

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General requirements that are common to NMS sections found in Division 26 - Electrical

1.2 REFERENCES

- A. Canadian Standards Association (CSA International)
 - 1. CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - 2. CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- B. Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - 1. EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.
- C. Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - 1. Material Safety Data Sheets (MSDS).

1.3 DESIGN REQUIREMENTS

- A. Operating voltages: to CAN3 C235.
- B. 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.
- C. Language operating requirements: provide identification nameplates for control items in English.

1.4 SUBMITTALS

- A. Submittals: in accordance with Section 01 33 00 - Submittal Procedures
- B. Quality Control:
 - 1. Provide CSA certified equipment and material.
 - 2. Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to Site.

3. Submit test results of installed electrical systems and instrumentation.
4. Permits and fees: in accordance with General Conditions of contract.
5. Submit, upon completion of Work, load balance report as described in PART 3 - Load Balance.
6. Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Contract Administrator.

C. 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.

1.5 QUALITY ASSURANCE

- A. Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction 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.
 2. Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.6 SYSTEM STARTUP

- A. Instruct City personnel in operation, care and maintenance of systems, system equipment and components.
- B. Assist City personnel and the Contract Administrator in the start-up of equipment.
- C. 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.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to Site and submit such approval as described in PART 1 - Submittals.
- B. Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- A. Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

- B. 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

- A. Warning Signs: in accordance with requirements of inspection authorities.
- B. Lamacoid signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

- A. The City will provide the nameplates and identification for installation under this Contract.

2.6 WIRING IDENTIFICATION

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

2.7 CONDUIT AND CABLE IDENTIFICATION

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

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Other Communication Systems	Green	Blue

2.8 FINISHES

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

PART 3 EXECUTION

3.1 INSTALLATION

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

3.2 NAMEPLATES AND LABELS

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

3.3 MOUNTING HEIGHTS

- A. Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- B. If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- C. Install electrical equipment at following heights unless indicated otherwise.
 - 1. Local switches: 1400mm.
 - 2. Wall receptacles:
 - a. General: 300 mm.
 - b. In mechanical rooms: 1400mm.
 - 3. Panelboards: as required by Code or as indicated.
 - 4. Control panels: as indicated.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.5 FIELD QUALITY CONTROL

- A. 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.
- B. Conduct following tests :
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. Insulation resistance testing:
 - a. Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - b. Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - c. Check resistance to ground before energizing.
 6. Carry out tests in presence of Contract Administrator.
 7. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- 1.01 CLEANING
- A. Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
 - B. Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

SECTION 26 05 20

WIRE AND BOX CONNECTER (0 – 1000 – V)

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 REFERENCES

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

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.
- B. Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- C. Bushing stud connectors: to EEMAC 1Y 2 to consist of:
 - 1. Connector body and stud clamp for stranded copper conductors.
 - 2. Clamp for stranded copper conductors.
 - 3. Stud clamp bolts.
 - 4. Bolts for copper conductors.
 - 5. Sized for conductors as indicated.
- D. Clamps or connectors for armoured cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA C22.2No.18.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Remove insulation carefully from ends of conductors and:
 - 1. Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
 - 2. Install fixture type connectors and tighten. Replace insulating cap.
 - 3. Install bushing stud connectors in accordance with EEMAC 1Y 2.

END OF SECTION

SECTION 26 05 21

WIRES AND CABLES (0 - 1000 – V)

PART 1 GENERAL

1.1 RELATED SECTIONS

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

1.2 REFERENCES

- A. CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
- B. CAN/CSA C22.2 No. 131, Type TECK 90 Cable.

1.3 PRODUCT DATA

- A. Submit product data in accordance with Section 01 33 00, Submittal Procedures.

PART 2 PRODUCTS

2.1 TECK CABLE

- A. Cable: to CAN/CSA C22.2 No. 131.
- B. Conductors:
 - 1. Grounding conductor: copper.
 - 2. Circuit conductors: copper, size as indicated.
- C. Insulation:
 - 1. Chemically cross linked thermosetting polyethylene rated type RW90, 1000 V.
- D. Inner jacket: polyvinyl chloride material.
- E. Armour: interlocking aluminum.
- F. Overall covering: thermoplastic polyvinyl chloride material.
- G. Fastenings:
 - 1. One hole stainless steel straps to secure surface cables 50 mm and smaller. Two hole stainless steel straps for cables larger than 50 mm.
 - 2. Channel type supports for two or more cables at 900 mm centers.
 - 3. Stainless steel threaded rods: 6 mm dia. to support suspended channels.
- H. Connectors:

1. Watertight approved for TECK cable.

2.2 VFD DRIVE CABLE

- A. Cable: to CAN/CSA C22.2 No. 131.
- B. Conductors:
 1. Sectored Grounding conductors: three (3) bare copper.
 2. Circuit conductors: copper, size as indicated.
- C. Insulation:
 1. Type: ethylene propylene rubber.
 2. Chemically cross linked thermosetting polyethylene rated 1000 V.
- D. Inner jacket: polyvinyl chloride material.
- E. Armour: heavy wall, continuously corrugated aluminum.
- F. Overall covering: thermoplastic polyvinyl chloride material.
- G. Fastenings:
 1. One hole stainless steel straps to secure surface cables 50 mm and smaller. Two hole stainless steel straps for cables larger than 50 mm.
 2. Channel type supports for two or more cables at 1000 mm centers.
 3. Stainless steel threaded rods: 9 mm dia. to support suspended channels.
- H. Connectors:
 1. Watertight, approved for TECK cable.

