**Eaton Guide Specification**

**Notes and instructions to Specwriter**

The following guide specification is offered for your assistance in specifying this product as part of a CSI (Construction Specification Institute) compliant document.

This guide specification has been created in MS Word and uses Word features including **Styles** and **Review** to assist in editing and formatting. You may also find it helpful to view the document in **Outline** mode when editing or selecting sections to copy/paste into your base document.

**Styles**

Styles are provided for all paragraph types described in the CSI Masterformat. Applying a Style to text will provide the correct indentation, paragraph letter/number, font, capitalization, etc…. Styles are shown on the right-hand side of the Word “Home” ribbon.



**Review**

“Notes to Specwriter” (when available) are provided using the Reviews feature in Word. To view “Notes to Specwriter” select “All Markup” in the Tracking dropdown menu on the Review ribbon. To hide notes, select “No Markup”. You can advance from one note to the next using the Previous and Next buttons on the same ribbon. In earlier versions of MSWord hide notes by un-checking ‘Comments’ under Review>SH



**Outline view**

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section 26 23 00.11

Arc Resistant metal-enclosed drawout switchgear (MAGNUM DS) – Low Voltage

# General

## Scope

### The Contractor shall furnish and install, where indicated on the drawings, a deadfront type, arc resistant low voltage switchgear assembly utilizing Eaton Magnum DS drawout power circuit breakers, as specified herein and shown on the contract drawings.

## Related Sections

### Section 26 43 13 – Transient Voltage Surge Suppression.

### Section 26 27 13.11 – Microprocessor-Based Metering Equipment.

## References

### The low voltage metal-enclosed switchgear assembly and all components shall be designed, manufactured and tested in accordance with the following latest applicable standards:

#### ANSI-C37.20 – Switchgear assemblies

#### ANSI-C37.13 – Low voltage power circuit breakers

#### ANSI-C37.17 – Trip devices

#### ANSI C37.20.7 – Arc Resistant Testing

#### UL 1558 Low Voltage Switchgear

#### UL1066 Low Voltage Power Circuit Breakers

## Submittals – for Review/approval

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

#### Master drawing index

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

#### Three-line diagram

#### 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

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

#### Busway connection

#### Composite front view and plan view of close-coupled assemblies

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

#### Automatic transfer scheme sequence of operations

#### Mimic bus size and color

#### Arc Plenum and Duct details

## 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 as specified

#### Arc Plenum and Arc Exhaust details as specified

## Qualifications

### Provide Seismic qualified equipment as follows:

#### The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the [latest International Building Code (IBC)] [latest California Building Code (CBC) with OSHPD Amendments]. [The equipment shall have OSHPD Special Seismic Certification (OSP) Pre-Approval.]

#### The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.

#### The IP rating of the equipment shall be 1.5

#### The Structural Engineer for the Site will evaluate the SDS values published on the [Manufacturer’s] [OSHPD] website to ascertain that they are "equal to" or "greater than" those required for the Project Site.

#### The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

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

##### 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.

##### 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.

## Regulatory Requirements

### The switchgear shall bear a UL 1558 label. [Certified copies of production test reports shall be supplied demonstrating compliance with these standards.] The switchgear shall bear a label specifying that the assembly has been assembled and tested according to the specifications set forth by ANSI C.37.20.7.

## 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 and instruction bulletins for the complete assembly and each major component.

# products

## manufacturers

### Eaton

### \_\_\_\_\_\_\_\_\_\_

### \_\_\_\_\_\_\_\_\_\_

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.

## Ratings

### Voltage rating shall be as indicated on the drawings. The entire assembly shall be suitable for 600 volts maximum ac service.

### [The rear accessible switchgear 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 [42,000] [65,000] [85,000] [100,000] amperes symmetrical at 480Vac or [42,000] [65,000] [85,000] at 600Vac.]

### [The front access only switchgear 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 [42,000] [65,000] [85,000] amperes symmetrical at 480Vac or [42,000] [65,000] [85,000] at 600Vac.]

### The bus system shall have a minimum ANSI short-circuit withstand rating of [100,000] [150,000] amperes symmetrical tested in accordance with ANSI C37.20.1 and UL1558.

