**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**

The Outline view within Word is often helpful when editing or copying sections from this Guide Specification. Also, when pasting sections from this document into a base document the specwriter may want to consider using right-click and “Merge Formatting’ or ‘Keep Text Only” features.

Section 26 13 26.11

Metal-Clad MEDIUM VOLTAGE Arc Resistant Switchgear (Vacclad-W)

# general

## Scope

### The Contractor shall furnish and install the equipment as specified herein and as shown on the contract drawings.

## Related Sections

### Section 26 18 29 – Metal-Enclosed Bus – Medium Voltage

### Section 26 32 13.11 – Partial Discharge Sensors in MV Switchgear.

### Section 26 09 11 – Protective Relays

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

### Section 26 09 13.13 – Power Monitoring Communication Systems

## References

### The metal-clad switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI/IEEE C37.20.2and CSA C22.2 No. 34-04. The switchgear shall also be tested in accordance with ANSI C37.20.7, guide for testing metal-enclosed switchgear for internal arcing faults. 5/15 switchgear shall be [UL listed][CSA listed] and supplied with [UL labels][CSA labels].

## Submittals – for Review/approval

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

#### Master drawing index

#### Front view elevation

#### Floor plan

#### Top view

#### Single line diagram

#### Schematic diagram

#### Nameplate schedule

#### Component list

#### Conduit entry/exit locations

#### Assembly ratings including:

##### Switchgear assembly short-circuit withstand rating

##### Accessibility Type

#####  Enclosure internal arc short circuit rating and duration

##### Voltage

##### Continuous current

##### Basic impulse level for equipment over 600 volts

#### Major component ratings including:

##### Voltage

##### Continuous current

##### Interrupting ratings

#### Cable terminal sizes.

#### Product data sheets.

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

#### Busway connection

#### Connection details between close-coupled assemblies

#### Composite floor plan of close-coupled assemblies

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

#### Descriptive bulletins

## 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, incorporating all changes made during the manufacturing process.

#### Wiring diagrams

#### Certified production test reports

#### Installation information including equipment anchorage provisions

#### Seismic certification, when applicable

## 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 manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

### Provide Seismic tested 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

## 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.

### Shipping groups shall be designed to be shipped by truck, rail, or ship. Breakers and accessories shall be packaged and shipped separately.

### Switchgear shall be equipped to be handled by crane. Where cranes are not available, switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

### Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors, indoor gear shall be covered and heated, and outdoor gear shall be heated.

## 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

### The switchgear described in this specification shall be designed for operation on a \_\_\_\_\_\_ kV, three-phase, three wire, [solidly grounded] [ungrounded] [impedance grounded] [high impedance grounded], [50][60]-hertz system. [(5)(15) kV switchgear enclosure shall provide protection against internal arcing faults at the front, sides, and rear as designated by accessibility Type 2B under IEEE test guide C37.20.2] [(27)(38) kV switchgear enclosure shall provide protection against internal arcing faults at the front, sides, and rear as designated by accessibility Type 2 under IEEE test guide C37.20.2] . The switchgear assembly shall be rated for [60 kV (4.76 kV assemblies)][95 kV (15 kV assemblies)][125 kV (27 kV assemblies)][150 kV (38 kV assemblies)] BIL.

Note to Spec. Writer:

Fill in data under 2.02B from **Table 26 13 26-1**. For K>1.0 and special application breakers see Eaton’s Consulting Application Guide, Tab 5.

