section 26 24 13.20

SWITCHBOARDS – low VOLTAGE (pow-r-line Xpert- Microgrid)

# general

## Scope

### The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low voltage distribution switchboard, utilizing group mounted circuit protective devices, metering and relaying and control components as specified herein, and as shown on the contract drawings.

## Related Sections

### Specification Section 26 28 11 – Circuit Breakers – Low Voltage

### Specification Section 26 27 13 – Microprocessor- Based Metering Equipment

### Specification Section 26 37 19 – Microgrid Controller – Power Xpert Microgrid Controller 3000

### Specification Section 26 43 13 – Surge Protection Devices for Low Voltage Electrical Circuits

## References

### The low voltage distribution switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:

#### UL Standard 891 - Switchboards

#### UL Standard 50 – Enclosures for Electrical Equipment

#### NEMA PB-2 Switchboards

#### UL Standard 489 – Circuit Breakers

#### UL Standard 1449 – Surge Protective Devices

#### UL Standard 508 – Industrial Control Equipment

## Submittals – for Review/approval

### The following information shall be submitted to the Engineer:

#### Front view and plan view of the assembly

#### Floor plan

#### Top view

#### Single line diagrams

#### Schematic diagram

#### Nameplate schedule

#### Component list

#### Conduit space locations within the assembly

#### Assembly ratings including:

##### Short-circuit rating

##### Voltage

##### Continuous current rating

#### Major component ratings including:

##### Voltage

##### Continuous current rating

##### Interrupting ratings

#### Cable terminal sizes

#### Product data sheets

#### Provide system architecture documentation

#### Provide a sequence of operation for the Microgrid Controller

### Where applicable, the following additional information shall be submitted to the Engineer:

#### Busway connection

#### Connection details, composite front view, and plan view of close-coupled assemblies

#### Key interlock scheme drawing and sequence of operations

#### Automatic transfer scheme sequence of operation

#### Mimic bus size and color

## Submittals – for construction

### The following information shall be submitted for record purposes:

#### Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process

#### Wiring diagrams

#### Certified production test reports

#### Installation information

#### Seismic certification with equipment anchorage details and center of gravity as specified

#### Coordination Drawings if required: Floor plans, drawn to scale, showing dimensioned layout upon which the following items are shown and coordinated with each other, using input from installers of the items involved:

##### Required working clearances and required area above and around Switchboard.

##### Show Switchboard layout and relationships between electrical components and adjacent structural and mechanical elements.

## Qualifications

### The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

### For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

### The Switchboard manufacturer shall have the Environment Certification ISO 14001.

### The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

### Where noted in the contract documents provide seismic qualified equipment.

## Regulatory Requirements

### The low-voltage switchboard shall be UL labeled.

## Delivery, Storage and Handling

### Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

## Operation and Maintenance Manuals

### Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

# Products

## manufacturer

### Eaton (Basis of Design)

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

### The switchboard shall be equal to Eaton type Pow-R-Line Xpert utilizing the components herein specified and as shown on the drawings.

## Ratings

### The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of [65,000 or 100,000] amperes symmetrical at rated voltage or as shown on the contract documents.

### Bus voltage and current rating to be standard at 480V, 3-phase 4-wire.

## Construction

### Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

### All sections of the switchboard shall be front and rear aligned with depth(s) shown on the drawings.

### The assembly shall be provided with adequate lifting means.

### The switchboard shall be suitable for use as service entrance equipment and provisions for utility metering sections when indicated on Contract Documents and be labeled in accordance with UL requirements.

## Bus

### All bus bars shall be [tin-plated aluminum or silver-plated copper]. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria.

### Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

### A 1/4 x 2-inch copper ground bus (minimum) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

### All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

### All bussing shall be fully-rated for the entire length of the switchboard lineup. Tapered bus is not acceptable.

## Wiring/Terminations

### Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

### Mechanical-type terminals shall be provided for all line and load terminations. Terminals shall be suitable for copper or aluminum conductors rated per 75 degrees C for the size as shown on the drawings. 90 degrees C conductor is permissible but must be sized in accordance with 75 degrees C rated conductor tables.

### Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

### All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

## main, tie and distributed energy resource protective devices

### INSULATED CASE MAIN, TIE AND DER PROTECTIVE DEVICES

#### Protective devices shall be fixed mounted, insulated case, low-voltage circuit breakers, [Power Defense RF or approved equal. All breakers shall be UL listed for continuous application in their intended enclosures for 100% of their continuous ampere rating.