### All circuit breakers shall have a minimum symmetrical interrupting capacity of [42,000] [65,000] [85,000] [100,000] amperes. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 85,000 amperes, regardless of whether equipped with instantaneous trip protection or not.

### All ratings shall be tested to the requirements of ANSI C37.20.1, C37.50, C37.51, and C37.20.7, and UL 1558 witnessed and approved.

## Construction

### The switchgear shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide ventilators located on the top of the switchgear over the breaker and bus compartments to ensure adequate ventilation within the enclosure. The top of the enclosure shall also have arc ventilation that allows exhaust of arc gases during an arcing event. Power termination area shall be enclosed by single hinged panel with captive hardware [and padlockable handle].

### 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 required use of floor sills providing the floor is level to 1/8 inch per 3-foot distance in any direction. [Contractor supplied floor sills to be set level in concrete per manufacturer’s recommendations]. Provisions shall be made for jacking of shipping groups, for removal of skids or insertion of equipment rollers. Base of assembly shall be suitable for rolling directly on pipes without skids. The base shall be equipped with slots in the base frame members to accommodate the use of pry bars for moving the equipment to its final position.

### Each vertical steel unit forming part of the switchgear line-up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment and a rear cable compartment. Each individual circuit breaker compartment, or cell, shall be segregated from adjacent compartments and sections by means of steel barriers to the maximum extent possible. An arc ventilation system shall be provided within each breaker cell to redirect arc energy to the top of the enclosure away from operating personnel. Each cell shall be equipped with drawout rails and primary and secondary disconnecting contacts. Removable hinge pins shall be provided on the breaker compartment door hinges. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells and be front accessible , removable and provided with shorting terminal blocks in the front wireway. Circuit breaker doors shall not be ventilated.

### The stationary part of the primary disconnecting devices for each power circuit breaker shall be breaker mounted and consist of a set of contacts extending to the rear through a glass polyester insulating support barrier; corresponding moving finger contacts, suitably spaced, shall be furnished on the power circuit breaker studs which engage in only the connected position. The assembly shall provide multiple silver-to-silver full floating high pressure point contacts with uniform pressure on each finger maintained by springs. Each circuit shall include the necessary three-phase bus connections between the section bus and the breaker line side studs. Load studs shall be equipped with insulated copper load extension buses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be plated similar to the main bus where outgoing terminals are attached.

### The circuit breaker door design shall be such that the following functions may be performed without the need to open the circuit breaker door: lever circuit breaker between positions, operate manual charging system, close and open circuit breaker, examine and adjust trip unit, and read circuit breaker rating nameplate. The circuit breaker door shall be one-piece and shall be specifically designed to resist forces produced during an arcing event. A two-point latch shall be provided for additional rigidity. A door bellows system shall be placed around the front of each breaker to prevent arc gasses from escaping around the breaker escutcheon, while also allowing easy racking of the breaker into the disconnected position with the door closed.

### The secondary disconnecting devices shall consist of floating terminals mounted on the stationary unit and engaging mating contacts at the front of the breaker. The breaker secondary disconnecting devices shall be maintained in the “connected” and “test” positions. Customer access to secondary terminations shall be in a separate compartment from the breaker cell and the compartment shall be rated Type 2B per ANSI C37.20.7.

### The removable power circuit breaker element shall be equipped with disconnecting contacts and interlocks for drawout application. It shall have four positions, “connected,” “test,” “disconnected” and “removed.” The breaker drawout element shall contain a worm gear levering “in” and “out” mechanism with removable lever crank. Levering shall be accomplished via the use of conventional tools. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering “in” or “out” of the cell. Interlocking that trips the breaker will not be accepted. The breaker cell shall include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall provide for securing the breaker in the connected, test, or disconnected position by preventing levering. Breaker shall be ready to accept connection of remote racking device without modification of breaker, cell or door.

### An insulating flash shield shall be mounted above each circuit breaker to prevent flashover from the arc chutes to ground.

### The switchgear shall be Eaton Magnum DS low voltage metal-enclosed switchgear, utilizing Magnum DS power circuit breakers as herein specified.

### Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus.

### The switchgear shall have a ventilation system that allows exhaust of arc gasses regardless of the origination location of the arc event. The ventilation system shall be designed to exhaust arc events originating in the breaker cell, bus compartment, and rear cable compartment. [The arc resistant switchgear shall not have an arc plenum, and shall require ten (10) feet minimum floor-to-ceiling height for arc exhaust, with no obstructions in the space above the switchgear.] [The arc resistant switchgear shall have an arc plenum included that has been tested according to ANSI C.37.20.7. External connections to an arc duct shall be provided.]

### The arc rating of the switchgear shall be Type 2B as defined by ANSI C37.20.7. such that the operator is protected around entire perimeter of equipment with the low voltage control, instrumentation and breaker secondary customer termination compartment doors open.

### [The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.]

### [Provide a vented barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.]

### [Provide a safety shutter in the cell when the circuit breaker is withdrawn which automatically covers the line and load stabs and protects against incidental contact. Provide key-lockable breaker door to prevent access to shutter when breaker is removed from cell.]

### [Provide a metal barrier full height and depth between adjacent vertical structures in the cable compartment.]

## Bus

### All bus bars shall be [silver-plated copper] [tin-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 ANSI standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

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

### A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchgear. The ground bus short-time withstand rating shall meet that of the largest circuit breaker within the assembly. The ground bus plating shall match main bus plating.

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

### The primary means of insulation and isolation of main and vertical bus shall be by air gap. Minimal use of insulating material in addition to air gap shall be provided.

## Wiring/Terminations

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

### Provide a front accessible, isolated vertical wireway for routing of factory and field wiring. Factory provisions shall be made for securing field wiring without the need for adhesive wire anchors.

### Front access to all circuit breaker secondary connection points shall be provided for ease of troubleshooting and connection to external field connections without the need of removing the circuit breaker for access.

### All control wire shall be type SIS. Control wiring shall be [16 ga] [14 ga] for control circuits and [14 ga] [12 ga] [10 ga] for current transformer circuits. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances or nylon non-adhesive anchors. All current transformer secondary leads shall first be connected to conveniently accessible shorting terminal blocks before connecting to any other device. Shorting screws with provisions for storage shall be provided. All groups of control wires leaving the switchgear shall be provided with terminal blocks with suitable numbering strips and provisions for #10 AWG field connections. Each control wire shall be marked to the origin zone/wire name/destination zone over the entire length of the wire using a cured ink process.[Provide additional printed sleeve wire markers at each end of all control wiring]. [Provide additional printed heat-shrink wire markers at each end of all control wiring]. Plug-in terminal blocks shall be provided for all shipping split wires.

### NEMA 2-hole [mechanical-] [compression-] type lugs shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size indicated on the drawings.

### Lugs shall be provided in the incoming line section for connection of the main grounding conductor and at each end of the ground bus for connection to system ground. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

### [Reusable insulating boots shall be provided to cover all power cable terminations.]

## circuit breakers

### All protective devices shall be low voltage power circuit breakers, Eaton type Magnum DS or approved equal. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.

### All power circuit breakers shall be constructed and tested in accordance with ANSI C37.13, C37.16, C37.17, C37.50, and UL 1066. The breaker shall carry a UL label.

### Breakers shall be provided in drawout configuration. All breaker cell sizes shall have a common height and depth. Breaker frames of the same size shall be fully interchangeable.

### Power circuit breakers shall utilize a two-step stored-energy mechanism to charge the closing springs. The closing of the breaker contacts shall automatically charge the opening springs to ensure quick-break operation. Slow closing speed shall not be required to properly maintain the breaker contacts.

### Breakers shall be manually operated (MO) unless electrically operated (EO) is indicated on the drawings.

### Electrically operated breakers shall be complete with [120 Vac] [240 Vac] [24 Vdc] [48 Vdc] [125 Vdc] motor operators. The charging time of the motor shall not exceed 6 seconds.

