branch circuit wiring sized to Table 16 of the current edition of the Canadian Electrical Code.

.9 Expansion joints and telescoping sections of raceways shall be bonded using jumper cables as per the current edition of the Canadian Electrical Code.

.10 Use Burndy compression connectors or approved equal for all grounding splices and terminations unless otherwise shown on the Drawings. For bolted ground connections use Burndy Engineering Company's "Durium" or approved equal hardware.

.11 Connect all transformer neutrals to the main building ground wire, using compression terminations.

.12 Install rigid conduit sleeves c/w bushings where ground wires pass through concrete slabs.

.13 Use mechanical connectors for grounding connections to equipment provided with lugs.

.14 Connect building structural steel and metal siding to ground by welding copper to steel.

.15 Ground secondary service pedestals.

3.2 Electrodes

.1 Install rod electrodes and make grounding connections.

.2 Bond separate, multiple electrodes together.

.3 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 System and Circuit Grounding

.1 Install system and circuit grounding connections to neutral of secondary 120 V system.

3.4 Equipment Grounding

.1 All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded through the conduit system or/and via a ground wire.

.2 All transformers, switchgear, motor control centres, panelboards and splitters fed from the main distribution center shall be grounded by grounding conductors sized in accordance with the current edition of the Canadian Electrical Code. The ground wire shall be terminated at each end with an appropriate grounding lug which shall be connected to the equipment ground bus.

.3 All sub panels such as lighting panels, local distribution panels, etc., shall be grounded with a green ground wire run back to the panel from which it is fed. The ground conductor shall be sized according to the current edition of the Canadian Electrical Code.

.4 All main distribution centres, switchgear, motor control centres, and all panels requiring equipment grounds shall contain a ground bus of adequate size, and tapped for lugs for the ground wire required.

.5 All motors shall be grounded by means of an adequately sized ground wire contained within the feeder conduit.

.6 Ground buried corrugated metal pipe to existing ground grid as shown on the drawings.

3.5 Communication Systems

.1 Install grounding connections for telephone systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

3.6 Field Quality Control

.1 Perform tests in accordance with Section 16010- Electrical General Requirements.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

PART 1 GENERAL

PART 2 PRODUCTS

2.1 Support Channels

.1 U shape, size 41 x 41 mm, 12 gauge, solid configuration.

.2 Surface mounted or suspended.

PART 3 EXECUTION

3.1 Installation

.1 Secure equipment to solid concrete or steel structures.

.2 Secure equipment to hollow or solid masonry with lead anchors and to toggle bolts.

.3 Secure equipment to poured concrete with expandable inserts.

.4 Secure equipment to wood trusses with ¼" lag screws.

.5 Support equipment, armoured cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.7 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.8 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.9 Fasten exposed armoured cable to building construction or support system using straps.

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

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel work.

.10 For surface mounting of two or more conduits use channels at spacing as per Rule 12-1010(1) of the current edition of the Canadian Electrical Code.

.11 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.13 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.14 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.

.15 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

PART 1 GENERAL

1.1 Related Sections

.1 Section 16151 - Wire and Box Connectors - 0 - 1000 V.

1.2 References

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

.2 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

1.3 Product Data

.1 Submit product data.

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 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 1 kV TECK90 Power Cable

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated (#12 AWG minimum where not indicated).

.3 Insulation:

.1 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

.4 Inner jacket: polyvinyl chloride material. Black in colour.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

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

.2 Channel type supports for two or more cables at 300 mm centers to prevent cable from drooping.

.8 Connectors:

.1 Watertight, explosion proof approved for TECK cable.

2.3 600 V TECK90 Control Cable

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: #14 AWG copper, number coded.

.3 Insulation:

.1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.

.4 Inner jacket: polyvinyl chloride material. Black in colour.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

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

.2 Channel type supports for two or more cables at 300 mm centers to prevent cable from drooping.

.8 Connectors:

.1 Watertight, explosion proof approved for TECK cable.

2.4 300 V Instrument Cable - Armoured

.1 Conductors: #16 AWG, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.

.2 Insulation: PVC TW75, 75 °C Wet, 105 °C Dry (-40 °C), 300 Volt.

.3 Twisted pairs/triads cabled with staggered lays.

.4 Shielding: Individual twisted pair(s)/triads Aluminum/mylar shield with ST drain wire, 100 % shield. Overall aluminum/mylar shield with ST drain wire. Individual drain wires one size smaller than conductor AWG. Overall drain wire the same AWG as conductors.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material (90 °C, -40 °C).

.7 Fastenings:

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

.2 Channel type supports for two or more cables at 300 mm centers to prevent cable from drooping.

.8 Connectors:

.1 Watertight, explosion proof approved for armoured cable.