2.3 CONTROL CABLES

- A. Type LVT: soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket
- B. 600 V type: stranded annealed copper conductors, sizes as indicated with PVC insulation type TW, or cross linked polyethylene type RW90 (x link with shielding of metallized tapes over each pair of conductors and overall covering of thermoplastic jacket interlocked armour and jacket over sheath of PVC.

PART 3 EXECUTION

3.1 INSTALLATION OF TECK CABLE 0 – 1000 – V

- A. Install cables.
 1. Group cables wherever possible on channels.
- B. Lay cable in cabletroughs/cable tray in accordance with Section 26 05 36.

- C. Terminate cables in accordance with Section 26 05 20 Wire and Box Connectors (0 - 1000 – V).

3.2 INSTALLATION OF CONTROL CABLES

- A. Install control cables in conduit.
- B. Ground control cable shield.

3.3 INSTALLATION OF VFD DRIVE CABLE

- A. Install drive cable between VFD output and motor load.
- B. Install cables.
 - 1. Group cables wherever possible on channels.
- C. Lay cable in cable troughs in accordance with Section 26 05 34.
- D. Use approved connectors
- E. Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0 - 1000 – V).

END OF SECTION

SECTION 26 05 22

CONNECTORS AND TERMINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and installation for connectors and terminations.

1.2 REFERENCES

- A. Canadian Standards Association (CSA International)
 - 1. CSA C22.2 No.2012 (22nd Edition)
 - 2. CSA C22.2 No.41 M1987 (R1999), Grounding and Bonding Equipment.

1.3 PRODUCT DATA

- A. Submit product data in accordance with Section 01 33 00, Submittal Procedures.

PART 2 PRODUCTS

2.1 CONNECTORS AND TERMINATIONS

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

PART 3 EXECUTION

3.1 INSTALLATION

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

END OF SECTION

SECTION 26 05 28

GROUNDING SECONDARY

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 26 05 00 - Common Work Results For Electrical.

1.2 REFERENCES

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

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- B. Insulated grounding conductors: green, type RW90.
- C. Ground bus: copper, size as required, complete with insulated supports, fastenings, connectors.
- D. 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.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

- A. Install complete permanent, continuous grounding system including, conductors, connectors, accessories for new equipment. Where EMT is used, run ground wire in conduit.
- B. Install connectors in accordance with manufacturer's instructions.
- C. Protect exposed grounding conductors from mechanical injury.
- D. Use mechanical connectors for grounding connections to equipment provided with lugs.
- E. Soldered joints not permitted.
- F. Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- G. Ground secondary service pedestals.

3.2 SYSTEM AND CIRCUIT GROUNDING

- A. Install system and circuit grounding connections to neutral of 208 V system.
- B. Install copper ground bar in Pilot Plant Control Room. Connect ground bar to main building ground in Electrical Room1 using insulated green copper #1 awg.

3.3 EQUIPMENT GROUNDING

- A. Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, frames of motors, motor control centres, starters, control panels, distribution panels.

3.4 FIELD QUALITY CONTROL

- A. Perform tests in accordance with Section 26 05 00 - Common Work Results For Electrical.
- B. Perform tests before energizing electrical system.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORT FOR ELECTRICAL SYSTEM

PART 1 GENERAL

1.1 NOT USED

PART 2 PRODUCTS

2.1 SUPPORT CHANNELS

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

PART 3 EXECUTION

3.1 INSTALLATION

- A. Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors.
- B. Secure equipment to poured concrete with expandable inserts.
- C. Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- D. Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- E. Fasten exposed conduit or cables to building construction or support system using straps.
 - 1. One hole stainless steel straps to secure surface conduits and cables 50 mm and smaller.
 - 2. Two hole stainless steel straps for conduits and cables larger than 50 mm.
 - 3. Beam clamps to secure conduit to exposed steel work.
- F. Suspended support 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.
- G. For surface mounting of two or more conduits use channels at 1 m on centre spacing.
- H. Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

- I. Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- J. Do not use wire lashing or perforated strap to support or secure raceways or cables.
- K. 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.
- L. 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

SECTION 26 05 32

OUTLET BOXES, CONDUIT BOXES, AND FITTINGS

PART 1 GENERAL

1.1 REFERENCES

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

PART 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- A. Size boxes in accordance with CSA C22.1.
- B. 102 mm square or larger outlet boxes as required for special devices.
- C. Gang boxes where wiring devices are grouped.
- D. Blank cover plates for boxes without wiring devices.
- E. 347 V outlet boxes for 347 V switching devices.
- F. Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

- A. 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.
- B. Electro galvanized steel utility boxes for outlets connected to surface mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- C. 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- D. Matching extension and plaster rings as required.

