THE CORPORATION OF THE TOWNSHIP OF CRAMAHE

TENDER NO. 2025-01 – ADDENDUM #5

Colborne Water Treatment Plant Electrical and SCADA System Upgrades

Item A1: Questions and Answers:

Question 1. After review of addendum 3, will you be providing a revised page TF-8 to be included with tender submissions?
Answer 1. Refer to Appendix A for revised page TF-8.

Question 2. Please provide VFD specification and panel schedules.
Answer 2. Refer to Appendix B for 16481 Variable Frequency Drive Specification. For Lighting Panels, LP-1 and LP-A, follow schedules of existing panels with additional modifications as indicated on Single Line Diagram, drawing number E-0006.

Question 3. Can you please provide a specification document for the new motor control centre MCC-1?
Answer 3. Refer to Appendix C for 16480 Motor Control Centres Specification.

Question 4. There are no detailed specs for the MCC and VFD required in this project. Please provide them.
Answer 4. Refer to Questions 2 and 3.

Question 5. Please provide panel schedules for LP-1 and LP-A. They are not shown in the drawings.
Answer 5. Refer to Question 2.

Question 6. Spec Section 16015 Article 1.4 outlines the requirement of conducting a harmonic analysis for this project, but the Article 1.9 Sub-heading within the same spec section states that it is not required. So please confirm that this requirement of harmonic analysis is not applicable to this project and is not required?
Answer 6. Harmonic study is not required at this stage.

Question 7. Spec Section 16412 Article 2.1.7 requires all breakers to be 100% rated but this is not indicated anywhere on the SLD. So please confirm that it is acceptable to provide breakers as 80% rated only and this spec requirement is not applicable to the project?
Answer 7. The main circuit breaker to be 100% rated. Branch circuit breakers are acceptable as 80% rated.

Appendix A - revised page TF-8.

BREAKDOWN OF THE TOTAL LUMP SUM TENDER PRICE

No.	Description	Amount
	General Requirements	
1	Bonds and Insurance	$
2	Mobilization and Demobilization	$
3	Testing & Commissioning	$
4	System Demonstration & Operator Training	$
5	As-Built Drawings and O&M Manual Updates	$
6	Project Management and Coordination	$
7	Lump Sum for All Other Requirements	$
	Instrumentation & Control (I&C)	
8	PLC Equipment	$
9	Other I&C Equipment	$
	Electrical Works	
10	Motor Control Center (MCC)	$
11	Variable Frequency Drive (VFD)	$
12	Wires and Cables	$
13	Other Electrical Equipment	$
No.	**Description**	**Amount**
14	**Provisional:** Conduits	$
	Total Lump Sum Tender Price	**$**

(Transfer Total to Line 1) denoted as (1) on the first page of Schedule of Items and Tender Prices

(This form shall be completed and included as part of the tender submission)

Appendix B - 16481 Variable Frequency Drive Specification

SECTION 16481
VARIABLE FREQUENCY DRIVE

SECTION 16481
VARIABLE FREQUENCY DRIVE

1 GENERAL

1.1 INTENT OF SECTION

1.1.1 This section describes the requirements for supply, installation, and commissioning of variable frequency drives.

1.1.2 Provide variable frequency drives as specified herein and shown on the drawings.

1.1.3 All VFD motor cables are to be installed in dedicated conduit unless otherwise indicated on drawings.

1.1.4 Refer to all Other Divisions of the specification and these documents to determine their effect upon the work of this section.

1.1.5 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 for Electrical General Requirements related to this work.

1.2 DESIGN REQUIREMENTS

1.2.1 Continuous duty, solid state, modular, variable frequency drive (VFD) system suitable for operation on plant electrical power system, controlled locally or remotely as indicated.

1.2.2 Furnish VFD to match motor and driven equipment characteristics.

1.2.3 Furnish VFD package with 24VDC power supply for its control circuit.

1.2.4 Design drive system against:

1.2.4.1 Premature breakdown of motor insulation.

1.2.4.2 Higher than rated motor temperature rise as dictated by motor manufacturer, under intended operating speed and load range.

1.3 SUBMITTALS

1.3.1 In accordance with Section 01300 – Submittals.

1.3.2 Submit shop drawings in accordance with the requirements of Section 01300, aligned with existing pump and the following:

1.3.2.1 Detail specific electrical performance characteristics for each drive.

1.3.2.2 Detail layout, enclosure, and similar items.

1.3.2.3 Heat generation and cooling calculations and requirements.

1.3.2.4 Include values of notching and distortion factors at 600V input to drive. If additional filtering is required, state notching and distortion factors with and without filtering.

1.3.2.5 Dimensional outline and equipment arrangement drawings including clearance requirements, foundation details and weights.

1.3.2.6 Electrical schematics, wiring and interconnection drawings.

1.3.2.7 Three-line diagram.

1.3.2.8 Communications schematics to suit applications where remote monitoring is required. Provide all communications parameters settings to suit remote monitoring.

1.3.2.9 Configuration Parameters to suit each VFD application. Highlight parameters that have been changed from the default drive settings.

1.3.2.10 Bill of Materials.

1.3.3 Submit operation and maintenance manual with detailed records of start-up procedure, site calibration settings and adjustments in typewritten tabular form. Report voltage and current values at intermediate operating points.

1.3.4 Manufacturer to provide Overall Efficiency data at 50%, 75% and 100% speed for all main components including the drive isolation transformer. For VFDs, producing output voltage harmonic distortions greater than 2%, the Overall Efficiency to be decreased by 0.5% at each point to account for the additional losses which will occur at the motor.

1.4 OPERATIONS AND MAINTENANCE DATA

1.4.1 Provide operation and maintenance data for incorporation into manual specified in Section 01730 - Operations and Maintenance Manuals.

1.4.2 Include installation, programming, operation and maintenance manuals.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Environmental conditions: Ambient operating temperature range 0□C to 40□C, humidity range 20% to 90% RH non-condensing, altitude 1000 m maximum above sea level.

1.5.2 VFD system: Pulse width modulating (PWM) technology, 600 V (+10%, 10%), 3 phase, 60 Hz (±3%) input 3 phase, adjustable frequency and voltage output, suitable for controlling speed of standard AC squirrel cage induction motor.

1.5.3 Voltage/Frequency ratio (V/Hz): Vary output voltage proportionally with output frequency to maintain a constant V/Hz value over output range of 0.5 to 60 Hz. Output voltage to remain constant above 60 Hz.

1.5.4 Rating: 100% continuous motor current under ambient conditions indicated and 150% rated motor current for one minute when applied to constant or high starting torque loads.

1.5.5 Displacement power factor: 0.93 minimum lagging over entire speed and load range.

1.5.6 Drive efficiency: 95% minimum.

1.5.7 Output: Output frequency regulation within ±1% and output current waveform close to sine wave such that motor rating, excluding service factor, is not reduced by more than 5%.

1.5.8 Motor: Furnish VFD to match motor and driven equipment characteristics. Motor shall be inverter duty design.

1.5.9 Internal components, including printed circuit boards: conformal coating for corrosion protection against chlorine and hydrogen sulphide.

1.5.10 The VFD enclosure, the main disconnect and primary power components are to be adequate for available fault current of 42kA, symmetrical.

1.5.11 The drives shall be capable of being controlled from a PLC control system.

1.5.12 4-20 mA signal input will be the speed control in "Remote Mode" of operation.

1.5.13 The drive shall have feedback signal; digital inputs shall include control outputs from external control circuiting to start and stop VFD.

1.5.14 Design drive to withstand without damage, the following conditions:

1.5.14.1 Phase-to-phase short circuit on output.

1.5.14.2 Phase-to-ground short circuit on output without utilizing an isolation transformer.

1.5.14.3 Application of stationary, reverse or forward rotating motor while the drive is starting or while inadvertently running open circuit.

1.5.14.4 Momentary loss of line voltage, whether partial or complete.

1.5.14.5 Damage to DC bus soft charging circuitry by internal short circuit.

1.5.15 Resetting after a fault: Latching. By reset input or by reissuing the Run command. Resetting by removing drive input power not acceptable.

1.5.16 The manufacturer shall guarantee the VFD will start and operate the motor within the entire range of operating speed and loads.

1.6 HARMONIC DISTORTION AND NOISE

1.6.1 Voltage Distortion Factor: As defined by IEEE 519, 3% maximum at the input terminals. Harmonic analysis based on available symmetrical short circuit current of 35,000 A at 600 V at input to VFD.

1.6.2 Input current harmonics: 20% maximum for any individual current harmonic and 30% maximum total current harmonics at rectifier input, with balanced and unbalanced line voltage, under any load condition.

1.6.3 Furnish isolating transformers or series reactors, harmonic filters, or other devices and circuits to prevent one drive from adversely affecting operation of other drives supplied from the same transformer or same bus.

1.6.4 Ensure that means are provided to prevent EMI and RFI, if any that are generated do not reflect back into the power distribution system.

1.6.5 All VFDs supplied shall comply with IEEE 519 requirements.

1.7 QUALITY ASSURANCE

1.7.1 Inspect and test components and sub-assemblies for conformance to manufacturer’s engineering and quality assurance specifications.

1.7.2 Test printed circuit boards for minimum 20 hours while heat cycled to maximum temperature of 55°C.

1.7.3 Operate power sections under worst case conditions minimum of 12 hours and operate with motors 6 hours minimum.

1.7.4 Test drive with motor before shipment to assure proper operation within the driven equipment speed range. Test and verify operating, alarm and interlock conditions.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 ABB.

2.1.2 Eaton.

2.1.3 Rockwell.

2.1.4 Allen Bradley.

2.1.5 Schneider Electric.

2.2 MANUFACTURED UNITS

2.2.1 Enclosure

2.2.1.1 Enclosure: Free standing floor mounted/wall mounted as indicated, compartmentalized, steel, EEMAC 12 design, completely front accessible to internal components and wiring connections.

2.2.1.2 Access doors: Hinged with automotive type door handles and three points latches, key operated with two sets of keys. Interlock door opening mechanism with main disconnecting device operating handle.

2.2.1.3 Ventilation Openings: Size to dissipate heat at full VFD capacity, vermin proof screens, dust filters, sprinkler proof louvers, and drip shields.

2.2.1.4 Cooling fans: Minimum additional 25% extra capacity.

2.2.1.5 Conduit/cable entry points: Top or bottom.

2.2.1.6 Ground bus: Tin plated copper.

2.2.1.7 Finish: Exterior, primed and two coats ASA#61 Light Gray epoxy enamel or powder coat; interior, matte white.

2.2.2 Primary Filters and Surge Protection

2.2.2.1 Filter circuits and surge suppressors: to protect inverter from AC line disturbances including 5000 V, 120 joules, maximum voltage spikes. Filters to prevent VFD from causing line voltage disturbances on plant distribution system.