|  |
| --- |
| **Table 26 13 26-1** |
| Rated Maximum Voltage | Lightning Impulse Withstand Voltage | Rated Short Circuit Current at Rated Maximum Voltage | Rated Voltage Range Factor | Maximum Symmetrical Interrupting and 2-Second Short Time Current Carrying Capability | Closing and Latching Capability (Momentary) |
| V |  | I | K | K \* I |  |
| kV rms | kV peak | kA rms sym |  | kA rms sym | kA peak |
| 4.76 | 60 | 25 | 1.0 | 25 | 65 |
| 4.76 | 60 | 40 | 1.0 | 40 | 104 |
| 4.76 | 60 | 50 | 1.0 | 50 | 130 |
| 4.76 | 60 | 63 | 1.0 | 63 | 164 |
|  |  |  |  |  |  |
| 8.25 | 95 | 50 | 1.0 | 50 | 130 |
| 8.25 | 95 | 63 | 1.0 | 63 | 164 |
| 15 | 95 | 25 | 1.0 | 25 | 65 |
| 15 | 95 | 40 | 1.0 | 40 | 104 |
| 15 | 95 | 50 | 1.0 | 50 | 130 |
| 15 | 95 | 63 | 1.0 | 63 | 164 |
|  |  |  |  |  |  |
| 27 | 125 | 16 | 1.0 | 16 | 43 |
| 27 | 125 | 22 | 1.0 | 22 | 60 |
| 27 | 125 | 25 | 1.0 | 25 | 68 |
| 27 | 125 | 32 | 1.0 | 31.5 | 85 |
| 27 | 125 | 40 | 1.0 | 40 | 108 |
| 38 | 150 | 16 | 1.0 | 16 | 43 |
| 38 | 150 | 25 | 1.0 | 25 | 68 |
| 38 | 150 | 31.5 | 1.0 | 31.5 | 85 |
| 38 | 150 | 40 | 1.0 | 40 | 108 |

### Each circuit breaker shall have the following ratings:Rated Maximum Voltage \_\_\_\_kVLightning Impulse Withstand Voltage (BIL) \_\_\_\_kV PeakContinuous Current (5/15 kV) \_\_\_\_Ampere [1200] [2000] [3000]Continuous Current (27 kV) \_\_\_\_Ampere [1200] [2000] Continuous Current (38 kV, 16 and 25 kA) \_\_\_\_Ampere [1200] [2000]

### Continuous Current (38 kV, 31.5 and 40 kA) \_\_\_\_Ampere [1200] [2000] [2500]

### Short-Circuit Current at rated  Maximum kV \_\_\_\_\_kA rms symRated Voltage Range Factor K \_\_\_\_\_\_Closing and Latching Capability \_\_\_\_\_\_kA crestMaximum Symmetrical Interrupting and Short Time Rating \_\_\_\_\_\_ka rms sym (2 sec for 5/15 kV K=1; 3 sec for 27/38 kV)Rated Interrupting Time \_\_\_\_\_\_ Cycle [5] [3] ( 3 is standard for 5/15 kV K=1 rated breakers; 5 cycle is standard for 27/38 kV breakers, 3 cycle is optional)

### Note: When a circuit breaker is used for switching a capacitor bank, it shall be rated for switching an isolated or back-to-back capacitor bank. Refer to drawings for identification of circuit breakers that are used for capacitor bank switching.

### The switchgear assembly short-time and momentary current withstand ratings shall be same as that of circuit breaker. [The 5/15 kV switchgear enclosure internal arc-short circuit rating shall be same as rated short-time short circuit current withstand rating of the assembly.] [The 27 or 38 kV switchgear enclosure internal arc-short circuit rating shall be same as rated short-time short circuit current withstand rating of the assembly.] The rated enclosure internal arc-short circuit duration shall be 0.5 second.

## Construction

### The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit. The 5/15 kV switchgear shall be arranged in [1-high][2-high] configuration, with two hinged rear covers furnished for each vertical section for circuit isolation and ease of handling. The 27 or 38 kV switchgear structures shall be provided with one full height hinged rear cover.

### Each breaker compartment door shall include a viewing window. The viewing window will allow the operator to:

#### Visually confirm the breaker position inside of the compartment.

#### Visually confirm that the arc resistant hardware is fully engaged and the door is secured, ensuring that the assembly is arc resistant.

### The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. [Provide rails to allow withdrawal of each 5, 15 and 27 kV circuit breaker for inspection and maintenance without the use of a separate lifting device]. [Provide 5/15 kV design that allow direct roll-in roll-out out of circuit breakers located in bottom compartments]. The 38 kV circuit breaker shall be roll-out design.