2.5 Type RW90 Conductor

.1 In accordance with CSA C22.2 No.38

.2 Circuit conductors shall be concentric stranded soft copper, size as indicated (#12 AWG minimum where not indicated).

.3 Insulation to be chemically cross-lined thermosetting polyethylene rated type RW90 XLP, 600V

.4 Suitable for installation in temperatures down to minus 40 °C.

.5 90 °C conductor operating temperature.

2.6 Type TEW Conductor

.1 Circuit conductors shall be stranded soft copper, as per ASTM B-3 and B-8.

.2 Insulation to be thermoplastic compound meeting the requirements of Canadian Standards Association Type TEW, per CSA 22.2 Part 1, No.127.

.3 Isulation rated to 600 Volts.

.4 Suitable for installation in temperatures down to minus 40 °C

.5 105 °C conductor operating temperature.

.6 Use #16 AWG for PLC cabinet internal wiring.

PART 3 EXECUTION

3.1 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Section 16133 – Conduits, Conduit Fastenings and Conduit Fittings.

3.2 Installation of TECK Cable 0 -1000 V

.1 Install cables.

.1 Group cables wherever possible on channels.

.2 Terminate cables in accordance with Section 16151- Wire and Box Connectors - 0 - 1000 V.

3.3 Installation of Control Cables

.1 Install control cables in cable troughs where quantity warrants it.

.2 Ground control cable shield at one end only.

END OF SECTION

SPLITTERS, JUNCTIONS, PULL BOXES AND CABINETS

PART 1 GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data for cabinets.

PART 2 PRODUCTS

2.1 Splitters

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

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

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

2.2 Junction and Pull Boxes

.1 PVC 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.

PART 3 EXECUTION

3.1 Splitter Installation

.1 Install splitters and mount plumb, true and square to the building lines.

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

3.2 Junction and Pull Boxes Installation

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 Identification

.1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.

.2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

PART 1 GENERAL

1.1 References

.1 Current edition of the Canadian Electrical Code (CSA C22.1).

PART 2 PRODUCTS

2.1 Outlet and Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 347 V outlet boxes for 347 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Conduit Boxes

.1 Cast FS or FD copper free aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles for rigid conduit or Teck Cable.

.2 PVC boxes for PVC conduit.

2.3 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 Provide correct size of openings in boxes for conduit or armoured cable connections. Reducing washers are not allowed.

END OF SECTION

PART 1 GENERAL

1.1 References

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No. 45-M1981(R1992), Rigid Metal Conduit.

.2 CSA C22.2 No. 211.2-M1984(R1999), Rigid PVC (Unplasticized) Conduit.

1.2 Preferences

.1 In general power and control wiring shall be by TECK or armoured cable. Where suitable, PVC conduit may be used in wet areas and RGS may be used in dry areas.

PART 2 PRODUCTS

2.1 Conduits

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel

.2 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. Two hole steel straps for conduits larger than 50 mm.

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

.3 Channel type supports for two or more conduits at 0.75 m oc.

.4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 Conduit Fittings

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90º bends are required for 25 mm and larger conduits.

2.4 Expansion Fittings for Rigid Conduit

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 Fish Cord

.1 Polypropylene.

PART 3 EXECUTION

3.1 Installation

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Surface mount conduits.

.3 Minimum conduit size for lighting and power circuits: 19 mm.

.4 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.5 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.6 Install fish cord in empty conduits.

.7 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.8 Dry conduits out before installing wire.

.9 Connect conduit to equipment securely to maintain continuity for the purpose of bonding to ground.

.10 Provide for expansion and contraction of the conduit system.

3.2 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Run conduits in flanged portion of structural steel.

.3 Group conduits wherever possible on suspended surface channels.

.4 Do not pass conduits through structural members except as indicated.

3.3 Concealed Conduits

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

3.4 Conduits in Cast-in-place Concrete

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.5 Conduits Underground

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

PART 1 GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings and product data.

PART 2 PRODUCTS

2.1 Switches

.1 15 A, 120 V, single pole, double pole, three-way, four-way industrial grade switches as required.

.2 Manually-operated general purpose ac switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver cadmium oxide contacts.

.3 Fully enclosed with urea or melamine molding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

.5 Brown toggle.

.3 Toggle operated fully rated for fluorescent lamps and resistance loads, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Acceptable materials: Hubbell 1200 Series or equivalent.

2.2 Receptacles

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground industrial grade, with following features:

.1 Brown urea molded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground industrial grade, with following features:

.1 Brown urea molded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

.5 Acceptable materials: Hubbell 5252 or equivalent.

2.3 Cover Plates

.1 Stainless steel or pvc cover plates for wiring devices.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.5 Weatherproof double lift spring-loaded stainless steel or pvc cover plates, complete with gaskets for duplex receptacles as indicated on the drawings.