### To facilitate lifting, the power circuit breaker shall have integral handles on the side of the breaker.

### The power circuit breaker shall have a closing time of not more than 3 cycles.

### The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.

### The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

### 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 tripped or opened.

### The current sensors shall have a back cover window that will permit viewing the sensor rating on the back of the breaker. A rating plug will offer indication of the rating on the front of the trip unit. The current sensor and rating plug shall be of the same current rating.

### A position indicator shall be located on the faceplate of the breaker. This indicator shall provide color indication of the breaker position in the cell. These positions shall be Connect (Red), Test (Yellow), and Disconnect (Green). The levering door shall be interlocked so that when the breaker is in the closed position, the breaker levering-in door shall not open.

### Each power circuit breaker cell shall offer up to seventy two (72) front-mounted dedicated secondary wiring points. Each wiring point shall have finger safe contacts, which will accommodate #10 AWG maximum field connections with ring tongue or spade terminals or bare wire.

Digitrip trip units are available in four (4) models:  
  
Digitrip 520 – Basic protection select Paragraph 2.07 A through I.  
  
Digitrip 520M – Basic protection with local current metering, select Paragraph 2.07 A through J.  
  
Digitrip 520MC – Basic protection with local current metering, remote communications and Arcflash Reduction Maintenance System, select Paragraph 2.07 A through L.  
  
Digitrip 1150 – Advanced protection, power metering, LED display,remote communications and Arcflash Reduction Maintenance System, select Paragraph 2.07 A through I and K through Z.

## trip units

### Each low voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker. The trip unit shall be Eaton type Digitrip RMS [520] [520M] [520MC] [1150].

### The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

### The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

### The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

### Trip unit shall have selectable powered and unpowered thermal memory for enhanced circuit protection.

### Complete system selective coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:

#### All circuit breakers shall have adjustments for long delay pickup and time

#### [Main] [Tie] [Feeders] [All circuit breakers] shall have individual adjustments for short delay pickup and time, and include I2t settings

#### [Main] [Tie] [Feeders] [All circuit breakers] shall have an adjustable instantaneous pickup

#### [Main] [Tie] [Feeders] [All circuit breakers] [Circuit breakers, where indicated on the drawings,] shall have individually adjustable ground fault current pickup and time, and include I2t settings or ground alarm only

### The trip unit shall have provisions for a single test kit to test each of the trip functions.

### The trip unit shall be capable of providing zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the present time delay. [Switchgear shall be wired for zone interlocking for the power circuit breakers within the switchgear.]

### [Main] [Tie] [Feeders] [All circuit breakers] [Circuit breakers, where indicated on the drawings,] shall have individually adjustable ground fault alarm only.

### [520M & 520MC] The trip unit shall have a 4-character LCD display showing phase, neutral, and ground current. The accuracy of these readings shall be +/- 2% of full scale.

### [520MC & 1150] The trip unit shall be equipped to permit communication via a network twisted pair for remote monitoring

### [520MC & 1150] The trip unit shall utilize ARMS (Arcflash Reduction Maintenance System). ARMS shall be provided in a system that shall reduce the trip unit Instantaneous pickup value when activated. ARMS device shall not compromise breaker phase protection even when enabled. Once ARMS unit is disabled, the recalibration of trip unit phase protection shall not be required. Activation and deactivation of ARMS setting shall be accomplished without opening the circuit breaker door and exposing operators to energized parts. ARMS shall provide a clearing time of 0.04 seconds, adjustable with a minimum of five settings ranging from 2.5X to 10X of the sensor value.

#### ARMS shall be enabled via a switch on the trip unit. It shall also provide confirmation of protection via a Blue LED.

#### ARMS shall be provided with remote “enable/disable” control

#### ARMS shall be provided with a switchgear panel mounted enable padlockable selector switch and indication via Blue LED pilot light.

#### [ARMS shall be wired locally with interposing relays and wired to terminal blocks to enable a remote selector switch and confirmation light to be mounted at the downstream protected distribution equipment.]

### [Only 1150] The trip unit shall be equipped to permit communication for remote monitoring and control.

### The trip unit shall include a power/relay module which shall supply control to the readout display. Following an automatic trip operation of the circuit breaker, the trip unit shall maintain the cause of trip history and the mode of trip LED indication as long as its internal power supply is available. [except 520] An internal relay shall be programmable to provide contacts for remote ground alarm indication.