2.3 CONDUIT BOXES

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

2.4 FITTINGS GENERAL

- A. Bushing and connectors with nylon insulated throats.
- B. Knock out fillers to prevent entry of debris.
- C. Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- D. Double locknuts and insulated bushings on sheet metal boxes.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Support boxes independently of connecting conduits.
- B. Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- C. For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- D. Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

SECTION 26 05 34

CONDUITS, CONDUITS FASTENING AND CONDUITS FITTING

PART 1 GENERAL

1.1 REFERENCES

- A. 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, Rigid Metal Conduit.
 - 3. CSA C22.2 No. 56 1977, Flexible Metal Conduit and Liquid Tight Flexible Metal Conduit.
 - 4. CAN/CSA C22.2 No. 227.3, Flexible Nonmetallic Tubing.

PART 2 PRODUCTS

2.1 CONDUITS

- A. Rigid metal conduit: to CSA C22.2 No. 45, aluminum, threaded.
- B. Flexible metal conduit: to CSA C22.2 No. 56, liquid tight flexible metal.

2.2 CONDUIT FASTENINGS

- A. One hole stainless steel straps to secure surface conduits 50 mm and smaller. Two hole stainless steel straps for conduits larger than 50 mm.
- B. Beam clamps to secure conduits to exposed steel work.
- C. Channel type supports for two or more conduits at 1 m oc.
- D. Stainless steel threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

- A. Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- B. Factory "ells" where 90° bends are required for 25 mm and larger conduits.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- A. Weatherproof expansion fittings with internal bonding assembly suitable for 100mm linear expansion.
- B. Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

- C. Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- A. Polypropylene.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- B. X-ray cast walls and floors before coring to confirm location of embedded items.
- C. Use rigid aluminum threaded conduit in areas subject to mechanical injury.
- D. Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
- E. Minimum conduit size for lighting and power circuits: 19 mm.
- F. Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- G. Install fish cord in empty conduits.
- H. Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- I. Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- A. Paint walls before installation of electrical equipment including conduits.
- B. Run parallel or perpendicular to building lines.
- C. Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- D. Run conduits in flanged portion of structural steel.
- E. Group conduits wherever possible on suspended or surface channels.
- F. Do not pass conduits through structural members except as indicated.
- G. Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

END OF SECTION

SECTION 26 05 36

CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 01 33 00, Submittal Procedures.

1.2 REFERENCES

- A. Canadian Standards Association (CSA International)
 - 1. CAN/CSA C22.2No.126, Cable Tray Systems.
- B. National Electrical Manufacturers Association (NEMA) standards
 - 1. NEMA FG 1, Fibreglass and Cable Tray Systems.
 - 2. NEMA VE 1, Metal Cable Tray Systems.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit shop drawings and product data in accordance with section 01 33 00 Submittal Procedures.
- B. Identify types of cable troughs used.
- C. Show actual cable trough installation details and suspension system.

PART 2 PRODUCTS

2.1 CABLETROUGH

- A. Cable troughs and fittings: to NEMA VE 1.
- B. Ladder type, Class D1 to CAN/CSA C22.2No.126.
- C. Trays: extruded aluminum, 750 mm wide with depth of 100 mm.
- D. Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cable trough supplied.
 - 1. Radii on fittings: 600 mm minimum.
- E. Barriers where different voltage systems are in same cable trough.

2.2 SUPPORTS

- A. Provide supports as required.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Extend existing cable trough system to provide support to final end device.
- B. Provide separate tray system for 600 VAC and 120 VAC and 24 VDC control cables. Provide barrier between 120 VAC and 24 VDC systems.
- C. Support cable trough on both side.
- D. Install green insulated 1/0 copper bonding conductor to run full length of new cable troughs. Connect new bonding conductor to existing bonding conductor where extending tray system
- E. Bonding conductors to be fastened with electrically conducting metal clamps at 6 m centres and at each end of terminated cable trough.
- F. Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

- A. Install cables individually.
- B. Lay cables into cable trough. Use rollers when necessary to pull cables.
- C. Secure cables in cable trough at 3 m centres, with nylon ties.
- D. Identify cables every 30 m with size 2 nameplates.

END OF SECTION

SECTION 26 09 43

NETWORK LIGHTING CONTROLS

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

- A. Existing Douglas BP-C12M factory assembled networked switching panels, interfaces, modules and software
- B. Existing low voltage wall stations and control interfaces.
- C. New low voltage wall station.

