

SECTION 26
ELECTRICAL

COMMON WORK RESULTS - FOR ELECTRICAL

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 02 61 33 - Hazardous Materials.
- .2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th 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 and labels for control items in English.

1.5 SUBMITTALS

- .1 Submittals: in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 02 61 33 - Hazardous Materials.

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- .3 Submit for review single line electrical diagrams and locate under plexiglass as indicated.
 - .1 Clarifier MCC Room.
- .4 Shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit copies of 600 x 600 mm minimum size drawings and product data to inspection authorities.
 - .6 If changes are required, notify Contract Administrator of these changes before they are made.
- .5 Quality Control: in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions..
 - .1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
 - .2 Submit test results of installed electrical systems and instrumentation.
 - .3 Permits and fees: in accordance with General Conditions of contract.
 - .4 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
 - .5 Submit certificate of acceptance from inspection authority upon completion of Work to Contract Administrator.
- .6 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

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1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Contract Administrator with schedule within 2 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.8 SYSTEM STARTUP

- .1 Instruct Contract Administrator and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.10 POTENTIAL ASBESTOS HAZARD

- .1 Suspect asbestos in ceiling drywall within clarifier electrical room and clarifier control room. Coordinate with other trades on precautions taken for any disturbances to ceiling drywall.

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1.11 MISCELLANEOUS

- .1 Contractor shall provide control wiring from Scum Removal Screw Conveyor control panel to the DCS control panel for 3 discrete input points and 1 discrete output point. Termination points within DCS cabinet to be verified by City of Winnipeg personnel on-site.

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 inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities and Contract Administrator.
- .2 Decal signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicoid 3 mm melamine, black face, white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters

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

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

2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

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

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue

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	Prime	Auxiliary
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish 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.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.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 conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: plastic, 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 embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .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.

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- .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 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 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 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.
 - .6 Fire alarm stations: 1500 mm.
 - .7 Fire alarm bells: 2100 mm.
 - .8 Television outlets: 300 mm.
 - .9 Wall mounted speakers: 2100 mm.
 - .10 Clocks: 2100 mm.
 - .11 Door bell pushbuttons: 1500 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.7 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

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- .1 Power distribution system including phasing, voltage, grounding and load balancing.
- .2 Circuits originating from branch distribution panels.
- .3 Lighting and its control.
- .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .5 Systems: fire alarm system and communications.
- .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Contract Administrator.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 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.

3.9 SEQUENCE OF WORK

- .1 Physically locate the two new MCC's, MCC-1P and MCC-2P, in the clarifier electrical room.
- .2 Install new feeder cables for MCC-1P and MCC-2P from MCC-1GD and MCC-2GD in the pre-aeration and grit building, but do not terminate the cables.
- .3 Install a temporary feeder for the new MCC-1P from the existing MCC-1P.
- .4 Install a temporary feeder for the new MCC-2P from the existing MCC-2P.
- .5 Install new transformer and distribution panels.

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- .6 Relocate all existing MCC loads to new distribution panels.
- .7 Relocate power and control wiring from starters/feeders in the old MCC to starters/feeders in the new MCC. Since only small outages are acceptable coordinate with the City during equipment switchover. Only one piece of equipment should be relocated at a time and be fully tested and commissioned before proceeding with the next piece of equipment. All power and control wiring to equipment shall be new cabling.
- .8 Once all starters/feeders have been relocated to the new MCC a scheduled shutdown coordinated with the City can be used to switch the MCC feeder over to the new cable previously pulled and the old MCC can be de-energized.
- .9 Remove and dispose of old MCC's once each have been fully decommissioned.
- .10 Schedule for the removal of the existing walkway and to suit the installation of the new walkway.
- .11 Remove existing lighting, receptacles, and equipment wiring in the existing walkways to facilitate removal.
- .12 Supply and install new lighting in Clarifiers 1, 2 and 3 walkways and reconnect all removed services.

END OF SECTION

WIRE AND BOX CONNECTORS 0-1000 V

Part 1 General

1.1 SECTION INCLUDES

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

1.2 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.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

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 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

WIRE AND BOX CONNECTORS 0-1000 V

- .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
- .3 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

WIRES AND CABLES

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

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 in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

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 1000 V 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 size is not indicated.
- .3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

WIRES AND CABLES

- .4 Inner jacket: polyvinyl chloride material.
- .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.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors: watertight, explosion-proof approved for TECK cable.