### The trip unit shall include a voltage transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the voltage transformer module shall be connected internally to the line side of the circuit breaker through a dielectric test disconnect plug.

### [1150 only] The display for the trip units shall be a 24-character LED display. Metering display accuracy of the complete system, including current sensors, auxiliary CTs, and the trip unit, shall be +/- 1% of full scale for current values. Metering display accuracy of the complete system shall be +/- 2% of full scale for power and energy values.

### [1150 only] The unit shall be capable of monitoring the following data:

#### Instantaneous value of phase, neutral and ground current

#### Instantaneous value of line-to-line voltage

#### Minimum and maximum current values

#### Watts, vars, VA, watthours, varhours and VA hours

### [1150 only] The energy-monitoring parameter values (peak demand, present demand, and energy consumption) shall be indicated in the trip unit’s alphanumeric display panel.

### [1150 only] The trip unit shall display the following power quality values: crest factor, power factor, percent total harmonic distortion, and harmonic values of all phases through the 31st harmonic.

### [1150 only] An adjustable high load alarm shall be provided, adjustable from 50 to 100% of the long delay pickup setting.

### [1150 only] The trip unit shall contain an integral test pushbutton. A keypad shall be provided to enable the user to select the values of test currents within a range of available settings. The protection functions shall not be affected during test operations. The breaker may be tested in the TRIP or NO TRIP test mode.

### [1150 only] Programming may be done via a keypad at the faceplate of the unit or via the communication network.

### System coordination shall be provided by the following microprocessor-based programmable time-current curve shaping adjustments. The short-time pickup adjustment shall be dependent on the long delay setting.

#### Programmable long-time setting

#### Programmable long-time delay with selectable I2t or I4t curve shaping

#### Programmable short-time setting

#### Programmable short-time delay with selectable flat or I2t curve shaping, and zone selective interlocking

#### Programmable instantaneous setting

#### Programmable ground fault setting trip or ground fault setting alarm

#### Programmable ground fault delay with selectable flat or I2t curve shaping and zone selective interlocking

### [1150 only] The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.

### [1150 only] The trip unit shall have the following advanced features integral to the trip unit:

#### Adjustable undervoltage release

#### Adjustable overvoltage release

#### Reverse load and fault current

#### Reverse sequence voltage alarm

#### Underfrequency

#### Overfrequency

#### Voltage phase unbalance and phase loss during current detection

### [1150 only] The trip unit shall offer information on the circuit breaker’s health. The data available shall include total number of all Instantaneous and Short Delay trips seen by the circuit breaker, an additional count of all the overloads and ground fault trips seen by the circuit breaker, an operation counter, a time stamp of the last breaker operation, and the maximum temperature seen by the trip unit. All these data points will be stored in non-volatile memory and available for remote communications.

## MISCELLANEOUS DEVICES

### Key interlocks shall be provided as indicated on the drawings. These interlocks shall keep the circuit breakers trip-free when actuated.

### Each section of the switchgear shall be provided with a 240v space heater operated at 120vac [thermostatically controlled]. Power for the space heaters shall be obtained [from a control power transformer within the switchgear] [from a source as indicated on the drawings].

### Fused control power transformers shall be provided as indicated on the drawings or as required for proper operation of the equipment. A manual disconnect shall be provided ahead of the primary fuses. [Control power transformers shall have adequate capacity to supply power to the transformer cooling fans.]

## METERING, MONITORING and control

**Note to Spec. Writer:**   
Refer to Section 26 27 13.11 for detailed specification for metering.

### Microprocessor-Based Metering System as indicated on drawings.

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

#### Provide current transformers for ach meter. Current transformers shall be wired to shorting-type terminal blocks.

#### Provide potential transformers including primary and secondary fuses with disconnecting means for metering as shown on the drawings.

### Web-Enabled Communications

#### Where indicated on the drawings, provide a separate compartment with a front facing hinged door as a central point of connection for all internally located communicating devices to an external Ethernet network and allow close monitoring of the power infrastructure with real-time, web-enabled data.