.6 Weatherproof spring-loaded stainless steel or pvc cover plates, complete with gaskets for single receptacles or switches as indicated on the drawings.

PART 3 EXECUTION

3.1 Installation

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height specified in Section 16010- Electrical General Requirements or as indicated.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height specified in Section 16010- Electrical General Requirements or as indicated.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 Mount lighting fixture receptacles local to fixtures.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

PART 1 GENERAL

1.1 References

.1 Most recent CSA C22.2No.65-1956Wire Connectors.

.2 Most recent EEMAC 1Y-2, Bushing Stud Connectors and Aluminium Adapters (1200 Ampere Maximum Rating).

PART 2 PRODUCTS

2.1 Materials

.1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armored cable, flexible conduit, non-metallic sheathed cable as required.

PART 3 EXECUTION

3.1 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer.

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

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 16010 - Electrical General Requirements.

1.2 References

.1 NEMA ICS 2, Industrial Controls and Systems

.2 CSA 22.2 No.14-95, Industrial Control Equipment

1.3 Extra Materials

.1 Provide maintenance materials.

.2 Provide listed spare parts for each different size and type of starter:

.1 3 contacts, stationary.

.2 3 contacts, movable.

.3 1 contacts, auxiliary.

.4 1 control transformer.

.5 1 operating coil.

.6 2 fuses.

.7 10% indicating lamp bulbs used.

PART 2 PRODUCTS

2.1 Manual Motor Starters

.1 Nema rated single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One or three overload heater(s) as required, manual reset, trip indicating handle.

.2 Accessories:

.1 Toggle switch: Heavy duty oil tight labelled as indicated.

.2 Indicating light: Heavy duty LED oil tight type and colour as indicated.

.3 Locking tab to permit padlocking in "OFF" position.

2.2 Full Voltage Magnetic Starters

.1 Nema rated magnetic and 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.

.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 fuse or circuit breaker with operating lever on outside of enclosure to control circuit breaker, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Selector switches: Heavy duty oil tight labelled as indicated.

.2 Indicating lights: Heavy LED duty oil tight type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.3 Control Transformer

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.4 Finishes

.1 Apply finishes to enclosure in accordance with Section 16010 - Electrical General Requirements.

2.5 Equipment Identification

.1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.

.2 Manual starter designation label, white plate, black letters, size 1, engraved.

.3 Magnetic starter designation label, white plate, black letters, size 1, engraved.

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 16010 - Electrical General Requirements and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.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 References

.1 CSAC9-M1981 (R1997), Dry-Type Transformers.

1.2 Source Quality Control

.1 Submit to Contract Administrator 6 copies of standard factory test certificates of each transformer and type test of each transformer in accordance with CSAC9.

1.3 Shop Drawings

.1 Submit shop drawings.

.2 Include:

.1 Dimensioned drawing showing enclosure, mounting devices, terminals, taps, internal and external component layout.

.2 Technical data:

.1 kVA rating.

.2 Primary and secondary voltages.

.3 Frequency.

.4 Number of phases.

.5 Polarity or angular displacement.

.6 Full load efficiency.

.7 Regulation at unity pf.

.8 BIL.

.9 Insulation type.

.10 Sound rating.

1.4 Closeout Submittals

.1 Provide operation and maintenance data for dry type transformers for incorporation into O&M manual.

.2 Operation and maintenance instructions to include:

.1 Tap changing.

.2 Recommended environmental conditions.

.3 Recommended periodic inspection and maintenance.

PART 2 PRODUCTS

2.1 Materials

.1 Dry-type transformers: to CSAC9.

.2 Bushings: to EEMACGL1-3.

2.2 Transformer Characteristics

.1 Type: ANN.

.2 Rating: As specified on drawings.

.3 220 ºC insulation system class, 115 ºC temperature rise.

.4 Impedance: 4 - 6 %.

.5 Primary winding: 600 V, delta, BIL 10 kV.

.6 Secondary winding: Voltage and winding connection as specified on drawing.

.7 No load losses not to exceed 1 % of kVA rating.

.8 Full load losses not to exceed 6 % of kVA rating.

.9 Sound rating: 50 dB maximum.

2.3 Enclosure

.1 Heavy duty ventilated NEMA type 1, Fabricated from sheet steel.

.2 Bolted removable panels for access to access separated primary and secondary terminals.

.3 Conductor entry: Knockouts

.4 Designed for universal floor, wall mounting or trapeze hung.

.5 Indoor, ventilated, self cooled type. Temperature of exposed metal parts not to exceed 90ºC rise.

2.4 Voltage Taps

.1 Three phase units:

.1 Units rated to 15 kVA, 1 ± 5 % FCAN & 1 ± 5 % FCBN.