1.2 SHOP DRAWINGS

- A. Submit shop drawings in accordance with Section 01 33 00, Submittal Procedures.
- B. Indicate:
 - 1. Wiring diagrams.
 - 2. Catalogue information
 - 3. Connection details for integration into existing system.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Two (2) WR-6161 2-wire HID relays
- B. One (1) 2-wire LED switch located at mezzanine door
- C. Layout and connections as per plans.
- D. Low Voltage Switch Kit.
- E. Approved Manufacture: Douglas Lighting.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install system and components in accordance with manufacturer's instructions.
- B. Install low voltage switch at mezzanine door and connect to existing panel LC-R22.

- C. Install new relays in existing panel LC-R22.
- D. Install two (2) new 120 VAC lighting circuits to panel LC-R22.
- E. Connect new low voltage switch at mezzanine door to new relay supplying power to mezzanine fixtures.
- F. Connect new relay supplying power to new main level fixtures to existing low voltage switches
- G. Update lighting panel schedule with new typed written schedule for panel LC-R22.

3.2 FIELD QUALITY CONTROL

- A. On completion of installation, manufacturer representative shall be notified to carry out Site inspection and report any inconsistencies to the Contract Administrator. Corrections are to be implemented to comply with manufacturer's report.

END OF SECTION

SECTION 26 12 17

DRY TYPE TRANSFORMERS UP TO 600 V PRIMARY

PART 1 GENERAL

1.1 SCOPE SECTION INCLUDES

- A. Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 RELATED SECTIONS

- A. Section 01 33 00, Submittal Procedures.
- B. Section 26 05 00, Common Work Results for Electrical.

1.3 REFERENCES

- A. Canadian Standards Association (CSA International)
 - 1. CAN/CSA C22.2 No.47, Air Cooled Transformers (Dry Type).
 - 2. CSA C9, Dry Type Transformers.
- B. National Electrical Manufacturers Association (NEMA)

1.4 PRODUCT DATA

- A. Submit product data in accordance with Section 01 33 00, Submittal Procedures.

PART 2 PRODUCTS

2.1 GENERAL TRANSFORMERS

- A. Use transformers of one manufacturer throughout project and in accordance with CAN/CSA C22.2No.47.
- B. Design.
 - 1. Type: ANN.
 - 2. Rating as specified.
 - 3. Voltage taps: standard.
 - 4. Insulation: 180 degrees C temperature rise.
 - 5. Basic Impulse Level (BIL): standard.
 - 6. Hipot: standard.
 - 7. Average sound level: standard
 - 8. Impedance at 17 degrees C: standard

9. Enclosure: CSA 1, removable metal front panel c/w sprinkler shield.
10. Finish: in accordance with Section 26 05 00 - Common Work Results - Electrical.
11. Acceptable manufactures: Schneider Electric, Eaton, Rex Manufacturing.

2.2 EQUIPMENT IDENTIFICATION

- A. Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- B. Label size: 7.
- C. Nameplate wording:
 1. T-2
 2. 15kVA
 3. 600V – 120/208V

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount dry type transformers up to 75 kVA as indicated.
- B. Mount dry type transformers above 75 kVA on floor.
- C. Ensure adequate clearance around transformer for ventilation.
- D. Install transformers in level upright position.
- E. Remove shipping supports only after transformer is installed and just before putting into service.
- F. Loosen isolation pad bolts until no compression is visible.
- G. Make primary and secondary connections in accordance with wiring diagram.
- H. Energize transformers after installation is complete.

END OF SECTION

SECTION 26 24 17

PANELBOARDS BREAKER TYPE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

- A. Section 01 33 00, Submittal Procedures.
- B. Section 26 05 00, Common Work Results for Electrical.
- C. Section 26 28 21, Moulded Case Circuit Breakers.

1.3 REFERENCES

- A. Canadian Standards Association (CSA International)
 - 1. CSA C22.2 No.29-11, Panelboards and enclosed Panelboards.

1.4 SHOP DRAWINGS

- A. Submit shop drawings in accordance with Section 01 33 00, Submittal Procedures.
- B. Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

PART 2 PRODUCTS

2.1 PANELBOARDS

- A. Panelboards: to CSA C22.2No.29 and 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.
- B. 600 V panelboards: bus and breakers rated for 35kA (symmetrical) interrupting capacity or as indicated.
- C. 250 V panelboards: bus and breakers rated for 10kA (symmetrical) interrupting capacity or as indicated.

- D. 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.
- E. Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- F. Two keys for each panelboard and key panelboards alike.
- G. Copper bus with neutral of same ampere rating as mains.
- H. Mains: suitable for bolt on breakers.
- I. Trim with concealed front bolts and hinges.
- J. Trim and door finish: baked grey enamel.
- K. Approved manufacture: Schneider Electric

2.2 BREAKERS

- A. Breakers: to Section 26 28 21, Moulded Case Circuit Breakers.
- B. Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- C. Lock on devices for fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

- A. Provide equipment identification in accordance with Section 26 05 00, Common Work Results for Electrical.
- B. Nameplate for each panelboard size 4 engraved as indicated.
- C. Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- D. Complete circuit directory with typewritten legend showing location and load of each circuit.