#### Main and tie breakers shall be true two-step stored energy devices and shall be electronically operated unless otherwise indicated on contract documents.

#### All main and tie circuit breakers shall have a minimum symmetrical interrupting capacity of [65,000 or 100,000] amperes. Main and tie circuit breakers shall have 3 cycle short-time withstand ratings.

#### All main and tie insulated case circuit breakers shall be UL489 listed.

#### All insulated case circuit breakers shall have a nameplate clearly marking any electrical accessories that are mounted in the breaker at the time of sale. The accessory shall have a label that will indicate its function and voltage. All accessories shall be modular, plug and lock type, and UL listed for easy field installation.

#### The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a “Positive On” feature. The breaker flag will read “Closed” if the contacts are welded and the breaker is attempted to be tripped or opened.

#### Each insulated case circuit breaker shall be equipped with a true RMS sensing, solid-state PXR25 trip unit consisting of at least three current sensors microprocessor-based trip device and trip actuator. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection.

#### Provide trip units with integral arc flash reduction mode (ARMS) for 1200A frame and above to meet NEC Article 240.87. The use of ZSI to satisfy NEC 240.87 does not meet the intent of these specifications and will not be acceptable as a substitution.

#### Where noted on the contract documents, provide zone selective interlocking between trip units.

#### System coordination shall be provided by adjusting rotary switches for the following microprocessor-based time-current curve shaping adjustments:

##### Adjustable long-delay pick-up setting with minimum of 10 settings

##### Adjustable long-delay time - 0.5 to 24 seconds

##### Adjustable short-delay pick-up setting – 1.5x to Max allowable by frame

##### Adjustable short-delay time 0.0 sec up to 0.5 sec depending on frame with selectable flat or I2t curve shaping

##### Adjustable instantaneous setting 2x to Max allowable by frame

##### Where indicated, adjustable ground fault current pickup (0.2 – 1.0 x In in 0.10x increments) and time (0.1 – 1.0 sec in 0.10sec increments), with selectable flat or I2t curve shaping. Provide switch selectable options for GF OFF, GF alarm, or GF trip.

## feeder protective devices

### All feeder protective devices shall be Eaton type Power Defense or approved equal molded case circuit breakers with inverse time tripping characteristics unless otherwise noted. Molded case breakers are acceptable for PV and BESS breakers but shall include a shunt trip and aux contact accessories.

### Any feeder protective devices noted as electrically operated on the contract drawings are to be insulated case protective devices as specified in Section 2.06.

### Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

### Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the contract documents.

### Circuit breakers to be fixed mounted.

### Breaker model to be Power Defense MCCB, minimum symmetrical interrupting capacity of [35,000 or 65,000] amperes, for up to [600 or 1200] amperes breakers.

### Circuit breakers shall have microprocessor-based rms sensing trip units as specified below:

#### All molded case circuit breakers shall be equipped with the no less than a PXR-20 trip unit, a true RMS sensing, solid-state tripping system consisting of at least three current sensors microprocessor-based trip device and trip actuator. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection.

#### Provide trip units with integral arc flash reduction mode for 1200A frame and above. The use of zone selective interlocking to emulate this feature does not meet the intent of these specifications and will not be allowed.

#### System coordination shall be provided by adjusting rotary switches for the following microprocessor-based time-current curve shaping adjustments:

##### Adjustable long-delay pick-up setting with minimum of 10 settings

##### Adjustable long-delay time - 0.5 to 24 seconds

##### Adjustable short-delay pick-up setting – 1.5x to Max allowable by frame

##### Adjustable short-delay time 0.0 sec up to 0.5 sec depending on frame with selectable flat or I2t curve shaping

##### Adjustable instantaneous setting 2x to Max allowable by frame

##### Where indicated, adjustable ground fault current pickup (0.2 – 1.0 x In in 0.10x increments) and time (0.1 – 1.0 sec in 0.10sec increments), with selectable flat or I2t curve shaping. Provide switch selectable options for GF OFF, GF alarm, or GF trip.

#### Where indicated provide 100% rated UL listed circuit breakers.

#### Trip units shall be capable of metering phase, neutral, and ground current with an accuracy of +/- 2.0% of the reading.