2.2.2.2 Furnish input and output line reactors. Furnish line filters to protect motor from damaging switching spikes.

2.2.3 Radio Frequency Suppression

2.2.3.1 Suppress generation of radio frequencies.

2.2.4 Primary Disconnect Device

2.2.4.1 Main power disconnecting device: Disconnect switch, molded case breaker, fuses and similar protection devices rated for full load current of drive, mounted at top of unit, horsepower rated and shall be lockable in open position.

2.2.4.2 Primary Disconnect handle: Operable from outside without opening cubicle doors, mechanically interlocked to prevent door from being opened with primary disconnect in ON position.

2.2.4.3 Shunt trip: as indicated or as required for safety shutdown.

2.2.4.4 Fuses and similar protection devices: As recommended by VFD manufacturer.

2.2.5 Control Transformer

2.2.5.1 Control transformer: Dry type, fused primary and secondary windings, sized for 150% of maximum system control circuit requirements, including external circuits.

2.2.5.2 Secondary voltage: 120 V, 60 Hz.

2.2.5.3 Furnish VFD package with 24VDC power supply for its control circuit.

2.2.6 Operator Controls

2.2.6.1 VFD controller to provide full motor selectable over-current protection (matching motor characteristics and overload heaters).

2.2.6.2 Electronic motor overload, with selectable class 5, 10, 15, 20, 25, and 30.

2.2.6.3 Protection to be adjustable for various motor sizes between 50% to 100% VFD rating. Where this protection does not match motor rating, provide separate overload relays.

2.2.6.4 Provide VFD input/output signals as per contract drawings.

2.2.6.5 Provide an isolated input (SPEED CONTROL) to accept a remote 4-20 mA 24V DC control signal when speed control is in Remote (PLC) mode.

2.2.6.6 Remote 4-20 mA input signal to control motor speed when the VFD panel selector switch is in “Remote” only. When the selector switch is in “Local” the VFD Keypad is to provide the adjustable speed reference control.

2.2.6.7 Provide remote indication of output speed, isolated 4-20 mA signal, 24VDC.

2.2.6.8 Provide an input (START/RUN) to accept a remote dry contact 24VDC, that starts the VFD when Remote (RPU) mode is selected.

2.2.6.9 Provide a dry contact capable of 120V AC as an output indicating VFD FAULT status to remote PLC.

2.2.6.10 Provide a dry contact capable of 120V AC as an output indicating VFD RUNNING status to remote PLC.

2.2.6.11 Provide a dry contact capable of 120V AC as an output indicating REMOTE/LOCAL status to remote PLC.

2.2.6.12 Surge suppressor: On relay coils.

2.2.6.13 General purpose relays: Heavy duty, industrial, EEMAC rated, electrically held, 120V, 60 Hz, 10 A, 120V AC convertible contacts, Type P by Allen-Bradley Canada Ltd.

2.2.6.14 Timing relays: 120V AC coil, 10 A, 120V AC, convertible contacts, knob adjustable timing range as indicated, Type PT or NT by Allen-Bradley Canada Ltd.

2.2.6.15 Solid state programming and diagnostic unit: Door mounted.

2.2.6.16 Door mounted Human Interface Module (HIM), or discrete selectors, potentiometers, and indicators, incorporating controls and indicators, heavy duty, oil tight design:

2.2.6.16.1 LOCAL/REMOTE: two position selector switch.

2.2.6.16.2 STOP/START pushbuttons: active when LOCAL/REMOTE switch in Local.

2.2.6.16.3 LOCAL speed control selection.

2.2.6.16.4 Manual speed control, 0 to 100% scale, via flush mount potentiometer.

2.2.6.16.5 Speed indication, 0 to 100% scale.

2.2.6.16.6 Output current indication, 0-125% scale.

2.2.6.16.7 Elapsed time meter for accumulated motor run time. Indicate hours.

2.2.6.17 Door mounted indicator lights: Push-to-test type with LED lamps, indicating VFD Running Status (green), VFD Stopped Status (red), and VFD Fault Status (amber).

2.2.6.18 Internal adjustment features:

2.2.6.18.1 Preset frequency adjustment, 50 to 100% range; while external preset speed contact is closed, during REMOTE and/or AUTO control mode, the VFD starts and goes to a preset speed and ignores the external AUTO speed reference signal and ignores the external auto run signal.

2.2.6.18.2 The VFD to include a customer selectable automatic restart feature. When enabled, the VFD to automatically attempt to restart after a trip condition resulting from over-current, overvoltage, under-voltage, or over-temperature. For safety, the drive will shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a customer programmable time period. Auto-Restart to be programmable to allow for individual fault selection.

2.2.6.18.3 Active current limit adjustment, 50 100% range.

2.2.6.18.4 Maximum frequency adjustment, 50 100% range.

2.2.6.18.5 Minimum frequency adjustment, 0 100% range.

2.2.6.18.6 Acceleration ramp rate adjustment, 3 200 seconds.

2.2.6.18.7 Deceleration ramp rate adjustment, 3 200 seconds.

2.2.6.18.8 Slip compensation, minimum range 5% of maximum frequency, no load to full load.

2.2.6.18.9 IR compensation or boost, minimum range 30 VAC.

2.2.6.19 Isolated output signals, 4-20 mA, for remote readouts of output frequency and total power.

2.2.6.20 Main logic PCB: Adjustment and test points at ground potential.

2.2.6.21 Communication

2.2.6.21.1 Each drive should be provided with an Ethernet Port.

2.2.7 Alarms and Safety Interlocks

2.2.7.1 Common “Drive Fault” contact to operate and VFD to shut down without damage under the following conditions: (unless otherwise indicated, precise limits to be specified and documented by VFD manufacturer)

2.2.7.1.1 Low AC input voltage. Indirect sensing of line voltage via DC bus not acceptable.

2.2.7.1.2 Loss of input phase.

2.2.7.1.3 High DC bus voltage.

2.2.7.1.4 Low DC bus voltage.

2.2.7.1.5 High peak DC bus or output current.

2.2.7.1.6 Drive over-temperature.

2.2.7.1.7 External contact operation.

2.2.7.1.8 Motor overload relay operation.

2.2.7.1.9 Motor over-temperature relay operation.

2.2.7.1.10 Motor ground fault.

2.2.7.1.11 Motor vibration.

2.2.7.2 Annunciators: LED type, visible on or through window in front door with the following real time annunciators:

2.2.7.2.1 Incoming power.

2.2.7.2.2 External interlock.

2.2.7.2.3 DC bus charged.

2.2.7.2.4 Drive over-temperature fault.

2.2.7.2.5 Motor ground fault.

2.2.7.3 Fault memory retention circuit: with manual reset, annunciating the following system conditions:

2.2.7.3.1 Line voltage fault.

2.2.7.3.2 Over current fault, including 50/51 and 50G/51G faults.

2.2.7.3.3 DC bus voltage fault.

2.2.7.3.4 Logic fault.

2.2.7.4 Current limit: Control logic, accurate over entire speed range, to automatically reduce output frequency when load current exceeds adjusted current limit level.

2.2.7.5 Motor regeneration: Override circuit to limit regenerated energy.

2.2.8 Wiring

2.2.8.1 Internal wiring: Copper conductor, stranded, 600V rated.

2.2.8.2 Wire identification: To correspond to wire numbers on schematic and control diagrams, Type Z wire marker by Wieland Electric Inc. on both ends. Colour coding is not acceptable.

2.2.8.3 Terminal blocks: Modular, for external wiring connections, 600V, 25A rating, DIN rail mounted. Label each terminal with same designation as connecting wire.

2.2.8.4 Group terminal blocks according to voltage or signal level and function. Allow 150 mm space between rows of terminals blocks. Install two conductors per block maximum.

2.2.8.5 Barriers: Covering exposed terminals and terminal blocks against inadvertent contact.

2.2.8.6 Warning labels: Lamacoid with 5 mm white letters on red background, on front of compartments where multiple power sources are present.

2.2.8.7 Lay-in duct: For wire groupings of six conductors or more. Acceptable Manufacturer: Panduit Canada. For smaller runs, use plastic tie wrap and clips.

2.2.9 Identification

2.2.9.1 Equipment identification: Refer to Section 16010 – Electrical General Requirements and Section 13040.

2.2.9.2 Nameplates: For face-mounted components.

2.2.9.3 Identify interior sub-assembly compartments with lamacoid labels.

2.2.9.4 Warning nameplates: Lamacoid, 5 mm white lettering on red background, indicating presence of live circuit when VFD is in normal mode. Mount on access doors and internal compartment doors or barriers.

3 EXECUTION

3.1 COORDINATION

3.1.1 Coordinate characteristics and integration of variable frequency drive units with manufacturer of motors and driven equipment supplied under this contract, other contracts or where existing.

3.2 INSTALLATION

3.2.1 Install equipment in locations indicated.

3.2.2 Verify required floor openings are provided.

3.2.3 Connect external power, control and instrumentation wiring.

3.2.4 Conduct VFD manufacturer's recommended tests and start-up procedures.

3.3 START-UP AND COMMISSIONING

3.3.1 Include services of manufacturer's technical representative to assist in setting up control system on job site.

3.3.2 Follow the VFD manufacturer's recommended test and start-up procedures and refer to Division 1.

3.3.3 Provide as-build VFD parameters settings.

3.3.4 Include necessary visits by manufacturer's representative to start up and ensure trouble free operation of the systems. The number of visits and person-days per visit to be coordinated with the Contractor in accordance with Division 1.

3.3.5 The VFDs to be programmed to reset automatically in the event of an internal VFD fault. If the fault is still present after three (3) automatic restart attempts the VFD shall require manual rest.

3.3.6 The VFD manufacture shall provide a listing of all programmed VFD settings.

3.3.7 The VFD manufacturer shall be present for start-up and commissioning and shall coincide with the start-up and commission of the ventilation Fans on VFDs.

3.4 FIELD QUALITY CONTROL

3.4.1 Test Equipment and Test Plan

3.4.1.1 Furnish and install all instruments, both mechanical and electrical, required for tests to prove compliance with specification following installation. Submit the test plan, including test instrumentation, for approval before commencement of the tests.

3.4.1.2 Provide two weeks notification before commencing tests for witnessing by the Owner.

3.4.1.3 At the conclusion of the tests, submit the test results in a bound document for approval.

3.4.2 Visual and Mechanical Inspection

3.4.2.1 Motor running protection

3.4.2.1.1 Compare drive overcurrent setpoints with motor full-load current rating to verify correct settings.

3.4.2.1.2 Apply minimum and maximum speed setpoints. Confirm setpoints are within limitations of the load coupled to the motor.

3.4.2.1.3 Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.

3.4.2.1.4 Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

3.4.2.2 Verify correct fuse sizing in accordance with manufacturer's published data.

3.4.2.3 Bolt VFD enclosure to concrete housekeeping pads in minimum 3 internal corners.

3.4.3 Electrical and Performance Tests

3.4.3.1 Test the motor overload relay elements by measuring primary current to a dummy load and monitoring trip time of the overload element.

3.4.3.2 Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation.

3.4.3.3 Prove the operation of the protective devices for the following parameters in accordance with relay calibration procedures outlined by the manufacturer:

3.4.3.3.1 Low AC input voltage. Indirect sensing of line voltage via DC bus not acceptable.

3.4.3.3.2 Loss of input phase.

3.4.3.3.3 High DC bus voltage.

3.4.3.3.4 Low DC bus voltage.

3.4.3.3.5 High peak DC bus or output current.

3.4.3.3.6 Drive over-temperature.

3.4.3.3.7 External contact operation.

3.4.3.3.8 Motor overload relay operation.

3.4.3.3.9 Motor over-temperature relay operation.

3.4.3.3.10 Motor ground fault.

3.4.3.3.11 Motor vibration.

3.4.3.3.12 Input phase loss protection.

3.4.3.3.13 Input overvoltage protection.

3.4.3.3.14 Output phase rotation.

3.4.3.3.15 Overtemperature protection.

3.4.3.3.16 DC overvoltage protection.

3.4.3.3.17 Over frequency protection.

3.4.3.3.18 Drive overload protection.

3.4.3.3.19 Fault alarm outputs.

3.4.3.4 Perform continuity tests on bonding conductors.

3.4.3.5 Inspect bolted electrical connections for high resistance using the following methods:

3.4.3.5.1 Use of low-resistance ohmmeter.

3.4.3.5.2 Perform thermographic survey.

3.4.3.6 Using handheld loop calibrator, prove the remote speed setpoint, and reconcile with the speed indicator across the range of minimum and maximum speed setpoints.

3.4.4 Certification

3.4.4.1 Manufacturer's representative shall inspect and certify the completed VFD installation.

3.4.4.2 Verify voltage distortion and line notching factors do not exceed limits specified. Tests to be conducted by an approved independent engineering testing agency.

3.4.4.3 Submit report by testing organization, sealed by a Professional Engineer, verifying measured voltage distortion and line notching factors comply with specified requirements.

END OF SECTION

Appendix C - 16480 Motor Control Centres Specification

SECTION 16480
MOTOR CONTROL CENTRES

SECTION 16480
MOTOR CONTROL CENTRES

1 GENERAL

1.1 INTENT OF SECTION

1.1.1 This section describes the requirements for supply, installation, and testing of a new MCC.

1.1.2 Contractor to ensure that the MCC vendor shall visit each pumping station, measure and verify the space for installation of MCC before submitting MCC shop drawing and ensuring the MCC fits in the available space.

1.2 SCOPE

1.2.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install the Motor Control Centre and/or components assemblies specified herein and on the Contract drawings.

1.2.2 Provide Surge Protection Devices (SPDs).

1.3 COORDINATION

1.3.1 The MCC is to be installed in a building with limited space. The MCC is not permitted to exceed the dimensions identified on the drawings. MCC shop drawings that are submitted with dimensions that exceed the dimensions shown on the drawings will be rejected.

1.3.2 Dimensional Restrictions: Layout dimensions will vary between manufacturers. The Supplier shall coordinate with the Contractor to facilitate a proper installation, subject to acceptance by Engineer.

1.3.3 The installing Contractor shall verify that the equipment proposed shall fit into the available space. Coordinate installation with other trades and notify the approval authorities of any interferences or conflicts in the MCC system power and control wiring.

1.4 CONFLICTING REQUIREMENTS

1.4.1 Any ambiguities in, or contradictions between sections of this Specification, or between this Specification and the local codes, must be resolved by the equipment manufacturer to the satisfaction of the Engineer.

1.5 DEVIATIONS FROM SPECIFICATIONS

1.5.1 Deviations from this Specification may occur due to special design conditions. Such deviations may be permissible if they are equal to or better than the specified requirements, and only when they are approved by the Contract Administrator.

1.6 GENERAL DESIGN REQUIREMENTS

1.6.1 The MCC shall be provided with main disconnect circuit breakers, surge protection devices, power monitoring and branch and feeder circuit breakers as indicated on the drawings and as specified herein.

1.6.2 Provide the necessary shipping splits to ensure that the MCC may be installed in the new building through the access doors.

1.6.3 The short circuit & protection coordination study shop drawing is to be submitted prior to the submission of the MCC electrical distribution equipment shop drawings. Confirm that the available fault contribution does not exceed the rating of the MCC or any of its distribution components.

1.6.4 Equipment furnished under this section shall be fabricated, assembled, tested, and shipped to the job site in full conformity with the instructions and recommendations of the equipment manufacturer, unless Engineer notes exceptions.

1.6.5 Nameplates: Each hinged door shall be provided with a nameplate giving the units description. Each control or indicating device mounted on the face of each door shall be provided with a nameplate giving its designation. Each control device and each control wire terminal block connection inside each unit shall be identified with nameplates or painted legends to match the identification on the manufacturer's wiring diagrams. Unit nameplates for circuit breakers, motor starters and contactors shall indicate the equipment being controlled and the operating voltage and phase. Nameplates shall be attached with self-tapping screws. Adhesive backed nameplates are not acceptable. Nameplates shall be white and black laminated phenolic material of suitable size and shall be engraved with 10 mm high letters for compartment identity and 5 mm letters for other information. The engraving shall extend through the white exterior lamination to the black centre.

1.7 CODES AND STANDARDS

1.7.1 Materials and workmanship shall comply with codes and standards of Ontario and the local codes, regulation and standards.

1.7.2 In addition, the work to confirm to the latest editions and amendments of the applicable Codes and Standards of the following agencies:

1.7.2.1 NEMA ICS 18-2001 – Motor Control Centers

1.7.2.2 NEMA ICS 1-2001 – Industrial Control and Systems: General Requirements

1.7.2.3 NEMA ICS 2.3-2008 – Industrial Control and Systems: Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers

1.7.2.4 CSA Standard C22.2 – 14, “Industrial Control Equipment”

1.7.2.5 CSA Standard C22.1, Canadian Electrical Code, Part I plus Provincial supplements

1.7.2.6 Ontario Electrical Safety Code, latest Edition

1.7.2.7 Applicable sections of ANSI (American National Standards Institute) Standards

1.7.2.8 Manufacturer Qualification:

1.7.2.8.1 The low voltage motor control center shall meet and be certified to manufacturer requirements specified in the latest National Building Code and shall be CSA certified.

1.7.2.8.2 The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed engineer in the province. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.

1.7.2.8.3 The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

1.7.2.8.4 The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment meets, or exceeds, the specified response spectra.

1.8 SOURCE QUALITY CONTROL

1.8.1 Conduct equipment inspection and testing in accordance with NETA at manufacturer’s plant.

1.8.2 Submit certified written test results to Engineer prior to shipment.

1.9 SHOP DRAWINGS

1.9.1 In accordance with Section 01300 – Submittals.

1.9.2 Indicate on the shop drawing submission:

1.9.2.1 Outline dimensions and weight.

1.9.2.2 Configuration of identified compartments.

1.9.2.3 Floor anchoring method and dimensioned foundation template.

1.9.2.4 Cable entry and exit locations.

1.9.2.5 Dimensioned position and size of busbars and details of provision for future extension.

1.9.2.6 Elementary control diagrams, as indicated.

1.10 OPERATION AND MAINTENANCE MANUAL

1.10.1 Provide 3-ring binder(s) and indexed copies of operating and maintenance manuals in accordance with Section 01730 with the following:

1.10.1.1 Complete parts list

1.10.1.2 Spare parts list

1.10.1.3 Installation instructions

1.10.1.4 Operating instructions

1.10.1.5 Maintenance instructions

1.10.1.6 Detailed trouble shooting procedures and fault correction schedules

1.10.1.7 Data for each type and style of starter, relays and circuit breakers

2 PRODUCTS

2.1 MCC SUPPLY CHARACTERISTICS

2.1.1 600V, 60 Hz, three (3) phase, 4 wire grounded neutral.

2.2 GENERAL DESCRIPTION

2.2.1 Compartmentalized vertical sections with common power busbars.

2.2.2 Floor mounting, free standing, enclosed dead front.

2.2.3 Indoor NEMA 12 enclosure.

2.2.4 Equipment dimensions not to exceed dimensions shown on drawings.

2.2.5 Accommodate main circuit breaker, utility metering section, automatic transfer switch, combination starters and feeder/branch circuit breakers as indicated.

2.2.6 Suitable for front mounting.

2.2.7 EEMAC Class II Type B assembly.

2.2.8 General arrangement of Motor Control Centres as indicated on electrical contract drawings.

2.2.9 Provide all necessary warning signs as required by local Inspection Authorities.

2.2.10 Short circuit rating: 35 kA rms symmetrical.

2.2.11 Unless noted otherwise on drawings and/or Division 16 specs, ABB XT and Eaton FDE circuit breakers with electronic trip units are recommended for the circuits breakers larger than 15A in MCC, so that excellent coordination can be achieved and while achieving suitable Arc Flash results.

2.2.12 Relays and Timers: Auxiliary relays and timers shall have 120Vt, 60 Hz coils for continuous duty in 40°C ambient, and 10 ampere, 120V AC contacts. Auxiliary relays shall be NEMA rated.

2.2.13 Control Switches and Pilot Lights: Control switches and pilot lights shall be heavy-duty, oil tight construction. Pilot lights shall be transformer type with LED lamps.

2.2.14 Pilot/Indicator Light

2.2.14.1 All pilot/indicator lights to be LED type.

2.2.14.2 All lights to be push to test type.

2.2.15 Where MCCs have multiple incoming feeders, provide mechanical and/or electrical interlocks as shown on the drawings.

2.2.16 Isolation Barriers

2.2.16.1 Individual motor starter units, feeder breaker units, transformers, lighting panels, and control device compartments shall be isolated from each other by barriers of metal or a suitable insulating material.

2.2.16.2 Provide automatic vertical bus shutters for each unit.

2.2.16.3 Vertical metal barriers shall extend the full height and depth of each section to isolate adjacent sections.

2.2.16.4 Each unit shall have complete top and bottom steel plate for isolation between units.

2.2.16.5 Vertical wireways shall be separated from the vertical and horizontal power busses.

2.2.16.6 Provide labyrinth isolation barriers over buswork.

2.2.16.7 Provide bolted covers at both ends of motor control centre to allow future expansion without further drilling, cutting or preparation in the field.

2.2.16.8 Dimensions as indicated on drawings

2.2.17 Provide openings with removable cover plates in the side of vertical sections to allow horizontal wiring between sections.

2.3 VERTICAL SECTION CONSTRUCTION

2.3.1 Independent vertical sections fabricated from rolled flat steel sheets, bolted together to form rigid, completely enclosed assembly.

2.3.2 MCC dimensions: as indicated on drawings.

2.3.3 Each unit to have complete top and bottom steel plate for isolation between units.

2.3.4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

2.3.5 Vertical wireways for load and control conductors extending full height of vertical sections, minimum 152 mm wide and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

2.3.6 Openings, with removable cover plates, inside of vertical sections for horizontal wiring between sections.

2.3.7 Main incoming cables to enter at top.

2.3.8 Provision for outgoing cables to exit via top and/or sides, as needed, with numbered master terminal blocks.

2.3.9 Removable lifting means.

2.3.10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.

2.3.11 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly.

2.3.12 Provide each unit, including unused compartments, with a removable formed door with concealed hinges.

2.3.13 Provide adequate ventilation to limit the internal temperature rise to 55°C.

2.4 SILLS

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

2.5 HORIZONTAL BUSBARS

2.5.1 Provide main horizontal (three phase – 4 wires) of high conductivity tinned plated copper busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators and rated at 600.

2.6 MCC VERTICAL SECTIONS USING BUSBARS

2.6.1 Branch vertical busbars for distribution of power to units in vertical sections rated as required.

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

2.6.3 Brace buswork to withstand effects of short-circuit current of 42 kA rms symmetrical.

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

2.7 MCC VERTICAL SECTIONS USING CABLES

2.7.1 Branch vertical cables for distribution of power to units in vertical sections rated at 300 A.

2.7.2 Vertical cable shall be high temperature (200 degrees C) high flexibility copper cables.

2.7.3 Cables shall be installed in a dedicated vertical raceway for MCC sections with several compartments. Power cable replacement shall be possible through the provided door of this dedicated raceway. Cable bracing to withstand effect of short circuit current of 35 kA rms.

2.7.4 Cables shall be connected to horizontal busbars using 100 kA lugs.

2.8 GROUND BUS

2.8.1 300A Copper ground bus size 50 x 7 mm extending entire width of motor control centre, located at bottom.

2.8.2 Provide lugs (2) suitable for up to #4/0 AWG grounding copper (stranded) conductor.

2.9 MCC INCOMING BREAKER

2.9.1 Breaker frame: as indicated on the drawings, 600 V, 60 Hz, 3-pole, minimum 35,000 A interrupting capacity (symmetrical).

2.9.2 Main incoming breaker shall be 100 percent rated. Branch breakers shall be minimum 80 percent rated.

2.9.3 Enclosure: 16 inches (406 mm) deep full cell structure, flush mounted with the rest of the MCC.

2.9.4 Copper Lugs suitable for incoming cable copper conductors.

2.9.5 For main breakers that are Reverse Fed, that is incoming voltage is on the load side of the breaker, a clear warning note is required on the breaker cell door as follows “CAUTION, BREAKER IS REVERSE FED”.

2.10 THERMAL-MAGNETIC BREAKERS (FEEDER/BRANCH BREAKERS)

2.10.1 Moulded case motor 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. The breaker will be plug-in type with the cradle installed in the back of the compartment.

2.10.2 Breakers will be the current limiting type meaning a circuit breaker with a sufficiently short trip time to prevent the short-circuit current from reaching the peak value which would otherwise be reached (IEC 60947-2)

2.10.3 Breaker frame: 600 V, 60 Hz, 3-pole, interrupting capacity as per main breaker in the MCC (symmetrical). Approved series rated breakers with main MCC breaker is a suitable alternative.

2.10.4 Breaker trip unit: adjustable magnetic trip unit, properly rated for motor it is protecting.

2.10.5 Unless noted otherwise on drawings and/or Division 16 specs, ABB XT and Eaton FDE circuit breakers with electronic trip units are recommended for all branches including pump’s circuit breakers in MCC.

2.11 WIRING AND TERMINAL BLOCKS

2.11.1 Provide internal power wiring from the line side of each starter to the bus stabs with a minimum of #10 AWG wire, stranded copper, XLPE, 1 kV rated. Size wiring to accommodate the largest horsepower that the line starter is capable of switching.

2.11.2 Control wiring: 600 V rated, XLPE insulated, minimum #14 AWG size stranded copper. Install wiring to panel doors utilizing extra flexible 49-strand conductors.

2.11.3 Identify all wiring by means of oil-resistant markers fixed to each conductor at both ends.

2.11.4 Wires colour code:

2.11.4.1 Control circuits – Red

2.11.4.2 Power circuits – Black

2.11.5 Terminal blocks: compression type, modular pull-apart construction, enabling unit wiring to be easily separated from field wiring. Identify all terminal blocks with numbers identical to the wire numbers.

2.11.6 No more than two wires per terminal screw (i.e. on terminal block).

2.12 CONTROL DEVICES

2.12.1 Install operator's control devices for each starter or contactor unit on MCC units as indicated.

2.12.2 Install Control Circuit Transformers for each starter, Single phase, dry type, secondary: 120V or 24V AC, rating: as indicated plus 20% spare capacity, Secondary fuse kit (terminal block type chips) and fuse, size as needed, close voltage regulations as required by magnet coils and solenoid valves.

2.12.3 Motor control center components: Factory installed by motor control center manufacturer.

2.13 WITHDRAWABLE UNIT COMPARTMENTS

2.13.1 Provide withdrawable compartments for starters and circuit breakers where the compartment is less than 912 mm tall.

2.13.2 Withdrawable units shall be self-disconnecting plug-in type.

2.13.3 Provide guide rail supports for units to ensure that stabs make positive contact with vertical bus.

2.13.4 Withdrawable units shall be capable of insertion or removal with main bus energized.

2.14 COMPARTMENTS – GENERAL REQUIREMENTS

2.14.1 Hinge all unit doors on same side.

2.14.2 Overload relays shall be manually reset from front with door closed.

2.14.3 Pushbuttons and indicating lights mounted on door front.

2.14.4 Devices and components shall be by one (1) manufacturer to facilitate maintenance.

2.14.5 Provide pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring

2.15 FINISHES

2.15.1 Shop finish metal enclosure surfaces by application of rust-resistant primer inside and outside, and at least two coats of finish enamel.

2.15.2 Paint motor control centre exterior ASA #61 light grey and interiors white.

2.15.3 Provide a 100 mL container of finish enamel for touch-up of scratches during installation.

2.16 SPARE PARTS AND SPECIAL TOOLS

2.16.1 Provide an itemized list of spare parts as recommended for start-up.

2.16.2 Provide an itemized list of all recommended spare parts required for routine and minor overhauls for two (2) years of normal operation. Each piece of equipment must have part number or designation.

2.16.3 Use identical equipment and components where practical to permit inter-changeability of parts, minimize spare parts inventory, and to simplify maintenance.

2.16.4 Where two or more items of equipment perform similar functions, use the same make and, where practical, the same model number and size.

2.16.5 Provide a complete list with price list of special tools required for commissioning and servicing of the equipment.

2.16.6 Provide spare fuses for each rating, indicating lights and three sets of spare overload heaters for each rating.

2.17 EQUIPMENT IDENTIFICATION

2.17.1 Provide equipment identification in accordance with Section.

2.17.2 The Contractor shall apply Arc Flash Hazard labels in accordance with Section 16015.

2.18 ACCEPTABLE MANUFACTURERS

2.18.1 ABB

2.18.2 Eaton

2.18.3 Rockwell

2.18.4 Schneider Electric

2.18.5 General Electric

2.18.6 Siemens

3 EXECUTION

3.1 INSTALLATION

3.1.1 Install equipment in accordance with NEMA ICS 2.3, Submittal Drawings, and Manufacturer's Instructions and Recommendations.

3.1.2 Set and secure motor control centre in place on channel bases, rigid, plumb and square to floor and wall.

3.1.3 Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions.

3.1.4 Coordinate terminal connections with installation of secondary feeders.

3.1.5 Grout mounting channels into floor or mounting pads.

3.1.6 Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.

3.1.7 Remove foreign material, including dust before energizing equipment.

3.1.8 Connect power, control and grounding wiring.

3.1.9 Prior to energization, confirm in writing that solid state devices have been activated, programmed, calibrated, and set.

3.1.10 Make grounding connections between equipment ground busses and building grounding system.

3.1.11 Check all factory made connections for mechanical security, electrical continuity and current phasing.

3.2 CIRCUIT BREAKERS

3.2.1 Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.

3.3 OVERLOAD RELAY

3.3.1 Ensure correct protection devices installed as per coordination study, including current transformer ratings, fuse ratings, and protective device settings.

3.4 POWER AND LIGHTING PANELBOARDS

3.4.1 Supply and install new panelboards as indicated.

3.4.2 Connect loads to circuits.

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

3.4.4 For new lighting panels LP-1 and LP-A, follow schedules of existing panels with additional modifications as indicated on Single Line Diagram, drawing number E-0006.

3.5 MOTOR DATA

3.5.1 Provide typed, self-adhesive label attached inside each motor starter enclosure door displaying the following information:

3.5.1.1 Motor served by tag number and equipment name.

3.5.1.2 Nameplate horsepower.

3.5.1.3 Motor code letter.

3.5.1.4 Full load amperes.

3.5.1.5 Service factor.

3.6 FACTORY TESTS AND INSPECTIONS

3.6.1 Notify the Engineer two weeks in advance of the tentative FAT date. Coordinate with the Contractor and Engineer to schedule a date suitable to all parties for the FAT.

3.6.2 The manufacturer shall perform a complete operational Factory Acceptance Test (FAT) on the MCC and all components prior to shipping from the factory. A certified test report shall be sent to the Engineer prior to shipping.

3.6.3 Furnish manufacturer's representative for the following services at jobsite or classroom as designated by Engineer:

3.6.3.1 For installation assistance and inspection of installation, see Division 1.

3.6.3.2 For start-up and performance testing, see Specification 01650.

3.7 TESTS

3.7.1 Perform tests in accordance with Section 16010 – Electrical General Requirements, and International Electrical Testing Association (NETA).

3.7.2 Ensure moving and working parts are lubricated where required.

3.7.3 Operate starters in sequence to prove satisfactory performance of motor control centre.

END OF SECTION