PART 3 EXECUTION

3.1 INSTALLATION

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

- B. Install surface mounted panelboards on U-channel. Where practical, group panelboards on common supports.
- C. Mount panelboards to height specified in Section 26 05 00, Common Work Results for Electrical.
- D. Connect loads to circuits.
- E. Connect neutral conductors to common neutral bus with respective neutral identified.
- F. Measure load current on each phase and adjust phase loading for a balanced system.

END OF SECTION

SECTION 26 24 19

MOTOR CONTROL CENTRES

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 26 05 00, Common Work Results for Electrical.

1.2 REFERENCES

- A. Canadian Standards Association (CSA)
 - 1. CAN/CSA Q9000, Quality Management and Quality Assurance Standards Guidelines for Selection and Use.

1.3 PRODUCT DATA

- A. Motor Control Centres complete with motor starters will be supplied by the City.
- B. Product data will be provided to the Contractor including data sheets for sills, busbars and compartments, product characteristics, physical size and finish.
- C. Manufacturers Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.4 SHOP DRAWINGS

- A. Shop drawings will be provided to the Contractor by the Contract Administrator.
- B. Shop drawings will 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.

1.5 CLOSEOUT SUBMITTALS

- A. Provide operation and maintenance data for motor control centre for incorporation into manual.
- B. Include data for each type and style of starter.

PART 2 PRODUCTS

2.1 SUPPLY CHARACTERISTICS

- A. 600 V, 1200 amp, 65 kAIC, 60Hz, wye connected, 3 phase, 3 wire, grounded neutral.

2.2 GENERAL DESCRIPTION

- A. The City will supply additional sections to existing MCC, complete with motor starters as indicated on the plans and specifications.
- B. Compartmentalized vertical sections with common power busbars.
- C. Floor mounting, free standing, enclosed dead front.
- D. Indoor CSA 1 gasketed enclosure.
- E. Class I Type B.
- F. Assemble sections in widths capable of entry into building and final mounting location.
- G. Approved Manufacture: Schneider Electric, SquareD Model 6.

2.3 VERTICAL SECTION CONSTRUCTION

- A. Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.
- B. Each vertical section divided into compartment units, minimum 305 mm high, as indicated.
- C. Each unit to have complete top and bottom steel plate for isolation between units.
- D. Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.
- E. 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.
- F. Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.
- G. Incoming cables to enter at top with terminals.
- H. Provision for outgoing cables to exit via top or bottom with terminals.
- I. Removable lifting means.

J. Provision for future extension of right end of motor control centre including busbars without need for further drilling, cutting or preparation in field.

K. Divide assembly for shipment to Site, complete with hardware and instructions for re assembly.

2.4 SILLS

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

2.5 BUSBARS

A. Main horizontal and branch vertical, three phase high conductivity tin plated copper busbars in separate compartment self cooled, extending entire width and height of motor control centre, supported on insulators and rated:

1. Main horizontal busbars: 1200 A.
2. Branch vertical busbars: 600 A.

B. Branch vertical busbars for distribution of power to units in vertical sections.

C. No other cables, wires, equipment in main and branch busbar compartments.

D. Brace buswork to withstand effects of short circuit current of 65kA rms symmetrical.

E. Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.6 GROUND BUS

A. Copper ground bus extending entire width of motor control centre.

B. Vertical ground bus strap, full height of section, tied to horizontal ground bus, engaged by plug in unit ground stab.

2.7 MOTOR STARTERS AND DEVICES

A. Provide motor starters with required controls to interface with Programmable Logic Control System. This includes start signals, running signals, fault status, and HOA status.

2.8 STARTER UNIT COMPARTMENTS

A. 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.

B. 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.
- C. 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.
- D. Hinge unit doors on same side.
- E. Overload relays manually reset from front with door closed.
- F. Pushbuttons and indicating lights mounted on door front.
- G. Devices and components by one manufacturer to facilitate maintenance.
- H. Pull apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.
- 2.9 WIRING IDENTIFICATION
- A. Contractor to provide wiring identification in accordance with Section 26 05 00, Common Work Results for Electrical.
- 2.10 EQUIPMENT IDENTIFICATION
- A. Contractor to provide equipment identification in accordance with Section 26 05 00, Common Work Results for Electrical.
1. Motor control centre main nameplate: size No. 7
 2. Individual compartment nameplates: size No. 5.
- 2.11 FINISHES
- A. Apply finishes in accordance with Section 26 05 00, Common Work Results for Electrical.
- B. Paint motor control centre exterior light gray and interiors white.
- 2.12 SOURCE QUALITY CONTROL
- A. Contract Administrator to witness standard testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.
- B. Make field power and control connections as indicated.
- C. Ensure correct overload heater elements are installed.
- D. Coordinate shut down of MCC 3B with City staff.