#### Trip units shall have an integral, high-resolution liquid-crystal display (LCD) capable of displaying the trip unit programming, status, and monitoring information including bar graph display.

#### Trip units shall include embedded Modbus RTU communication capability. Breaker status and all monitored parameters shall be available.

#### Trip units shall collect and store pertinent information to the trip unit and circuit breaker health and event history. The trip unit shall also include diagnostic features to allow the user to investigate events and dynamically monitor the health of the trip unit and the breaker.

##### Number of operations (load and no-load)

##### Number of trips (overload trips, short circuit trips)

##### Run time

##### Breaker ambient temperature.

##### Breaker remaining life - The trip unit shall utilize an algorithm that applies a weighted value to monitored information to determine the remaining life of the breaker. The remaining life of the breaker shall be displayed or communicated in calculated percentage of life remaining.

##### All breaker health information shall be accessible via micro-USB port on front of trip unit and via embedded communications

#### Trip unit shall perform a waveform capture on trip, alarm, or user-initiated events.

##### Any breaker trip event shall capture a 10-cycle waveform. The trip unit shall store the most recent trip event waveform.

##### Any alarm event or user-initiated waveforms shall capture a 1-cycle waveform.

##### Waveform events shall capture and store all phase, neutral and ground currents.

## accessories

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

## miscellaneous devices

### Electrical interlocks shall be provided as indicated on the drawings.

### Control power transformers with primary and secondary protection shall be provided, as indicated on the drawings, or as required for proper operation of the equipment.

### Provide current transformers and voltage transformers as indicated on the drawings. If revenue current transformers are required, then additional space will be necessary.

### Provide Eaton EDR5000, or similar, multi-function relay on main breaker as indicated on drawings.

### Provide other protective relaying and control devices as indicated on drawings.

### For outdoor (NEMA 3R) installations, each section of the switchboard shall be provided with a heater controlled by a thermostat and humidistat..Power for the space heaters shall be obtained from a source as indicated on the drawings.

## utility metering

### Where indicated on the drawings, furnish a barrier to separate the utility metering compartment complete with hinged sealable door. Bus work shall include provisions for mounting utility company current transformers and potential transformers, or potential taps as required by the utility company.

### Provide service entrance label and provide necessary applicable service entrance features per NEC and local code requirements.

## surge protective device

### SPD shall comply with ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL).

### Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

### The SPD shall be of the same manufacturer as the switchboard.

### The SPD shall be factory installed integral to the switchboard by the original equipment manufacturer.

### Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.

### The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located within immediate proximity to the SPD.

### All monitoring and diagnostic features shall be visible from the front of the equipment.

### Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

### Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.

### Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.

### Type 2 units with filtering shall conform to UL 1283 5th Edition

### Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.

### Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered and hardwired with connections utilizing low impedance conductors.

### Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

#### Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

#### For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

#### For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes

#### The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

#### Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

#### Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

### Electrical Requirements:

#### Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

#### Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

#### The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Units with end of life short-circuit mode are not acceptable.

#### Unit shall operate without the need for an external overcurrent protection device (OCPD) and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.

#### Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Protection Modes | | | |
| Configuration | L-N | L-G | L-L | N-G |
| Wye | ● | ● | ● | ● |
| Delta | N/A | ● | ● | N/A |
| Single Split Phase | ● | ● | ● | ● |
| High Leg Delta | ● | ● | ● | ● |

#### Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.

#### ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

|  |  |  |  |
| --- | --- | --- | --- |
| Modes | 208Y/120 | 480Y/277 | 600Y/347 |
| L-N; L-G; N-G | 700 | 1200 | 1500 |
| L-L | 1200 | 2000 | 3000 |

## customer metering

### Where indicated on the drawings, provide a separate customer metering compartment with a front facing hinged door and a UL listed microprocessor-based multifunction power meter equal to Eaton PXM3000 or approved equal. Include current transformers wired to shorting-type terminal blocks for each meter. Provide fused potential taps as the potential source for metering as shown on the drawings.

### The meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems. The Meter shall support 3-Element Wye, 2 Element Delta, 4 wire Delta systems.

### Meter surge withstand shall conform to IEEE C37.90.1 and ANSI C62.41 (6KV)

### The meter shall have an accuracy of +/- 0.2% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC62053-22 (class 0.2S) and ANSI C 12.20 (Class 0.2).