2.3 600 V TECK90 CONTROL CABLE

- .1 Conductors:
 - .1 Grounding conductor: copper
 - .2 Circuit conductors: 14 AWG copper, number coded.
- .2 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.
- .3 Inner jacket: polyvinyl chloride material.
- .4 Armour: interlocking aluminum.
- .5 Overall covering: thermoplastic polyvinyl chloride 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.
 - .2 Channel type supports for two or more cables at 300 mm centers to prevent cable from drooping.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .7 Connectors: watertight, explosion-proof approved for TECK cable.

2.4 300 V INSTRUMENT CABLE - ARMoured

- .1 Conductors: 18 AWG minimum unless indicated otherwise, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.
- .2 Insulation: PVC TW75, 75 °C Wet, 105 °C Dry (-40 °C), 300 V.
- .3 Twisted pairs/triads cables with staggered lays.
- .4 Shielding:

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- .1 Individual twisted pair(s)/triad(s), 100% aluminum/mylar shield with ST drain wire.
- .2 Individual drain wires one size smaller than conductor AWG.
- .3 Overall drain wire the same AWG as conductors.
- .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.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors: Watertight, explosion-proof approved for TECK cable.

2.5 TYPE RW90 CONDUCTOR

- .1 Cable: to CAN/CSA-C22.2 No. 38.
- .2 Conductors: concentric stranded soft copper, size as indicated. 12 AWG minimum where size is not indicated.
- .3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90 XLP, 600 V.
- .4 Suitable for installation in temperatures down to -40 °C and a conductor operating temperature of 90 °C.

2.6 TYPE TEW CONDUCTOR

- .1 Cable: to CAN/CSA-C22.2 No.127
- .2 Conductors: 18 AWG, unless noted otherwise, for PLC/DCS cabinet internal wiring.
- .3 Insulation: thermoplastic compound, 600V.
- .4 Suitable for installation in temperatures down to -40 °C and a conductor operating temperature of 105 °C.

2.7 WIRING IDENTIFICATION

- .1 Provide wiring identification in accordance with Section 26 05 01 - Common Work Results – For Electrical

WIRES AND CABLES

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 TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels or in cabletroughs.
- .2 Lay cable in cabletroughs in accordance with Section 26 05 36- Cable Trays for Electrical Systems.
- .3 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0 - 1000 V.

3.3 INSTALLATION OF ARMoured INSTRUMENT CABLES

- .1 Install cables.
 - .1 Group cables wherever possible on channels or in cabletroughs.
- .2 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

3.4 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

GROUNDING - SECONDARY

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-1989(R1996), Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association, (CSA International)

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Contract Administrator.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required.
- .2 Grounding conductors: stranded copper, tinned, soft annealed, size as indicated.
- .3 Insulated grounding conductors: green, type RW90.
- .4 Ground bus: copper, size 2/0 AWG, complete with insulated supports, fastenings, connectors.
- .5 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.

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- .3 Bolted type conductor connectors.
- .4 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make connections to NEWPCC bonding loop using copper welding by thermit process. The NEWPCC bonding loop comes from the Grit Building through Gallery 4 and continues on to the Digestors through Gallery 5.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Connect building structural steel and metal siding to ground by welding copper to steel.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .11 Bond single conductor, metallic armoured cables to cabinet at supply end, and load end.
- .12 Ground secondary service pedestals.

3.2 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of primary 600 V system and secondary 120 V system.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

GROUNDING - SECONDARY

3.4 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.5 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, intercommunication systems as indicated.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .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

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

Part 1 General

1.1 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Contract Administrator.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 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.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables 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.
- .7 Suspended support systems.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

- .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 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.
- .13 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

SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

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 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.

2.3 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface mounting.

Part 3 Execution

3.1 SPLITTER INSTALLATION

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

SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

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

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 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 26 05 01 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

Part 1 General

1.1 REFERENCES

- .1 CSA C22.1-2006, Canadian Electrical Code, Part 1.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

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 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-glavanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

OUTLET BOXES, CONDUIT BOXES AND FITTINGS

2.5 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.
- .2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

- .1 Cast FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.7 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.

2.8 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for 1 duplex receptacles. Bottom plate with two knockouts for centered or offset installation. 12 x 102 mm extension piece as indicated.
- .2 Pedestal type 'low tension' fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish to accommodate two amphenol jack connectors.