3.2 FIELD QUALITY CONTROL

- A. Perform tests in accordance with Section 26 05 00, Common Work Results for Electrical.
- B. Ensure moving and working parts are lubricated where required.
- C. Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hours period

END OF SECTION

SECTION 26 27 26

WIRE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

- A. Section 01 33 00, Submittal Procedures.
- B. Section 26 05 00, Common Work Results for Electrical.

1.3 REFERENCES

- A. Canadian Standards Association (CSA International)
 1. CSA C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 2. CSA C22.2 No.42.1, Cover Plates for Flush Mounted Wiring Devices (Bi national standard, with UL 514D).
 3. CSA C22.2 No.55, Special Use Switches.
 4. CSA C22.2 No.111, General Use Snap Switches (Bi national standard, with UL 20, twelfth edition).

1.4 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit shop drawings and product data in accordance with Section 01 33 00, Submittal Procedures.

PART 2 PRODUCTS

2.1 SWITCHES

- A. 20 A, 120 V, single pole, double pole, three way, four way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- B. Manually operated general purpose ac switches with following features:
 1. Terminal holes approved for No. 10 AWG wire.
 2. Silver alloy contacts.
 3. Urea or melamine moulding for parts subject to carbon tracking.
 4. Suitable for back and side wiring.
 5. Ivory toggle.

- C. Toggle operated locking fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- D. Switches of one manufacturer throughout project.
- E. Acceptable materials: Leviton specification grade, Hubbell specification grade.

2.2 RECEPTACLES

- A. Duplex receptacles, CSA type 5 15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
 - 1. Ivory urea moulded 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.
- B. Single receptacles CSA type 5 15 R, 125 V, 15 A, U ground with following features:
 - 1. Ivory urea moulded housing.
 - 2. Suitable for No. 10 AWG for back and side wiring.
 - 3. Four back wired entrances, 2 side wiring screws.
- C. Other receptacles with ampacity and voltage as indicated.
- D. Receptacles of one manufacturer throughout project.
- E. Acceptable materials: Leviton specification grade, Hubbell specification grade.

2.3 COVER PLATES

- A. Cover plates for wiring devices to: CSA C22.2 No.42.1.
- B. Cover plates from one manufacturer throughout project.
- C. Sheet stainless steel utility box cover for wiring devices installed in surface mounted utility boxes.
- D. Stainless steel, 1 mm thick cover plates for wiring devices mounted in flush mounted outlet box.
- E. Stainless steel or cast aluminum cover plates for wiring devices mounted in surface mounted FS or FD type conduit boxes.
- F. Weatherproof double lift spring loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- G. Weatherproof spring loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

PART 3 EXECUTION

3.1 INSTALLATION

A. 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 in accordance with Section 26 05 00, Common Work Results for Electrical.

3.2 Receptacles:

- A. Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- B. Mount receptacles at height in accordance with Section 26 05 00, Common Work Results for Electrical.
- C. Where split receptacle has one portion switched, mount vertically and switch upper portion.

3.3 Cover plates:

- A. Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- B. Install suitable common cover plates where wiring devices are grouped.
- C. Do not use cover plates meant for flush outlet boxes on surface mounted boxes.

END OF SECTION

SECTION 26 28 21

MOULDED CASE CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials for moulded-case circuit breakers.

1.2 RELATED SECTIONS

- A. Section 01 33 00, Submittal Procedures.

1.3 REFERENCES

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

1.4 SUBMITTALS

- A. Submit product data in accordance with Section 01 33 00, Submittal Procedures.
- B. Include time current characteristic curves for breakers with ampacity of 90 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

- A. Moulded-case circuit breakers: to CSA C22.2 No. 5
- B. Bolt on moulded case circuit breaker: quick make, quick break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- C. Common trip breakers: with single handle for multi pole applications.
- D. Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - 1. Trip settings on breakers with adjustable trips to range from 3.8 times current rating.
- E. Circuit breakers to have minimum symmetrical rms interrupting capacity rating matching panel board or switchboard containing breaker.

2.2 THERMAL MAGNETIC BREAKERS DESIGN A

- A. Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC BREAKERS DESIGN B

- A. Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install circuit breakers as indicated.

END OF SECTION

SECTION 26 28 23

DISCONNECT SWITCHES – FUSES AND NON-FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

- A. Section 01 33 00, Submittal Procedures.
- B. Section 26 05 00, Common Work Results for Electrical.

1.3 REFERENCES

- A. Canadian Standards Association (CSA International).
 - 1. CAN/CSA C22.2 No.4, Enclosed Switches.
 - 2. CSA C22.2 No.39, Fuseholder Assemblies.