.2 Units rated greater than 15 kVA, 2 ± 2.5 % FCAN & 2 ± 2.5 % FCBN.

.2 Single phase units:

.1 2-2.5 % FCAN & 2-2.5% FCBN.

2.5 Windings

.1 High grade, non-aging grain oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum flux densities shall be substantially below the saturation point.

.2 Core volume shall allow for efficient transformer operation at 10 % above the nominal voltage.

.3 Core laminations shall be tightly clamped and compressed.

.4 Coils shall be wound of electrical grade copper with continuous wound construction.

.5 Core and coil to be vacuum pressure impregnated with polyester varnish or epoxy resin.

.6 The assembly shall be mounted on vibration absorbing pads.

2.6 Equipment Identification

.1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.

.2 Equipment nameplate size 7.

PART 3 EXECUTION

3.1 Installation

.1 Wall mount dry type transformers.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformer in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Set and secure transformers in place, rigid plumb and square.

.7 Connect primary terminals to high voltage circuit.

.8 Connect secondary terminals to secondary circuit.

.9 Energize transformers and check secondary no-load voltage.

.10 Adjust primary taps as necessary to produce rated secondary voltage at no-load.

.11 Use torque wrench to adjust internal connections in accordance with manufacturers' recommended values.

.12 Check transformer for dryness before putting it into service and if it has not been energized for some considerable time.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 16010 - Electrical General Requirements.

END OF SECTION

PART 1 GENERAL

1.1 References

.1 The moulded case circuit breakers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of the following:

.1 CSA C22.2 No. 5.1, Moulded Case Circuit Breakers

1.2 Regulatory Requirements

.1 Circuit breakers shall be CSA certified.

PART 2 PRODUCTS

2.1 Moulded Case Circuit Breakers

.1 Moulded case circuit breakers shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics and shall be Cutler-Hammer type Series C or approved equal.

.2 Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handler position. Contacts shall be nonwelding silver alloy, and arc extinguishing shall be accomplished by means of DE-ION arc chutes.

.3 Circuit breakers to have minimum symmetrical interrupting capacity rating as indicated on the drawings.

.4 Where indicated, circuit breakers shall be current limiting.

.5 Circuit breakers 400 ampere frame and below shall be Cutler-Hammer type Westinghouse Series C with thermal-magnetic trip units and inverse time-current characteristics.

.6 Circuit breakers identified as MCP will operate on the magnetic principle with a current sensing element in each pole.

.7 Circuit breakers 600 ampere through 2500 ampere frame shall be Cutler-Hammer type Westinghouse Series C with microprocessor-based RMS sensing trip units or approved equal.

.1 Each moulded case circuit breaker microprocessor-based tripping system shall consist of three current transformers, and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current transformers and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.

.2 Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed. Rating plugs shall be interlocked such that a breaker cannot be closed and latched with the rating plug removed.

.3 The microprocessor-based trip unit shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.

.4 When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override. Internal ground fault protection adjustable pick-up ratings shall not exceed 1200 amperes.

.5 Breakers shall have built-in test points for testing the long time delay, instantaneous, and ground fault functions of the breaker by means of a 120 Volt operated test set. Provide one test set capable of testing all breakers 600 ampere frame and above.

.6 System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

.1 Adjustable long time pick-up and delay.

.2 Adjustable short time pick-up and delay.

.3 Adjustable instantaneous pick-up.

.7 Circuit Breakers shall be Cutler-Hammer type Westinghouse Series C circuit breakers, microprocessor-based RMS sensing trip units type Digitrip RMS 310 LSI or LSIG trip units or approved equal.

.8 Accessories:

.1 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

.9 Enclosure:

.1 All enclosed circuit breakers shall have EEMAC 1 general purpose enclosures.

.2 All enclosed circuit breakers shall have metal nameplates, front cover mounted, that contain a permanent record of catalog number and maximum rating. Provide handle mechanisms that are padlockable in the “OFF” position.

PART 3 EXECUTION

3.1 Factory Testing

.1 Standard factory tests shall be preformed on the equipment under this section. All tests shall be in accordance with the latest version of EEMAC and CA standard.

3.2 Installation

.1 The Contractor shall install all equipment per the manufacturers recommendations and the contract drawings.

3.3 Field Settings

.1 The Contractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operating condition. The settings shall be in accordance with the drawings.

END OF SECTION

PART 1 GENERAL

PART 2 PRODUCTS

2.1 Disconnect Switches

.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure as required on the drawings sized as indicated.

.2 Provision for padlocking in off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated.

.5 Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

2.2 Equipment Identification

.1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 EXECUTION

3.1 Installation

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

PART 1 GENERAL

1.1 References

.1 CSA C22.2 No.29 Panelboards and Enclosed Panelboards.

1.2 Shop Drawings

.1 Submit shop drawings.