#### The compartment shall have a hinged door with a functional through-the-door RJ45 network access port. Power for the components in the compartment shall be supplied by a pre-wired, bus-connected control transformer in the compartment that is fused and has a disconnecting means.

#### The communication protocol shall be Ethernet Modbus TCP either native to the metering device or following interconnection to Eaton PowerXpert Gateway.

#### [PowerXpert Dashboard shall be capable of displaying web-based views of switchgear trip units, separate meters, and switchgear-specific documentation. [HMI to be mounted on front of switchgear.] [HMI to be provided in a remote wall-mounted enclosure.]]

### Automatic transfer between breakers as indicated on drawings.

#### Main-main arrangement controlled by [Eaton ATC-900] [Key interlock] [Hardwired control relays]

#### Main-tie-main arrangement controlled by [Eaton PLC] [Eaton PLC and Touchscreen] [Key interlock] [Hardwired control relays]

## [UTILITY METERING]

### Where indicated on the drawings, furnish a separate barriered-off 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 necessary applicable service entrance features per NEC and local code requirements.

## [arc flash detection system]

### Arc flash detection system shall satisfy NEC 240.87 requirements.

### System shall consist of an arc flash detection relay, point light sensors and current transformers per source bus.

### Relay light sensors shall be placed in the cable, bus and circuit breaker compartments to provide comprehensive switchgear protection. Locations of point sensors shall be tested and proven effective by switchgear manufacturer.

### Arc flash detection system shall utilize techniques to prevent nuisance tripping from the light emitted when an air circuit breaker interrupts a fault downstream from the switchgear during normal operation.

### System shall be factory installed and tested.

### Control power for the arc flash detection system shall be from [a power source internal to the switchgear] [an external power source].

## [Arc Quenching System]

### Provide arc quenching system integral to switchgear. System shall detect and quench arcing faults within the switchgear by creating a low impedance current path in a controlled compartment. System shall consist of an arc flash detection relay, point light sensors, current transformers and an arc quenching device per source bus.

### Arc quenching device shall be rated for 100 kA available short circuit current at 635 Vac.

### Arc quenching device shall be a draw-out, through-the-door device.

### Arc quenching system shall provide a quenching time of 0.004 seconds or less.

### Arc quenching device shall be component registered to UL 2748.

### Entire arc quenching system shall be installed and factory verified prior to shipment.

### Arc quenching device shall be designed for one operation and electrically interlocked with source breaker to prevent re-energization of the switchgear until quenching device has been replaced or removed.

### Control power for the arc flash detection system shall be from [a power source internal to the switchgear] [an external power source].

### Arc quenching system shall be tested, 3rd party certified and labeled according to the ANSI/IEEE C37.20.7, Type 2B arc-resistant test guide.

### Arc quenching system shall include an arc flash detection relay to satisfy NEC 240.87 requirements.

### Relay light sensors shall be placed in the cable, bus and circuit breaker compartments to provide comprehensive switchgear protection.

### Arc quenching system shall utilize techniques to prevent nuisance tripping from the light emitted when an air circuit breaker interrupts a fault downstream from the switchgear.

### Arc quenching system shall be an always-on system that does not require operator activation.

### Arc quenching system shall reduce the available peak fault current by at least 25% that of a bolted fault during quenching operation.

### Arc quenching system shall provide local and remote system status indication by dry status contacts.

### The switchgear manufacturer shall provide field commissioning of the arc quenching system.

## Enclosures

### [NEMA 1 Enclosure – Rear accessible cable compartment]

### [NEMA 1 Enclosure – Front accessible cable compartment]

### [NEMA 3R Outdoor Walk-in Enclosure with Arc Quenching System]

#### Switchgear shall be enclosed in an outdoor walk-in NEMA 3R enclosure conforming to all applicable requirements of UL and designed to withstand wind velocities of 125 mph. The enclosure shall have a roof sloping toward the rear. Outer sections shall be the same widths as indoor structures except the end sections of a walk-in enclosure shall be wider than the inner sections to permit opening the inner door. Each end of the outdoor structure shall have an end trim. Front aisle depth for walk-in structures shall be 42 inches, minimum