#### The meter shall sample the current and voltage inputs at 512 samples per cycle for high accuracy metering.

#### The meter shall sample the current and voltage inputs at 512 samples per cycle for high accuracy metering:

##### Volts (phase to phase and phase to neutral; per phase and average)

##### Amps (per phase, neutral, and average)

##### KW (per phase, and total)

##### KVAR (per phase and total)

##### KVA (per phase and total)

##### PF (apparent power factor)

##### Frequency

#### The meter shall provide the following measurements with a 1 s update rate:

##### kWh (forward, reverse, total, net)

##### kVARh , (forward, reverse, total, net)

##### kVAh (total)

##### kWh per phase (forward, reverse)

##### kVARh per phase (forward, reverse)

##### kVAh per phase (total)

##### % THD (Total Harmonic Distortion) monitoring to the 63rd harmonic order for currents and L-N voltage in 4 wire wye and L-L voltage in 3 Wire Delta

### The meter shall provide the following advanced analysis features:

#### Calculation of harmonic magnitudes for each phase voltage and current through the 63rd harmonic.

#### Minimum and Maximum values for the following parameters:

##### Voltage L-L and L-N

##### Current per phase

##### Apparent Power Factor

##### Real, Reactive, and Apparent total power

##### %THD voltage L-N

##### %THD Current per phase

##### Frequency

### The WEB server shall provide the user with remote WEB access to metered information including basic metering data, energy, harmonics, sequence components, Max/Min, Alarm Log, I/O status.

### The meter shall have a real-time clock with the added capability to synchronize with a network time server to maintain time accuracy.

## MICROGRID CONTROLLER INTEGRATION

1. Provide a Power Xpert Microgrid Controller and HMI factory-installed within the switchboard. The Controller shall consist of required user interfaces, communication interfaces and control functionality to operate two or more Distributed Energy Resources (DERs) as specified in the Power Xpert Microgrid Controller Specification 23-37-13.
2. The Microgrid Controller and associated components will be installed within a dedicated section or compartment within the switchboard assembly.
3. The Microgrid Controller installation will be coordinated with all features from the power distribution equipment, power monitoring and control components that interface with the controller to form an integrated, operational system.
4. The HMI used with the Microgrid Controller shall be an industrial panel PC with fanless design, 15.6” TFT touchscreen display, quad-core processor, 4 GB RAM, 32 GB SSD, 24Vdc power supply (XP-504-15).
5. The HMI shall be mounted in the door of the controller compartment at a convenient viewing height.
6. The Microgrid Controller and HMI shall be connected to a UPS capable of operating for a minimum of 5 minutes if power is lost.

## Enclosures

### NEMA 1 Enclosure

- OR -

### Outdoor NEMA 3R Enclosure

#### Outdoor enclosure shall be non-walk-in and meet applicable NEMA 3R UL requirements

#### Enclosure shall have sloping roof downward toward rear.

#### The enclosure shall be provided with bolt-on rear covers for each section

#### Doors shall have provisions for padlocking

#### Ventilating openings shall be provided complete with replaceable fiber glass air filters.

#### Provide space heaters for each section controlled by thermostat and humidistat to prevent the accumulation of moisture.

#### Power for space heaters, lights and receptacles shall be obtained from a source as indicated on the drawings.

## Nameplates

### Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer’s name, general order number, and item number.

### Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

## Finish

### All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

# execution

## Factory Testing

### The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

#### The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.

### The manufacturer shall provide three (3) certified copies of factory test reports.

### Factory to connect and set up ethernet gateways and/or data aggregation processors (such as Eaton PXG900 or Power Xpert Dashboard Lite) included in switchboard assemblies. Factory testing should also include confirmation that the processor and display communicate with each other and that every device connected to the processor is communicating with the processor. Addresses for the communicating devices in these networks will be indicated on factory supplied communication drawings.

## Manufacturer’s Certification

### A certified test report of all standard production tests shall be available to the Engineer upon request.

## Training

### The Contractor shall provide a training session for up to five (5) owner’s representatives for \_\_\_\_ normal workdays at a job site location determined by the owner.

### A manufacturer’s qualified representative shall conduct the training session. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

## Installation

### The Contractors shall install all equipment per the manufacturer’s instructions, contract drawings and National Electrical Code.

### The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills provided the floor is level to 1/8 inch per 3-foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

## field adjustments

### The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

### Necessary field settings of devices, adjustments, and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.