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

PART 2 PRODUCTS

2.1 Panelboards

.1 Panelboards: Product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 250 V panelboards: Bus and breakers rated for 10,000 A (symmetrical) interrupting capacity or as indicated.

.3 600 V panelboards: Bus and breakers rated for 25,000 A (symmetrical) interrupting capacity or as indicated.

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

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

.6 Two keys for each panelboard and key panelboards alike.

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

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked grey enamel.

2.2 Breakers

.1 Breakers: to Section 16412- Moulded Case Circuit Breakers.

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

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

.4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to City of Winnipeg.

2.3 Secondary Surge Arrester

.1 Able to withstand a maximum surge current of 40 kA per phase.

.2 SCCR Rating of 200 kA

.3 Acceptable Product: Square D Part No SDSA3650

2.4 Equipment Identification

.1 Provide equipment identification in accordance with Section 16010 - Electrical General Requirements.

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

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

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

PART 3 EXECUTION

3.1 Installation

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

.2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 16010 - Electrical General Requirements or as indicated.

.4 Connect loads to circuits.

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

END OF SECTION

PART 1 GENERAL

1.1 Scope

.1 This specification shall apply to the materials, design, fabrication, inspection, and testing of 600V Reduced Voltage Starters (RVS)

.2 Detailed specifications on the RVS shall be as indicated in this specification, drawings and attachments. In case of a conflict between the various specifications, the vendor shall contact the Purchaser for clarification. The RVS shall be manufactured by Benshaw.

1.2 Reference Documents

.1 The RVS shall be designed, manufactured and tested in accordance with the latest applicable standards of CSA, NEMA, ANSI and UL, including but not limited to:

.1 CSA C22.2 No. 14-M91—Industrial Control Equipment

.2 NEMA ICS7—Industrial Control and Systems Adjustable Frequency Drives

.3 NEMA MG1—Motors and Generators

.4 NEMA ICS 7.1—Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Frequency Drives

.2 In all cases where more than one regulation, code, standard or specification applies to the same conditions, the most stringent one shall apply. Conflicts among any of the provisions of these listed codes, standards or specifications shall be referred to the Purchaser for resolution.

1.3 Design

.1 General

.1 All RVS will be fed from a CDP provided by others and protected by Breakers. Vendor shall indicate recommended breaker size.

.2 The RVS shall consist of a disconnect, logic board, keypad, SCRs, and bypass contactors for up to speed paralleling and full voltage starting.

.3 The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs, and SCR gate firing output circuits. The logic board shall be identical for all ampere ratings and voltage classes specified.

.2 Enclosure

.1 NEMA 12 Gasketted. The RVS shall have complete front accessibility with easily removable assemblies.

.2 All RVS shall be suitable for mounting back to wall.

.3 Lamacoid nameplates shall be permanently attached with screws.

.4 The enclosure shall have appropriate warning labels indicating “CAUTION MULTIPLE CONTROL POWER SOURCES”

.5 Nameplates shall give the equipment tag number and the service description.

.6 A panel mounted non-resetable elapsed-time meter to measure operating hours with a minimum 6 digits display.

.3 Ratings

.1 The RVS shall be designed for heavy-duty applications and in accordance with applicable datasheets.

.2 The RVS shall operate normally with incoming voltage and frequency of 600V 60 Hz ±10% and have an overload capability of 125% continuous, 500% for 60 seconds and 600% for 30 seconds

.3 The RVS shall consist of six SCR rated for a minimum of 1600V peak inverse voltage and sized to withstand starting circuits of 500% for 60 seconds.

.4 Operating Conditions: Suitable for 0°C to 40°C and 5% to 95% relative humidity.

.5 The RVS shall be capable of starting when fed from temporary diesel generator (nominal size of 500 KVA).

.6 Drive rated for a minimum fault current of 22kA Sym. I.C.

.4 Protection

.1 Motor overload protection shall be two staged based upon an inverse time algorithm, one overload protection characteristic for starting and another for running. The overload characteristics shall be selectable by programming between Classes 5, 10, 20 and 30.

.2 Motor protection in the by-pass mode shall be provided by bimetallic overloads.

.3 Overload resets shall be mechanical pushbuttons from outside the enclosure and be capable of being electrically or automatically reset upon a fault condition.

.4 The SCR shall be complete with snubber networks to prevent false firing due to dV/dT effects.

.5 The RVS shall be capable of being setup and tested without a motor connected.

.6 Over-temperature protection shall be provided on the heat sink and the control board.