1.4 SUBMITTALS

- A. Submit product data in accordance with Section 01 33 00, Submittal Procedures.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

- A. Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure 12, to CAN/CSA C22.2 No.4 size as indicated.
- B. Provision for padlocking in on off switch position by three locks.
- C. Mechanically interlocked door to prevent opening when handle in ON position.
- D. Fuses: size as indicated
- E. Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- F. Quick make, quick break action.
- G. ON OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- A. Provide equipment identification in accordance with Section 26 05 00, Common Work Results for Electrical.
- B. Indicate name of load controlled on size 4 nameplate.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches complete with fuses if applicable.

END OF SECTION

SECTION 26 29 03

CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- A. Section 01 33 00, Submittal Procedures.
- B. Section 26 05 00, Common Work Results for Electrical.

1.3 REFERENCES

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

1.4 SHOP DRAWINGS

- A. Submit shop drawings in accordance with Section 01 33 00, Submittal Procedures.
- B. Include schematic, wiring, interconnection diagrams.

1.5 QUALITY ASSURANCE

- A. Submit to Contract Administrator copy of test results.

PART 2 PRODUCTS

2.1 AC CONTROL RELAYS

- A. Control Relays: to CSA C22.2 No.14.
- B. Fixed contact plug in type: general purpose heavy duty with 2 poles. Coil rating: 120 V. Contact rating: 240V, 2 A.

2.2 RELAY ACCESSORIES

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

2.3 OILTIGHT LIMIT SWITCHES

- A. Snap action type: roller, rod, fork, lever, top, side, push, wobble stick actuator, CSA type 4 enclosure. Contact rating 240VAC, 2A

2.4 SOLID STATE TIMING RELAYS

- A. Construction: AC operated electronic timing relay with solid state timing circuit to operate output contact.
- B. Operation: on delay or off delay.
- C. Potentiometer: self-contained to provide time interval adjustment.
- D. Supply voltage: 120 V, AC, 60 Hz.
- E. Temperature range: minus 20 degrees C to 60 degrees C.
- F. Output contact rating: maximum voltage 300 V AC or DC. Current: 2A
- G. Timing ranges: field adjustable, minimum 0.1s, maximum 60 hr.

2.5 OPERATOR CONTROL STATIONS

- A. Enclosure: CSA Type 4, surface mounting:

2.6 PUSHBUTTONS

- A. Illuminated, Heavy duty Oil tight. Operator extend type, as indicated. Black, with 2 NO and 2 NC contacts rated at 10 A, AC, labels as indicated. Stop pushbuttons coloured red. Start pushbuttons coloured green

2.7 SELECTOR SWITCHES

- A. Maintained 3 position labelled as indicated heavy duty oil tight, operators wing lever contact arrangement as indicated, rated 120 V, 10A, AC.

2.8 INDICATING LIGHTS

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

2.9 CONTROL AND RELAY PANELS

- A. CSA Type 12 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.10 CONTROL CIRCUIT TRANSFORMERS

- A. Single phase, dry type.
- B. Primary: 600 V, 60 Hz ac.
- C. Secondary: 120 V, AC.
- D. Rating: 150 VA, or larger as required.
- E. Secondary fuse: ampacity as required.
- F. Close voltage regulation as required by magnet coils and solenoid valves.

2.11 THERMOSTAT LINE VOLTAGE

- A. Wall mounted, for exhaust fan control.
- B. Full load rating: 8A at 120 V.
- C. Temperature setting range: 0 degrees C to 30 degrees C.
- D. Thermometer Range: 0 degrees C to 30 degrees C.
- E. Markings in 5 degrees increments.
- F. Differential temperature fixed at 1 degrees C.

PART 3 EXECUTION

3.1 INSTALLATION

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

3.2 FIELD QUALITY CONTROL

- A. Perform tests in accordance with Section 26 05 00, Common Work Results for Electrical.
- B. Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- C. Upon completion of sectional test, undertake group testing.
- D. Check out complete system for operational sequencing.

END OF SECTION

SECTION 26 29 10

MOTOR STARTERS TO 600 V

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. Section 26 05 00, Common Work Results for Electrical.

1.2 REFERENCES

- A. NEMA contactors and motor starters

1.3 PRODUCT DATA

- A. Motor Starters will be supplied by the City.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- A. Shop drawings will be provided to the Contractor by the Contract Administrator.
- B. Shop drawings will 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.

1.5 CLOSEOUT SUBMITTALS

- A. Provide operation and maintenance data for motor starters for incorporation into manual.
- B. Include operation and maintenance data for each type and style of starter.

PART 2 PRODUCTS

2.1 GENERAL DESCRIPTION

- A. The City will supply motor starters as indicated on the plans and specifications. The Contractor is responsible for the installation and equipment start-up

2.2 MANUAL MOTOR STARTERS

- A. Single 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 overload heater, manual reset, trip indicating handle.
- B. Accessories:
 - 1. Toggle switch, heavy duty oil tight, labelled as indicated.
 - 2. Indicating light: heavy duty oil tight, LED type and colour as indicated.
 - 3. Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- A. 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.
 - 5. Hand-Off-Auto selector switch mounted on starter door
- B. Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control disconnect 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.
- C. Accessories:
 - 1. Pushbuttons and selector switches: heavy duty, oil tight labelled as indicated.
 - 2. Indicating lights: heavy duty, oil tight, LED type and color as indicated.
 - 3. 1 N/O and 1 N/C spare auxiliary contacts unless otherwise indicated.