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 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 45-M1981(R1992), Rigid Metal Conduit.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

Part 2 Products

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, aluminum threaded.

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 1.5 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 90° bends are required for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT. Set-screws are not acceptable.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

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

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

- .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 Conceal conduits in finished areas.
- .3 Surface mount conduits except in mechanical and electrical service rooms and in unfinished areas.
- .4 Use rigid aluminum threaded conduit except where specified otherwise.
- .5 Use explosion proof flexible connection for connection to explosion proof motors.
- .6 Install conduit sealing fittings in hazardous areas. Fill with compound.
- .7 Minimum conduit size for lighting and power circuits: 19 mm.
- .8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 19 mm dia.
- .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .11 Install fish cord in empty conduits.
- .12 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel. Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 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.

3.4 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 in 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 IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.6 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

CABLE TRAYS FOR ELECTRICAL SYSTEMS

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.1 No.126.1-02, Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA VE 1-2002, Metal Cable Tray Systems.
 - .2 NEMA VE 2-2001, Cable Tray Installation Guidelines.

1.2 SUBMITTALS

- .1 Provide submittals in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4 Identify types of cabletroughs used.
- .5 Show actual cabletrough installation details and suspension system.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 CABLETROUGH

- .1 Cabletroughs and fittings: to NEMA VE 1 and CAN/CSA C22.1 No. 126.1.
- .2 Ladder type, Class D1 to CAN/CSA C22.2 No. 126.1.
- .3 Trays: extruded aluminum, minimum 300 mm wide with minimum depth of 75 mm.
- .4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
 - .1 Radii on fittings: 300 mm minimum.
- .5 Solid covers for complete cabletrough system including fittings.
- .6 Barriers where different voltage systems are in same cabletrough.

CABLE TRAYS FOR ELECTRICAL SYSTEMS

- .7 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.
- .8 Provide fire stop material at firewall penetrations.

2.2 SUPPORTS

- .1 Provide splices, supports for a continuously grounded system as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Install complete cabletrough system in accordance with NEMA VE 2.
- .2 Support cabletrough on both sides.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

- .1 Install cables individually.
- .2 Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .3 Secure cables in cabletrough at 6 m centres, with nylon ties.
- .4 Identify cables every 30 m with size 2 nameplates in accordance with Section 26 05 01 – Common Work Results – For Electrical.

END OF SECTION

MOTOR CONTROL CENTRES

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 29 10 – Motor Starters to 600 V

1.2 SUBMITTALS

- .1 Provide submittals in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.
- .3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence and cleaning procedures.
- .4 Submit shop drawings and indicate:
 - .1 Outline dimensions.
 - .2 Configuration of identified compartments.
 - .3 Floor anchoring method and dimensioned foundation template.
 - .4 Cable entry and exit locations.
 - .5 Dimensioned position and size of busbars and details of provision for future extension.
 - .6 Schematic and wiring diagrams.
- .5 Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
 - .1 Include data for each type and style of starter.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.
- .2 Collect, package and store existing busbars, wireways, sills, copper ground straps and other associated components for recycling and reuse.

1.4 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 SUPPLY CHARACTERISTICS

- .1 600 V, 600 A, 60Hz, 3 phase, 3 wire, feeds from MCC 1GD and MCC 2GD within the pre-aeration and grit building. Each feed shall be 2 x 3/c 350 MCM TECK cable.

MOTOR CONTROL CENTRES

2.2 METERING

- .1 Each MCC shall utilize a metering system capable of measuring and displaying at minimum the following on a digital display.
 - .1 Voltage L-N
 - .2 Voltage L-L
 - .3 Current per phase
 - .4 Watts
 - .5 VAr
 - .6 VA
 - .7 Frequency
 - .8 Power factor
 - .9 Watt hrs
 - .10 VAr hrs
 - .11 VA hrs
- .2 Metering devices shall utilize three (3) current transformers and three (3) potential transformers.
- .3 Separate potential transformer secondary fuses, shall be used for relaying and metering.
- .4 Each meter to have at minimum 2 programmable 4-20 mA analog outputs and 2 programmable discrete relay outputs (pulse).
- .5 The metering equipment shall be capable of transmitting all data via Modbus TCP protocol over an Ethernet network.