.7 Phase Current Imbalance Protection: Trip level: 5-30% of motor FLA between any two phases and 1-20 second delay

.8 Overcurrent Protection: Trip level:50-300 of motor FLA and 1-20 second delay

.9 Load Loss Trip Protection: Under current trip level: 10-90% of motor FLA and 1-60 second delay

.10 Coast down Lockout Timer: 1-60 minutes

.11 Starts-Per-Hour Lockout Timer: Range: 1-10 successful starts per hour. Time between starts: 1-60 minutes between start attempts

.5 Adjustments and Configurations

.1 Acceleration adjustments shall be programmable and shall be capable of dual ramp settings with the following ranges:

- Programmable Ramp Types: Voltage Ramp (VR) or Current Ramp (CR)

- Starting Torque: 0-100% of line voltage (VR) or 0-600% of motor FLA (CR)
- Ramp Time: 1-120 seconds
- Current Limit: 200-600% (VR or CR).

.2 Deceleration adjustments shall be programmable with the following ranges:

- Begin Deceleration Level: 0-100% of line voltage
- Stop Level: 0-1% less than Begin Deceleration Level
- Deceleration Time: 1-60 seconds

.3 The RVS shall be capable of being programmed that in the event of a fault, the motor either coasts to stop or decelerates according to the deceleration adjustment levels.

.6 Interface

.1 The operator interface terminal shall have an alphanumeric, high resolution, high brightness LCD display, door mounted and complete with the following status indicators:

- Control “Power On”
- Full Voltage “At Speed”
- Shorted SCR
- Phase loss
- Shunt trip
- Overload
- Over Temperature
- Overcurrent

.2 The operator interface terminal shall allow complete control of the RVS and modification of adjustments and configuration parameters. All electrical values, parameters, application and activity function access, faults, local control shall be in plain English. .

.3 The following monitoring values shall be available when in the operating mode:

- Phase currents
- Power factor
- Torque
- Remaining thermal capacity
- Elapse time
- Run cycle counter
- Lockout time values
- Fault codes
- Fault history complete with time and date stamps for the last three faults

.4 A reset key will allow a parameter to return the existing value if adjustment is not required and the value is displayed.

.5 The RVS shall have the following door mounted pilot light indicators (LED or neon type, colour as indicated), selector switches and push buttons:

- Running- Bypass Contactor Indicating Light (Green)
- Overload – Bypass Contactor Indicating Light (Yellow)
- Bypass Contactor -Overload Reset Pushbutton
- Soft Starter/Off/Bypass Contactor Selector Switch

.6 The RVS shall have Modbus (2 wire - multidrop) interface for remote interrogation by DCS. Vendor shall indicate all drive parameters that are accessible from this interface

.7 Control Systems - Analog and Digital I/O

.1 RVS shall have a minimum of 3 dry programmable relay outputs used to indicate:

- Fault (O/P)
- Run (O/P)
- Ready (O/P)

.2 The control power for the digital outputs shall be 120 VAC and be derived from the RVS control power transformer.

1.4 Testing

.1 Factory Testing

.1 The manufacturer's standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of CSA and NEMA standards. Results from the tests shall be provided

1.5 Marking

.1 Shipping crates shall be clearly identified with the project title, equipment tag number and the purchase order number.

1.6 Handling

.1 The Supplier shall recommend handling and installation requirements and ship the equipment accordingly.

.2 One copy of assembly drawings and operating instructions shall accompany the shipment.

1.7 Submittal Requirements

.1 Documentation submittal shall be in accordance with the drawings and data submittal requirements schedule. Drawings shall be in SI units. If imperial units are used as well, they shall be shown in parenthesis after the SI units. In case of conflict between the two, SI units shall be considered to be correct.

.2 Equipment tag number, purchase order number and project name shall be shown on all Supplier supplied drawings. Data shall be located close to the title block.

.3 All drawings and data shall be submitted in a form that is easily reproduced. All data and drawings shall be submitted in both paper and electronic form. Final drawings are all required to be as-built.

.4 Review or approval of Supplier's drawings, design calculations and other documentation does not relieve Supplier of any responsibility for correctness of such drawings, calculations or other documentation.

.5 The following information shall be submitted to the Contract Administrator for approval:

- Master Drawing Index

- Dimensioned Front view elevation
- Dimensioned Floor plan
- Dimensioned Top view
- Unit control schematics and wiring diagrams
- Nameplate schedule
- Cable entry/exit locations
- Assembly ratings, including short circuit, voltage, and continuous current ratings
- Major component ratings
- Minimum clearances to other equipment.
- Frequency spectrum for harmonic currents at line side of filter (where provided) at 50% and 100% of rated load.
- Manufacturers technical data sheets

.6 The following information shall be submitted to Contract Administrator for record purposes:

- Final as-built drawings and information
- Certified production test reports
- Installation information
- Seismic certification and equipment anchorage details (where applicable)
- Operation and maintenance manuals. Manuals shall include as a minimum: Instruction books and/or leaflets, recommended renewal parts list and a complete set of as-built drawings

PART 2 PRODUCTS

2.1 Not Used

PART 3 EXECUTION

3.1 Installation

.1 Install in accordance with Manufacturer's installation instructions.