2.4 CONTROL TRANSFORMER

- A. 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.
- B. Size control transformer for control circuit load plus 20% spare capacity.

2.5 EQUIPMENT IDENTIFICATION

- A. Provide equipment identification in accordance with Section 26 05 00, Common Work Results for Electrical.
- B. Manual starter designation label, black plate, white letters, size 1, engraved as indicated.

- C. Magnetic starter designation label, black plate, white letters, size 4 engraved as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

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

3.2 FIELD QUALITY CONTROL

- A. Perform tests in accordance with Section 26 05 00, Common Work Results for Electrical and manufacturer's instructions.
- B. Operate switches, contactors to verify correct functioning.
- C. Perform starting and stopping sequences of contactors and relays.
- D. Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

SECTION 26 29 20
VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SCOPE

- A. Division 26 Contractor shall install, wire and connect, and program all VFD controllers as indicated on the Drawings. Supply of all VFDs are by the City.

1.2 TESTS

- A. Field testing by equipment manufacturer. Contractor shall assist in the following
 1. The VFD supplier shall provide on-site start-up, fine-tuning, commissioning, operator training and instruction.
 2. The VFD supplier shall provide site functionality test reports indicating loading/current levels during testing as well as control point proving results.
 3. The VFD supplier shall ensure shaft to ground voltages do not exceed 1.5 V at any speed or load requirement.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit Shop Drawings will be provided to the Contractor.
- B. 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

- A. Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 23, Operation and Maintenance Data.
- B. Include operation and maintenance data for each type and style of VFD.
- C. Provide parameter settings for each VFD.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

- A. Variable Frequency Drives as supplied by the following acceptable manufacturer:

1. Asea Brown Boveri Ltd. (ABB) - ACS 800 series.
- B. Input frequency setting signal will be selective between 4-20 mA or 0-10v DC. Output speed monitoring signal shall be selective between 4-20 mA or 0-10 v DC.
- C. Enclosure:
 1. Drive shall be installed in MCC as indicated on drawings.
- D. Protective devices to be incorporated are:
 1. Provide 65kAIC fault interrupting capacity.
 2. Fast acting electronic circuit board protective devices for protection of electronic components.
 3. 3% Line reactor.
 4. Drive output filter.
 5. Integral electronic motor overload protection adjustable up to 150% of motor rating for sixty (60) seconds.
 6. Overcurrent instantaneous trip 250%.
 7. Programmable short-circuit protection.
 8. Programmable ground fault protection.
 9. Overvoltage/overcurrent DC bus monitor/protection.
 10. Undervoltage protection.
 11. Loss of phase and phase unbalance protection.
 12. Inverter over-temperature protection.
 13. Capable of running without motor for start-up.
 14. Maximum acceptable noise level is 80 dBA at 1 m.
- E. Output speed monitoring signal to be selective between 4-20 mA. or 0-10 V.
- F. Data communication link.
 1. Data communication links shall be provided to the VFDs. The data communication link shall be Modbus Ethernet.
 2. Each variable frequency drive shall be provided with Ethernet data communication link and connect to the Plant SCADA System using CAT5E cabling.
- G. Control wiring shall be TEW 105°C rise.
- H. Terminal blocks in separate control enclosures for remote interface shall be Weidmueller SAK6N.
- I. Provide wire markers at both ends of all control wires, Electrovert Type Z.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install VFD(s) in locations as indicated on drawings, and connect up all necessary wiring. All VFD(s) are mounted in MCC3B in the electrical room.

- B. Connect VFD output to motor using drive rated cable.
- C. Contractor shall program all VFD parameters to provide operation as indicated in the plans and specifications.
- D. Contractor shall ensure that all control and stop commands shut down the drive as per manufacture’s recommended procedure (example, ramp to stop, ramp and hold, or coast to stop). Contactors on the line or load side of the drive are not an approved method of control.
- E. MCC disconnect switch, VFD and motor isolation switch are to be labelled with proper shutdown procedures as follows:
 - 1. “Caution”
 - 2. “Ensure VFD is stopped before operating this switch”
 - 3. “Record all faults before resetting”

3.2 FIELD QUALITY CONTROL

- A. Perform tests in accordance with Section 26 05 00, Common Work Results for Electrical and Manufacturer's instructions.
- B. Operate switches, contactors to verify correct functioning.
- C. Perform starting and stopping sequences of contactors and relays.
- D. Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 SUPPLEMENTS

- A. Form: Installed VFD Test.

END OF SECTION