2.3 GENERAL DESCRIPTION

- .1 Compartmentalized vertical sections with common power busbars.
- .2 Floor mounting, free standing, enclosed dead front.
- .3 Indoor CSA 1 gasketed enclosure, back to back mounting.
- .4 Class II, Type B.

2.4 VERTICAL SECTION CONSTRUCTION

- .1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.
- .2 Each vertical section divided into compartment units, minimum 305 mm high, as indicated.
- .3 Each unit to have complete top and bottom steel plate for isolation between units.
- .4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

MOTOR CONTROL CENTRES

- .5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.
- .6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.
- .7 Cables to enter at top and/or bottom as required.
- .8 Removable lifting means.
- .9 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.
- .10 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

2.5 SILLS

- .1 Continuous channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.6 BUSBARS

- .1 Main horizontal and branch vertical, three phase and neutral high conductivity tin plated copper busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated:
 - .1 Main horizontal busbars: 600 A as indicated.
 - .2 Branch vertical busbars: 300 A as indicated.
- .2 Branch vertical busbars for distribution of power to units in vertical sections.
- .3 No other cables, wires, equipment in main and branch busbar compartments.
- .4 Brace buswork to withstand effects of short-circuit current of 42 kA rms symmetrical.
- .5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.7 GROUND BUS

- .1 Copper ground bus extending entire width of motor control centre.
- .2 Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug-in unit ground stab.

2.8 MOTOR STARTERS AND DEVICES

- .1 As per Section 26 29 10 – Motor Starters to 600 V.
- .2 Quantity and ratings as per single line drawings. Each MCC shall have at two (2) spare size 1 starters and one (1) spare size 2 starter.

MOTOR CONTROL CENTRES

2.9 STARTER UNIT COMPARTMENTS

- .1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.
- .2 Unit mounting:
 - .1 Engaged position - unit stabbed into vertical bus.
 - .2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.
 - .3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.
 - .4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.
- .3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.
- .4 Hinge unit doors on same side.
- .5 Overload relays manually reset from front with door closed.
- .6 Pushbuttons and indicating lights mounted on door front.
- .7 Devices and components by one manufacturer to facilitate maintenance.
- .8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.10 WIRING IDENTIFICATION

- .1 Provide wiring identification in accordance with Section 26 05 01 - Common Work Results - For Electrical.

2.11 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - For Electrical.
 - .1 Motor control centre main nameplate: size No. 7, engraved "MCC-1P" and "MCC-2P".
 - .2 Individual compartment nameplates: size No. 5, engraved as indicated.

2.12 FINISHES

- .1 Apply finishes in accordance with Section 26 05 01 - Common Work Results - For Electrical.
- .2 Paint motor control centre exterior light gray and interiors white.

MOTOR CONTROL CENTRES

2.13 SOURCE QUALITY CONTROL

- .1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

Part 3 Execution

3.1 INSTALLATION

- .1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.
- .2 Make field power and control connections as indicated.
- .3 Ensure correct overload heater elements are installed.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - For Electrical.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period.

END OF SECTION

CONTROL DEVICES

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

1.2 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results - Electrical.
- .2 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.14-95(R2001), Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2001, Industrial Control and Systems: General Requirements.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Include schematic, wiring, interconnection diagrams.

1.5 QUALITY ASSURANCE

- .1 Submit to Contract Administrator one copy of test results.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

CONTROL DEVICES

Part 2

Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Convertible contact type: contacts field convertible from NO to NC, electrically held, with poles to suit. Coil rating: 120 V. Contact rating: 120 V, 2 A minimum.
- .3 Fixed contact plug-in type: general purpose with poles to suit. Coil rating: 120 V. Contact rating: 120 V, 2 A minimum.

2.2 RELAY ACCESSORIES

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 SOLID STATE TIMING RELAYS

- .1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.
- .2 Operation: on-delay or off-delay.
- .3 Supply voltage: 120 V, AC, 60 Hz.
- .4 Temperature range: minus 20 degrees C to 60 degrees C.
- .5 Output contact rating: maximum voltage 300 V AC or DC. Current: NEMA ICS 1.
- .6 Timing ranges: minimum 1.0 s, maximum 5, 30 or 60 s.

2.4 OPERATOR CONTROL STATIONS

- .1 Enclosure:
 - .1 In general CSA Type 4X, surface mounting.
 - .2 In clarifier electrical room with positive pressure CSA Type 1, surface mounting.