.2 Hire factory trained representative for set up and commissioning of RVS. Provide written report to Contract Administrator.

.3 Set up so that Pump ramps up to speed over 30 seconds and ramps down over 30 seconds.

.4 Confirm power lugs on starter can accommodate the pump motor cable leads.

.5 Hire factory trained representative to provide one day of training for City of Winnipeg personnel.

END OF SECTION

PART 1 GENERAL

1.1 References

.1 American National Standards Institute (ANSI)

.1 Most recent ANSI C82.1- 1995, Specifications For Fluorescent Lamp Ballasts.

.2 Most recent ANSI C82.4- 19 92, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.

1.2 Shop Drawings and Product Data

.1 Submit shop drawings.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaries where specified, for approval by Consultant.

.3 Photometric data to include: VCP Table spacing criterion, polarplot candela distribution, IES photometric file on computer disk.

PART 2 PRODUCTS

2.1 Lamps

.1 Fluorescent lamps.

Wattage	Bulb	Base	Type	Initial Lumens	Life h	Notes	Colour
-	T8-32	md.bip	RS	3150	24000	Cool	4000 White

2.2 Ballasts

.1 Fluorescent ballast: CBM and CSA certified, energy efficient type, discrete electronic IC electronic IC.

.1 Rating: 120V, 60 Hz, for use with, rapid start lamps.

.2 RFI/EMI suppression circuit to: FCC (CFR47) Part 18, sub-part C, Class A and Part 15, sub-part B, Class B.

.3 Totally encased and designed for 40 C ambient temperature.

.4 Power factor: minimum 95 % with 95% of rated lamp lumens.

.5 Crest factor: 1.5 maximum current, 2.0 maximum voltage.

.6 Capacitor: thermally protected.

.7 Thermal protection: non-resettable on coil.

.8 Harmonics: 10 % maximum THD, including 49th for electronic discrete and hybrid ballasts, 25 % maximum THD including 49th for electromagnetic ballasts.

.9 Operating frequency of electronic ballast: 21 khz minimum.

.10 Total Circuit Power: 62 Watts.

.11 Ballast Factor: greater than 0.90.

.12 Sound rated: Class A.

.13 Mounting: integral with luminaire.

.14 Where available use premium electronic ballasts compliant with the Manitoba Hydro power smart program. Submit breakdown with tender documents.

2.3 Finishes

.1 Baked enamel finish:

.1 Conditioning of metal before painting:

.1 For corrosion resistance conversion coating to ASTM F 1137.

.2 For paint base, conversion coating to ASTM F 1137.

.2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel polyester powdercoat alzak aluminum to give smooth, uniform appearance, free from pinholes or defects.

.3 Reflector and other inside surfaces finished as follows:

.1 White, minimum reflection factor 85%.

.2 Colour fastness: yellowness factor not above 0.02 and after 250 h exposure in Atlas fade-ometer not to exceed 0.05.

.3 Film thickness, not less than 0.03 mm average and in no areas less than 0.025 mm.

.4 Gloss not less than 80 units as measured with Gardner 60 gloss meter.

.5 Flexibility: withstand bending over 12 mm mandrel without showing signs of cracking or flaking under 10 times magnification.

.6 Adhesion: 24 mm square lattice made of 3 mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.

PART 3 EXECUTION

3.1 Installation

.1 Locate and install luminaries as indicated.

3.2 Luminaire Supports

.1 For suspended ceiling installations support luminaries from ceiling in accordance with local inspection requirements.

3.3 Luminaire Alignment

.1 Align luminaries mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaries mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

PART 1 GENERAL

1.1 Shop Drawings and Product Data

.1 Submit shop drawings in accordance with the specifications

1.2 Field Instrument Installation

.1 The Contractor shall install each item in accordance with manufacturer's instructions and other applicable drawings. The term "installation" includes specifically the physical mounting of remote devices as well as all electrical/instrument cable/connections. The Contractor shall identify and provide all necessary mounting hardware not purchased with the instrument.

.2 Flow meters and pressure transmitters shall be handed over to the mechanical division for installation. Co-ordinate activities with mechanical.

1.3 Field Instruments

.1 Receive, calibrate, tag, and store all instruments.

.2 Install all necessary conduit and wiring from the field instruments or field control panel.

.3 Make all wiring terminations at the field instruments, field control panel, and the field junction box. Label all cables and wires.

.4 Isolate all applicable instruments for line testing and return to service after testing.

.5 Inspect all wiring, terminations and labelling.

.6 Unload control panel sections and racks which may be shipped at different times from different shippers.

.7 Move control panel sections and racks to their specified installation locations and permanently set in place. Unloading and moving may be done as one operation depending upon construction status.

PART 2 PRODUCTS

2.1 Level Transmitters

.1 Device LT-1

.1 Acceptable Product: Miltronics MultiRanger 200

.2 Transducer to be complete with a submergence shield

PART 3 EXECUTION

3.1 Installation

.1 Instrument systems components not specifically located on drawings, but located on the drawings shall be field located as defined by mechanical piping and in accordance with the following:

.1 Instrument components shall not be attached to vibrating equipment, but shall be

remotely mounted to a solid structure or on approved instrument mounting stands.

.2 Location of instruments, when shown on the drawings, is only approximate. The Contractor is responsible for actual location of field devices and must avoid interferences between conduit, pipes, equipment and instruments while providing maximum accessibility.

.3 Locate instrument components at eye level and in an easily accessible location.

.4 Instrument components that must be removed for servicing shall be installed with re-usable connectors, unions and flexible conduit.

.5 Electrical connections and terminations for field instruments and other field devices shall be in strict compliance with the manufacturer's instructions and loop drawings. This will include wire, wire termination, labeling, rigid and flexible conduit, fittings, and seals where required.

.2 Provide and route all instrument signal armoured cable (or conduit and conductors).

.3 For instruments with pre-terminated cable lengths provide a junction box as close as practical to connect with armoured cable or cable in conduit.

.4 Allow for a variation of 3 meters from locations of devices as shown on drawings without extra cost provided pertinent information is provided prior to installation. Exact location will be determined by the installation of piping and mechanical equipment.

.5 Threaded fastenings for mounting instrument components shall have either lock nuts or double nuts.

.6 Install wall and pipe stand mounted transmitters on approved mounting brackets or stands at a nominal height of 1.4 meters off floor.

.7 Cover locally mounted instrument components, after installation, with plastic bags to protect them from dust, dirt, paint spray, insulation materials, etc. Protect from mechanical damage.

.8 Set output pressure of local air sets to pressure recommended for instrument to which it is to be connected.

.9 Independently support solenoids, regulators or similar control devices on solid, vibration-free structures and not on control valves. Minimize load on pneumatic tubing.

.10 Field instruments located out doors shall be winterized to prevent process or measurement fluids from freezing. The use of steam or electrical tracing, fill fluids, or enclosures will be shown on the Installation Detail drawings.

.11 All instrument signal wiring and 120 V ac wiring shall be run by the Contractor from the field instrument to the field device as shown on the Loop drawings. This includes wiring, rigid and flexible conduit, fittings and seals where shown. Conduit penetrations are not permitted into the top of any field junction box.

3.2 Instrument Installation

.1 Level transmitters

.1 Provide, install and terminate power and control cables at remote electronics.

Install, route and terminate primary-converter cable as per manufacturers instructions and guidelines.

3.3 Instrument Supports

.1 Clean and paint fabricated galvanized carbon steel mounting stands and brackets.

.2 Before a mounting stand is attached to a concrete floor the surface of the concrete to be in contact with grout shall be roughed and cleaned of all dirt, oil, grease and loose material.

3.4 Calibration Tagging

.1 When satisfactorily inspected and calibrated, the item shall have a tag affixed to it in an immediately visible location, which shall indicate that the device has been calibrated, by whom and the date of the calibration. Calibration procedures and records shall be available to the Contract Administrator throughout the course of the project and shall be delivered to the Contract Administrator upon the completion of the work.

3.5 Permanent Instrument Identification Tagging

.1 All field-mounted instrument items shall have an approved identification tag permanently attached by the Contractor upon completion of the initial inspection and calibration. This tag shall reflect the device's identification as shown on the appropriate drawing.

.2 The tag will be permanently attached to the instrument with screws, rivets, or stainless steel or Monel wire, as appropriate. If an instrument is inside a protective enclosure or mounted behind a panel, instrument identity tags shall be mounted twice, once on the instrument and again on the enclosure. All instruments mounted on a control panel shall have an identity tag mounted on the instrument body and again on the face of the panel below the instrument face.

3.6 Wire, Cable and Terminal Tagging

.1 Each wire in alternating current applications and each wire in direct current applications shall be identified at each termination by a permanent label displaying the wire numbers. Each multiconductor cable shall be identified at each end with a permanent label displaying its cable number.

3.7 Documentation Responsibilities

.1 The Contractor shall maintain a current, complete set of prints for all instrument and electrical drawings, wire list, and specifications with markups reflecting all approved changes and actual as-installed status of equipment. These shall be kept in a neat and legible manner to facilitate direct transfer to The City of Winnipeg. One complete set of these marked-up drawings, wire lists, and specifications shall be provided to The City of Winnipeg after construction has been completed and before plant startup.

END OF SECTION