#### The enclosure shall be provided with rear hinged padlockable doors with wind stops for each section. Aisle doors shall be supplied with provisions for padlocking. A steel floor shall be provided in walk-in aisle space. [Steel floor plates shall be provided in the rear cable compartment.] An anti-skid floor strip shall be provided in the aisle. Ventilating openings shall be provided complete with replaceable fiberglass air filters which are removable from the exterior of the enclosure. Provide necessary space heaters thermostatically controlled for breaker, bus and cable compartments of adequate wattage to prevent the accumulation of moisture within the compartments

#### Provide panic door hardware on aisle doors at each end of the line-up. External padlocking of the aisle doors shall not prevent operation of the panic hardware from the interior of the enclosure. The construction of the enclosure shall be modular so future sections can be added without affecting NEMA 3R integrity. Provide interior aisle fluorescent lights, 3-way switches and GFI protected receptacles

#### The enclosure shall be provided with undercoating applied to all members in contact with the foundation surface to retard corrosion.  [The base material shall be standard steel.] [Galvanized steel base required.]

#### Power for the space heaters, lights and receptacles shall be obtained from a  [control power transformer within the switchgear] [source as indicated on the drawings]. Supply voltage shall be 120 volts ac

#### An overhead circuit breaker lifter shall be provided in the aisle of the enclosure

#### Each shipping section shall be shipped completely assembled

## 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, and secured with screws. Characters shall be 3/16-inch high, minimum.

### Furnish master nameplate giving switchgear designation, voltage ampere rating, short-circuit rating, and manufacturer’s name.

### 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 drawings.

### Arc Resistant Labeling – Labels shall be provided for each section that specify the gear has been assembled and tested as required by ANSI C.37.20.7.

## Finish

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

## Accessories

### [Provide a traveling type circuit breaker lifter, rail-mounted on top of switchgear when bottom entry conduits are used.]

### [Provide a floor running portable circuit breaker transfer truck with manual lifting mechanism].

### [A remote racking and operation device shall be provided for operation of the circuit breakers from a distance. No modification of breaker, cell or door shall be necessary to use the device. Opening and closing electrically and manually operated devices shall be possible.]

## [surge protective device]

### Provide surge protective device as indicated on drawing and as specified in Section 26 43.13.

# execution

## Factory testing

### The switchgear shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchgear shall be tested to ensure the accuracy of the wiring and the functioning of all equipment. The main bus system shall be given a dielectric test of 2200 volts for one 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 minute, or 1800 volts for one second, between live parts and ground, in accordance with ANSI C37.20.1.

### A certified test report of all standard production tests shall be shipped with each assembly.

## Factory test as outlined above shall be witnessed by the owner’s representative.

### The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed

## field Quality Control

### Provide the services of a qualified factory-trained manufacturer’s representative to assist the Contractor in start-up of the equipment specified under this section for a period of \_\_\_\_ working days.

### The Contractor shall provide three (3) copies of the manufacturer’s field startup report.

## 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.

### The training session shall be conducted by a manufacturer’s qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

## installation

### The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

### All necessary hardware to secure the assembly in place shall be provided by the Contractor.

### The equipment shall be installed and checked in accordance with the manufacturer’s recommendations. This shall include but not limited to:

#### Checking to ensure that the pad location is level to within 0.125 inches per three foot of distance in any direction

#### Checking to ensure that all bus bars are torqued to the manufacturer’s recommendations

#### Assembling all shipping sections, removing all shipping braces and connecting all shipping split mechanical and electrical connections

#### Securing assemblies to foundation or floor channels

#### Measuring and recording insulation resistance measurements phase-to-phase, phase-to-ground, and neutral-to-ground (four wire systems only)

#### Inspecting and installing all circuit breakers in their proper compartments

#### Inspecting to make sure all enclosure & panel bolts are present and fastened.

#### Inspecting to make sure all doors are closed and fully latched.

#### Inspecting to ensure rear dynamic flaps operate smoothly and always remain in the open position when no force is applied.

#### Inspecting to ensure that roof flap retaining bolts and washers are installed and torqued properly according to manufacturer’s specifications (when applicable).