2.5 PUSHBUTTONS

- .1 Heavy duty Oil tight. Operator extend type. Black, with 1-NO and 1-NC contacts rated at 2 A minimum, AC, labels as indicated. Stop pushbuttons coloured red, labelled as indicated.

2.6 SELECTOR SWITCHES

- .1 Maintained, 2 or 3 position as required labelled as indicated heavy duty oil tight, operators standard, contact arrangement as indicated, rated 120 V, 2 A, AC minimum.

CONTROL DEVICES

2.7 INDICATING LIGHTS

- .1 Heavy duty Oil tight, full voltage, LED type, lens colour: as indicated, supply voltage: 120 V, lamp voltage: 120 V, labels as indicated.

2.8 CONTROL AND RELAY PANELS

- .1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.9 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 600 V, 60 Hz ac.
- .3 Secondary: 120 V, AC.
- .4 VA Rating: as required by loads plus 20%.
- .5 Secondary fuse rating: as required by loads
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

Part 3 Execution

3.1 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, control devices and interconnect.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

END OF SECTION

MOTOR STARTERS TO 600 V

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

- .1 National Electrical Manufacturer's Association (NEMA)
 - .1 NEMA Standards Publication ICS 2-2000: Industrial Control and Systems
 Controllers, Contactors and Overload Relays Rated 600 Volts.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with The City of Winnipeg Standard Construction
 Specifications Section CW1110 – General Instructions.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for motor starters for incorporation into manual
 specified in Section 01 78 00 - Closeout Submittals.
- .2 Include operation and maintenance data for each type and style of starter.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout
 Submittals.
- .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.

MOTOR STARTERS TO 600 V

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 MATERIALS

- .1 Starters: to NEMA ICS 2-2000

2.2 MANUAL MOTOR STARTERS

- .1 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 Three overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
 - .1 Pushbutton: heavy duty oil tight labelled as indicated.
 - .2 Indicating light: heavy duty oil tight type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 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 motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, 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 Pushbuttons and selector switches: heavy duty oil tight labelled as indicated.
 - .2 Indicating lights: heavy duty oil tight type and color as indicated.
 - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

MOTOR STARTERS TO 600 V

2.4 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.

2.5 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

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 01 - Common Work Results - Electrical 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

LIGHTING

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-97, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Surge Voltages in Low-Voltage AC Power Circuits.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM F1137-88(1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 United States of America, Federal Communications Commission (FCC)
 - .1 FCC (CFR47) EM and RF Interference Suppression.

1.2 RELATED SECTIONS

- .1 The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with The City of Winnipeg Standard Construction Specifications Section CW1110 – General Instructions.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Contract Administrator.
- .3 Photometric data to include: VCP Table and spacing criterion.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Disposal of fluorescent lamps.
- .5 Disposal of old PCB filled ballasts (if still existing) on renovation jobs.

LIGHTING

Part 2 Products

2.1 LAMPS

.1 Fluorescent lamps.

Lamp Design	Bulb shape Wattage	Base	Type	Initial Lumens	Life h	Description	Colour °K
A	T8-32	md.bip	RS	3150	18000	Cool white	4100

2.2 BALLASTS

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

- .1 Rating: 120 V, 60 Hz, for use with 2-32W, 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.

2.3 FINISHES

.1 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 hours exposure in Atlas fade-ometer not to exceed 0.05.
- .3 Gloss not less than 80 units as measured with Gardner 60° gloss meter.

2.4 LIGHT CONTROL DEVICES

.1 Design A.

- .1 Material: polycarbonate.
- .2 Frame: hinged gasketed latched.

2.5 LUMINAIRES

.1 Fluorescent luminaire design: A.

LIGHTING

- .1 No. of lamps: 2.
- .2 Enclosed and gasketed industrial explosion proof fluorescent luminaire for use in hazardous locations.
- .3 Mounting: surface.
- .4 Nominal dimensions: 1219 mm long x 305 mm wide.
- .5 Lamp design: A.
- .6 Light control device design: A.
- .7 Ballast design: A.
- .8 Ballast chamber: built-in.
- .9 Housing: Fiberglass reinforced polyester material.
- .10 Internal Reflector: Highly reflective white polycarbonate material.

2.6 ACCEPTABLE PRODUCT

- .1 NRL: VP4-211
- .2 Appelton: FVR232120

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.

3.2 WIRING

- .1 Connect luminaires to lighting circuits using wiring methods appropriate for hazardous locations.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION