|  |  |  |
| --- | --- | --- |
| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | February 19, 2010 | Modified ‘Related Sources’ and approved suppliers |
| 3 | March 22, 2011 | Minor edits |
| 4 | July 8, 2013 | Final Draft – Consolidated Comments Spec Update Project. Incorporation of new Commissioning and Computerized Maintenance Management System Data Requirements Specification cross references. Incorporated several aspects of the NL building specifications. |
| 5 | July 30, 2014 | Changes to reflect renaming of commissioning specification and final review (AV). |
| 6 | February 4, 2015 | Updated, Finalized Specification – Reference eDOCS #5630497 v5 (AV) |
| 7 | May 19, 2015 | First draft phase 2 update incorporating improved arc flash protection specifications for MCC’s as per RH request (AV) |
| 8 | September 9, 2015 | Final Phase 2 update for improved arc resistant equipment (AV) |
| 9 | October 6, 2015 | Updated, Finalized Specification – Reference eDOCS #5630497 v10 (AV) |
| 10 | December 3, 2018 | iMCC standards update (MS) |
| 11 | November 30, 2021 | Review of acceptable manufacturers (BM, MS) |

NOTE:

This is a CONTROLLED Document. Any documents appearing in paper form are not controlled and should be checked against the on-line file version prior to use.

**For each project the Consultant is responsible for the correct application of the specifications and for updating and modifying all highlighted items, as well as updating and modifying those sections that are directly applicable to the project. All updates and modifications to this standard document are to be highlighted to the Region for review and acceptance on each project.**

**Notice:** This Document hardcopy must be used for reference purpose only.

**The on-line copy is the current version of the document.**

# GENERAL

## Related Sections

### [Under "Related Sections", identify other Sections that are related to, and/or dependent on, the work results or information specified elsewhere. The list should be limited to Sections with specific information that the reader might expect to find in this Section, but is specified elsewhere. For example, if hardware for aluminum entrances is specified in the aluminum entrance Section, a cross-reference would be appropriate in the finish hardware Section. The purpose of this cross-referencing is for information only, to aid in finding those other requirements—not to define the scope of the Section.

### Cross-referencing here may also be used to coordinate assemblies or systems whose components may span multiple Sections and which must meet certain performance requirements as an assembly or system.

### This Section is to be completed/updated during the design development by the Consultant. If it is not applicable to the Section for the specific project it may be deleted.]

### [List Sections specifying installation of products supplied but not installed under this Section and indicate specific items.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Execution requirements for ...[item]... specified under this Section.

### [List Sections specifying products installed but not supplied under this Section and indicate specific items.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Product requirements for ...[item]... for installation under this Section.

### [List Sections specifying related requirements.]

### Sections:

#### Section 01425 – Computerized Maintenance Management System Data Requirements

#### Section 01430 – Operation and Maintenance Data

#### Section 01600 – Material and Equipment

#### Section 01740 – Cleaning

#### Section 01810 – Equipment Testing and Facility Commissioning

#### Section 01820 – Demonstration and Training

#### Division 01 – General Requirements (insert applicable specifications)

#### Division 11 – Equipment (insert applicable specifications)

#### Division 16 – Equipment (insert applicable specifications)

#### Division 40 – Process Interconnections (insert applicable specifications)

#### Division 15 – Mechanical (insert applicable specifications)

#### Product requirements for [item]... for installation under this Section.

## Submittals for Review and Approval

### The Contractor shall provide the following O&M documentation: manufacturers’ printed O&M documentation; installation instructions; specifications; operation manuals, including electrical drawings, and plumbing diagrams; sales literature; materials; and training materials as applicable.

### Comply with the requirements of Division 1.

### Provide all necessary licenses, permits, approvals and certificates required in order to complete the work.

### Submittals include but are not necessarily limited to Shop Drawings, Product Data, Samples and other Documents for Review and Submittals for Information Only.

### Indicate:

#### Master drawing index

#### Front view elevation

#### Floor plan

#### Top view

#### Outline dimensions

#### Nameplate schedule

#### Starter and component schedule

#### Assembly ratings including:

##### Short-circuit rating

##### Voltage

##### Continuous current

#### Major component ratings including:

##### Interrupting ratings

##### Voltage

##### Continuous current

#### Dimensioned layout of internal and front mounted components.

#### Configuration of identified compartments.

#### Floor anchoring method and dimensioned foundation template.

#### Cable/Conduit entry and exit locations.

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

#### Schematic and wiring diagrams. Drawings shall follow the Region standard control schematics.

##### Drawings shall follow the format and standards used on the contract drawings. Line numbers, same symbols as per Region templates, relays use line numbers, wire numbers linked to the line numbers. Call out where the NO and NC contacts are used.

#### Single line diagram

#### Cable terminal sizes

#### Key interlock scheme drawing and sequence of operations ***[Consultant to confirm]***

### Provide Final as shipped drawings

### Provide a complete list of recommended spare parts for each different size and type of VFD.

## Measurement and Payment

*[Choose one of the following payment language provisions that best suits the individual project.*

*If this Section is not specifically referenced by an item in the Bid Form, please use the following language:*

.1 The work of this Section will not be measured separately for payment. All costs associated with the work of this Section shall be included in the Contract Price.

*OR If this Section is specifically referenced in the Bid Form, use the following language and identify the relevant item in the Bid Form:*

.1 All costs associated with the work of this Section shall be included in the price(s) for Item No(s). \_\_\_ in the Bid Form.

*If the work of this Section is to be measured and paid for by several different methods, please amend the standard wording given above to reflect the different methods of measurement and payment.*]

## Warranty

### Refer to Division 1, the Articles of Agreement and the General Conditions for warranty details. Where a conflict exists between these requirements and additional requirements within Division 40, the Contractor shall meet the more stringent requirement.

### The warranty for products supplied under this section shall be by a local Canadian distributor in the Province of Ontario.

## Final Documentation

### The manufacturer shall provide the following documentation:

#### Final as-built drawings incorporating all changes made during the manufacturing process.

#### Unit wiring diagrams.

#### Certified production test reports.

#### MCC installation instructions including installation/operation instructions for all major components.

#### MCC Spare parts listing.

#### Warranty Information.

#### Control schematics to be provided in accordance with the Region of York standards. Provide CAD and PDF versions in electronic format. Files in PDF format shall be combined into a single package.

## Regulatory Requirements

### The motor control centres shall bear a CSA/ULc label. Certified copies of production test reports shall be supplied demonstrating compliance with these standards when requested by the Consultant.

## Delivery, Storage and Handling

### The contractor shall coordinate the shipping splits with the MCC manufacturer for entry into the building. Shipping splits shall be identified on the MCC manufacturer drawings.

### The contractor shall store the MCC in a clean, dry and heated space.

### The contractor shall protect the MCC from dirt, water, construction debris and traffic.

## Field Measurements

### Installing Contractor shall verify that equipment proposed will fit into the available space, and meet all relevant codes pertaining to working space around the equipment. Coordinate installation with other trades and notify the Consultant of any interferences or conflicts in the MCC system power and control wiring.

### The location of various items on the drawings are approximate, unless specified otherwise, and are subject to slight revisions as the Work is installed in order to accommodate construction conditions.

### Where equipment and material dimensions are dependent upon building dimensions, take field measurements, do not scale the drawings.

## Source Quality Control

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

### The Consultant and owner`s representative are to witness the factory acceptance testing (FAT) and inspect the complete motor control centre. Where location of FAT is further than 4 hours from the Consultant and/or owner’s representative’s office, the contractor shall arrange and pay for the following:

#### Transportation for one (1) Consultant and one (1) owner`s representative to and from the FAT location.

#### Hotel accommodations for the duration of the FATs.

#### Transportation for the duration of the FATs (rental car or driver).

#### Food arrangements and/or allowances for the duration of the FATs.

### Submit written test results to Consultant.

## Maintenance Materials

### Provide maintenance materials in accordance with Section 16010 – Electrical General Requirements. Also provide spare parts as follows:

#### One (1) contactor of each size used.

#### Four (4) sets (1 N/O, 1 N/C) of auxiliary contacts.

#### One (1) RVSS of each size.

#### One (1) VFD of each size.

#### One (1) circuit breaker of each size.

#### One (1) overload coil of each size used.

#### One (1) control transformer.

#### Ten (10) control fuses.

#### Four (4) indicating lamp assemblies complete with tools.

#### Ten (10) indicating lamp bulbs with insertion tool.

## References

### The Motor Control Centre (MCC) and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI, CSA and UL 845.

## Design Requirements

### The manufacturer of the MCC shall also be the manufacturer of the motor starters, solid-state reduced voltage starters and variable frequency drives. Use of third-party supply and assembly for these components in the motor control centre is not acceptable.

# PRODUCTS

## Supply Characteristics

### The MCC shall be rated for the system voltage as indicated on the contract drawings. The system operating voltage and number of wires shall be as indicated on the drawings.

### The MCC horizontal and vertical power bus bracing shall be rated to meet or exceed the available fault current as shown on the contract drawings.

### All MCC units shall have a full rated short-circuit rating that meets or exceeds the available fault current as shown on the contract drawings.

### All circuit breakers used in the MCC shall have full-rated short-circuit interrupt ratings equivalent to or exceeding the bus fault current rating.

## Construction

### Compartmentalized vertical sections with common power busbars.

### Floor mounting, free standing, enclosed dead front construction and incorporate vertical buses connected to a horizontal bus. The MCC shall be designed to permit future section additions or change of units by the user.

### Sections to be 90 inches high, 20-21 inches deep and 20 inches wide, except where larger widths are required.

### The control centre shall consist of vertical sections fabricated of Code gauge steel, shaped and reinforced to form a continuous rigid free standing, enclosed, completely dead front EEMAC 1, which is gasketed.

### The panels shall be Type "B" construction with all units having individual line and control leads brought to terminal boards suitably located in each starter, and wiring shall conform to EEMAC Class II requirements.

### The complete panels shall have adequate ventilation to limit the internal temperature rise to 55ºC.

### All necessary control transformers, switches, indicating lights, wiring, fuses, interlocks, terminal boards, etc. shall be included to suit the power and control requirements specified herein and/or on the Drawings. All indicating light lamps shall be long life LED type.

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

### Vertical wireways for load and control conductors extending full height of vertical sections.

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

### Openings, with removable coverplates, in side of vertical sections for horizontal wiring between sections.

### Incoming cables to enter at top and bottom with terminals as indicated in the Contract Documents. ***[Consultant to confirm]***

### Incoming cables to enter as indicated.

### Provision for outgoing cables to exit as indicated.

### Removable lifting means.

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

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

### Each MCC shall be provided with a low-voltage control I/O section, allowing for marshalling of all hardwired I/O points (breaker status, field-device status) as indicated on drawings to a common location.

### Motor Control Centre is to provide an integrated hardware, software and communication solution.

### All of the new MCCs for this project shall include Ethernet/IP network connections for all devices as outlined in the projects contract drawings.

## Sills

### Continuous 25 mm channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

## Busbars

### Main horizontal and branch vertical bus bars shall be tin plated copper.

### Horizontal bus bar shall be rated as shown on the contract documents.

### Vertical busbar shall be isolated except where necessary to connect to the horizontal bus.

### Vertical busbar to be rated 600A. ***[Consultant to confirm]***

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

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

## Ground Bus

### Copper ground bus extending entire width of motor control centre, located at bottom.

### Each structure shall contain tin-plated vertical ground bus. The vertical ground bus shall be directly connected to the horizontal ground bus via a tin- plated copper connector. Units shall connect to the vertical bus via a tin-plated copper stab.

## Starter Unit Compartments

### Combination starter units shall be full-voltage non-reversing (FVNR) utilizing circuit breakers unless shown otherwise on contract documents.

### NEMA size 4 FVNR and FVR and smaller shall be provided as plug-in type with self-disconnect.

### Guide rail supports for units to ensure that stabs make positive contact with vertical bus.

### Unit mounting

#### Engaged position - unit stabbed into vertical bus.

#### Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.

#### Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.

#### Stab-on connectors free floating silver plated clips, self-aligning.

### 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.

### Hinge unit doors on same side.

### Overload relays (when required) to be manually reset from front with door closed.

### Pushbuttons, potentiometers, keypads, displays, indication lights, etc. to be mounted on door front.

### Control devices mounted on panel door such as push-buttons, selector switches, pilot lights shall be according to the Region of York standards. Refer to Division 16 specifications and contract drawings for more details.

### Devices and components by one manufacturer to facilitate maintenance.

### Control terminal blocks to be provided in all contactor and starter units.

### Fused control power transformer located within the starter unit when required.

### Starter requirements per Section 16223 – Motor Starters up to 600V.

### Reduced Voltage Soft Starter requirements per Section 16226 – Reduced Voltage Soft Starters up to 600V.

### Variable Frequency Drive requirements per Section 16224 – Variable Frequency Drives up to 600V.

## Main Circuit Breaker

### Lugs to be sized to accommodate the incoming power conductors as indicated on the contract documents.

### Size frame and trip rating as shown on the contract documents.

### The interrupting capacity rating shall meet or exceed the available fault current of the MCC main bus work.

### Provide circuit breaker with thermal magnetic trip unit for 250A and smaller; provide electronic trip unit for 400A and larger frames.

### Provide removable protective barrier to reduce the possibility of incidental contact with the line terminals.

### For circuit breakers rated 1000A and above, on Wye connected systems with a solidly grounded neutral, provide integrated ground fault protection with adjustable pick-up and adjustable time delay.

## Feeder Circuit Breakers

### The interrupting capacity rating shall meet or exceed the available fault current of the MCC main bus work.

### Provide circuit breaker with thermal magnetic trip unit for 250A and smaller; provide electronic trip unit for 400A and larger frames.

## Metering

### Where indicated on the drawings, provide a separate, owner metering compartment with front hinged door.

### Provide necessary current transformers and potential transformers including secondary fuses with disconnecting means.

### Utility metering compartments sized to/conforming to local utility requirements. ***[Consultant to confirm]***

## Equipment Identification

### Provide equipment identification in accordance with Section 16010 – Electrical General Requirements.

#### MCC main nameplate: size 3” x 7”, 1” high lettering, engraved as indicated.

#### Individual compartment nameplates: size 1” x 2.5”, 0.125” high lettering engraved as indicated.

## Finishes

### Apply finishes in accordance with Section 16010 – Electrical General Requirements.

### Paint MCC exterior light grey and interiors white.

## Surge Suppression

### Refer to Specification 16289 for requirements.

## Non-Intelligent Motor Control Centres

### Acceptable Manufacturers

#### Acceptable Manufacturers are listed in the following table in no order or preference. The design has been completed around the first named supplier. The Contractor is responsible for all costs associated with any changes required to the design to accommodate an alternate manufacturer.

|  |  |  |
| --- | --- | --- |
|  | Manufacturer | Model |
| 1 | Allen Bradley | Centerline 2100 |
| 2 | Eaton | Freedom 2100 |
| 3 | ABB | Reliagear LV MCC |
| 4 | Or Equivalent |  |

#### Where an alternate manufacturer is provided, they shall meet the performance specifications of the first named manufacturer.

#### The Contractor shall select the appropriate options to suit the application and the requirements of the Section.

### Non-Intelligent Motor Control Centres

First Named Manufacturer:

|  |  |
| --- | --- |
| Manufacturer | Allen-Bradley |
| Model | Centerline 2100 |
| Voltage | 600V, 3 phase, 3W [Consultant to confirm] |
| Amperage | 1200A [Consultant to confirm] |
| Short Circuit Rating | 42kAIC [Consultant to confirm] |
| Service Entrance Rated | Yes/No [Consultant to choose] |
| Enclosure Type | NEMA 12/4/4X [Consultant to choose] |
| Network Communication | Ethernet/IP |

Second Named Manufacturer:

|  |  |
| --- | --- |
| Manufacturer | Eaton |
| Model | Freedom 2100 |
| Voltage | 600V, 3 phase, 3W [Consultant to confirm] |
| Amperage | 1200A [Consultant to confirm] |
| Short Circuit Rating | 42kAIC [Consultant to confirm] |
| Service Entrance Rated | Yes/No [Consultant to choose] |
| Enclosure Type | NEMA 12/4/4X [Consultant to choose] |
| Network Communication | Ethernet/IP |

Third Named Manufacturer:

|  |  |
| --- | --- |
| Manufacturer | ABB |
| Model | Reliagear LV MCC/MNS |
| Voltage | 600V, 3 phase, 3W [Consultant to confirm] |
| Amperage | 1200A [Consultant to confirm] |
| Short Circuit Rating | 42kAIC [Consultant to confirm] |
| Service Entrance Rated | Yes/No [Consultant to choose] |
| Enclosure Type | NEMA 1/1HG/2/3R/12 [Consultant to choose] |
| Network Communication | Ethernet/IP |

## Intelligent Motor Control Centres

### Acceptable Manufacturers

#### Acceptable Manufacturers are listed in the following table in no order or preference. The design has been completed around the first named supplier. The Contractor is responsible for all costs associated with any changes required to the design to accommodate an alternate manufacturer.

#### The Contractor shall select the appropriate options to suit the application and the requirements of the Section.

#### Where an alternate manufacturer is provided, they shall meet the performance specifications of the first named manufacturer.

|  |  |  |
| --- | --- | --- |
|  | Manufacturer | Model |
| 1 | Allen Bradley | Centerline 2100 IntelliCENTER |
| 2 | Eaton | Freedom 2100 with Intelligent MCC Option |
| 3 | ABB | Reliagear LV MCC |
| 4 | Or Equivalent |  |

### Intelligent Motor Control Centres

First Named Manufacturer:

|  |  |
| --- | --- |
| Manufacturer | Allen-Bradley |
| Model | IntelliCENTER |
| Voltage | 600V, 3 phase, 3W [Consultant to confirm] |
| Amperage | 1200A [Consultant to confirm] |
| Short Circuit Rating | 42kAIC [Consultant to confirm] |
| Service Entrance Rated | Yes/No [Consultant to choose] |
| Enclosure Type | NEMA 12/4/4X [Consultant to choose] |
| Network Communication | Ethernet/IP |

Second Named Manufacturer:

|  |  |
| --- | --- |
| Manufacturer | Eaton |
| Model | Freedom 2100 with Intelligent MCC Option |
| Voltage | 600V, 3 phase, 3W [Consultant to confirm] |
| Amperage | 1200A [Consultant to confirm] |
| Short Circuit Rating | 42kAIC [Consultant to confirm] |
| Service Entrance Rated | Yes/No [Consultant to choose] |
| Enclosure Type | NEMA 12/4/4X [Consultant to choose] |
| Network Communication | Ethernet/IP |

Third Named Manufacturer:

|  |  |
| --- | --- |
| Manufacturer | ABB |
| Model | Reliagear LV MCC/MNS |
| Voltage | 600V, 3 phase, 3W [Consultant to confirm] |
| Amperage | 1200A [Consultant to confirm] |
| Short Circuit Rating | 42kAIC [Consultant to confirm] |
| Service Entrance Rated | Yes/No [Consultant to choose] |
| Enclosure Type | NEMA 1/1HG/2/3R/12 [Consultant to choose] |
| Network Communication | Ethernet/IP |

## Ethernet/IP Communication

### The MCC shall have Ethernet wiring incorporated into its design.

#### The MCC shall have factory installed industrial Ethernet cabling incorporated throughout the vertical section across the entire lineup.

#### The network cabling shall be built into the MCC, routed behind permanent MCC walls and barriers to prevent accidental exposure and/or damage during installation.

#### Each motor starter, electronic overload relay, power monitor, AC drive, and soft starter unit in the MCC shall be supplied with a means to communicate via EtherNet/IP network protocol as shown on contract drawings.

#### Maintenance activities should be able to be performed without impacting the network.

#### The IP Address shall not be visible on the unit Nameplate for any units containing an EtherNet/IP enabled device.

## Industrial Ethernet Switch [Consultant to confirm]

### The MCC shall have a managed industrial Ethernet switch mounted in the top or bottom horizontal wireway or in fixed mounted units within the lineup.

### The managed industrial Ethernet switch shall deliver optimal network security, network resiliency (if needed), and flexibility. The functionality should include port based control/prioritization, switch-level ring support, VLAN segmentation, REP and other Layer-2 switch features.

### The EtherNet/IP device within each unit shall be factory connected to the industrial Ethernet switch directly by using a properly rated Ethernet cable.

### Acceptable Manufacturers

#### Acceptable Manufacturers are listed in the following table in no order or preference. The design has been completed around the first named supplier. The Contractor is responsible for all costs associated with any changes required to the design to accommodate an alternate manufacturer.

|  |  |  |
| --- | --- | --- |
| Preference | Manufacturer | Model |
| 1 | Cisco | IE-2000 |
|  |  |  |

## Industrial Ethernet Cabling

### The network cable shall have an insulation rating equal to at least the maximum circuit voltage applied to any conductor within the enclosure or raceway (i.e., no special separation, barriers, or internal conduit shall be required for the network conductors) as per local code requirements.

### The use of a 300V rated cable is not acceptable.

### STP cable will be used for Multilin protection relays, MCCs, power meters and any other location where susceptible to electromagnetic interference. For these installations, jacks, patch panel ports, and other associated equipment must also be shielded. Proper grounding is to be applied.

### Provide twisted-pair cable, connectors and appurtenances that make up the horizontal cables segments.

### Horizontal cable segments shall meet the requirements of IEC 11801/TIA/EIA-568-B specification for Category 6 (CAT6), Shielded Twisted Pair (STP) cable.

### Acceptable Manufacturers

#### Acceptable Manufacturers are listed in the following table in no order or preference. The design has been completed around the first named supplier. The Contractor is responsible for all costs associated with any changes required to the design to accommodate an alternate manufacturer.

|  |  |  |
| --- | --- | --- |
| Preference | Manufacturer | Model |
| 1 | Belden Canada Inc | 7953A 0021000 |
| 2 | Allen-Bradley | 1585-C8EB-S |
| 3 | Or Equivalent |  |

#### The Contractor shall select the appropriate options to suit the application and the requirements of the Section.

#### Where an alternate manufacturer is provided, they shall meet the performance specifications of the first named manufacturer.

### Refer to Section 13510 - PCS SCADA Local Area Network for additional details.

## Power Supplies [Consultant to confirm]

### All network switches shall be powered from an external 24VDC source (i.e. PAC Panel).

### The MCC manufacturer shall confirm the 24VDC power requirement for network switches (W, VA, Amps).

### Provision shall be made for proper termination of external power source wiring.

# Execution

## Installation

### Contractor shall install MCC in accordance with manufacturer’s instructions.

### Set and secure new and extended motor control centre in place on channel bases, rigid, plumb and square to building floor and wall

### Contractor shall tighten accessible bus connections and mechanical fasteners to the manufacturer’s torque requirements.

### Contractor shall adjust circuit breaker settings based upon field requirements.

### Contractor shall adjust solid state overloads to match the installed motor characteristics.

### . Ensure moving and working parts are lubricated where required.

## Tests

### Perform tests in accordance with Section 16010 – Electrical General Requirements.

### Perform tests in accordance with Section 13510 – PCS SCADA Local Area Network.

### The MCC manufacturer shall load the IP Address, Subnet Mask and Gateway into each unit.

### The IP Address will be provided by the Region after the contractor has submitted the completed IP request form (found in 1810A forms).

### The MCC manufacturer shall test the MCC to ensure that each unit and device communicates properly prior to shipment.

### A qualified manufacturer's representative shall attend the site setting and commissioning of the MCC and all network enabled devices and provide the Consultant with written certification that the completed assembly has been properly installed, configured and setup.

#### IR Scan under load:

#### .1 Perform thermograms at all connections, plus heat sinks, body, etc.

#### .2 Record ambient temperature and temperature rise above ambient.

#### .3 Compare information with every other subsequent inspection.

#### .4 Compare with the specifications for maximum temperature above ambient and maximum operating temperature. Refer to latest ANSI/NETA standards.

#### .5 Provide documentation that the individual that performed the IR scan is a certified Level 2 thermographer.

### Reliability Test to include the following:

1. Electromagnetic- compatibility (electrical noise) series of tests.
2. Electrostatic discharge immunity test.
3. Chattering contactor test.
4. Surge immunity tests.
5. High current noise effect (jogging starter) test.
6. RFI - immunity test.
7. Load testing - all devices (VFD's, O/L relays etc.) fully loaded and subjected to their respective temperature rise tests.
8. Power supplies tested for regulation under load, ability to withstand a short circuit and reverse output capacity.

### Functional test to include (but not limited to) the following:

1. Network cable and connection integrity tests.
2. Network verification tests - For each device, an IP address and data rate is set and verified. System tests to ensure all devices operate in harmony and that no addressing conflict exists.
3. A command to verify operation to be transmitted to each device output to energize and de-energize its respective contactor or starter.

## Training

### The Contractor shall provide a training session for up to five (5) owner’s representatives for two (2) normal workdays at the job site or other office location chosen by the owner.

### A manufacturer’s qualified representative shall conduct the training session.

### The manufacturer shall offer off-site training on the concepts, knowledge and tools necessary to design, specify, install, troubleshoot, and use a networked MCC.

**END OF SECTION**