### The switchgear assembly shall be of arc resistant construction that provides [Type-2 accessibility around the perimeter (front, sides, and rear) of the line-up in accordance with IEEE C37.20.7][Type-2B accessibility around the perimeter (front, sides, and rear) of the line-up plus arc-resistant in front of the instrument/control compartment with instrument/control compartment door opened].

### Each individual vertical section of the switchgear shall include integral and top mounted pressure release flaps to facilitate a controlled upward release of arc created overpressures, smoke, and gasses. Individual vertical sections shall be of a unitized design to allow removal of a damaged vertical section after a fault incident, without requiring the removal of the adjacent vertical sections.

### For 5/15kV switchgear, an enclosed arc-chamber with arc duct exit shall be furnished for installation above the switchgear. Arc-duct exit location(s) shall be as shown on the drawing. Arc exhaust shall be vented from the arc-chamber to the exit location(s) via arc-duct as shown on the drawings. Field assembly of the arc-chamber and arc-duct shall be by installing contractor. For 27/38 kV switchgear, an arc containment wall shall be furnished for installation above the perimeter of the switchgear for equipment required to meet ANSI applications.

### Space heaters shall be provided in each vertical section to prevent condensation. A thermostatically controlled heater bus, protected by a properly sized molded case circuit breaker shall be provided in each switchgear assembly to provide control power to space heaters. AC control voltage for space heaters [shall be derived from a control power transformer supplied within the switchgear] [shall be provided by purchaser from a remote source].

## bus

### The main bus shall be copper, insulated with fluidized bed epoxy flame-retardant and track-resistant insulation. The bus supports between units shall be flame-retardant, track-resistant, [glass polyester for 5 and 15 kV class] [cycloaliphatic epoxy for 27 and 38 kV class]. The switchgear shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers. [Main bus for [5 kV] [15 kV] shall be rated [1200] [2000] [3000][4000] amperes.] [Main bus for 27 kV shall be rated [1200] [2000] [2500] [3000] amperes.] [Main bus 38 kV shall be rated [1200] [2000] [2500] [3000] ampere.] Insulated copper main bus shall be provided and have provisions for future extension. All bus joints shall be [silver -standard][tin -optional] plated, bolted and insulated with easily installed boots. The bus shall be braced to withstand fault currents equal to the close and latch rating of the breakers. The temperature rise of the bus and connections shall be in accordance with IEEE standards and documented by design tests.

### A copper ground bus shall extend the entire length of the switchgear.

## Wiring/terminations

### The switchgear manufacturer shall provide suitable terminal blocks for secondary wire terminations with a minimum of 10% spare terminals. One control circuit cutout device shall be provided in each circuit breaker housing. Switchgear secondary wire shall be #14 AWG, type SIS rated 600 volt, 90 degrees C, furnished with wire markers at each termination. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams. Wire markers shall be marked with [wire ID (standard)][opposite end designations with wire ID (optional)][To-From designations and wire ID (optional)] at each end.

### Incoming line and feeder cable lugs shall be 2- hole mounting, long barrel, copper compression lugs.

## Circuit breakers

### The circuit breakers shall be horizontal drawout type, [capable of being withdrawn on rails (except 38 kV)] [capable of being rolled directly onto the floor when installed in lower compartments (except 27 kV)]. The breakers shall be operated by a motor-charged stored energy spring mechanism, charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts shall be silver-plated copper.

### Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily. The vacuum interrupter pole unit shall be mounted on [glass polyester supports for 5 and 15 kV class] [cycloaliphatic epoxy supports for 27 and 38 kV class]. A contact wear gap indicator for each vacuum interrupter, which requires no tools to indicate available contact life, shall be easily visible when the breaker is removed from its compartment. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

### The secondary contacts shall be silver-plated and shall automatically engage in the breaker operating position. For 5/15 kV switchgear, there shall be a distinct test position, which shall be automatically engaged. For 27/28 kV switchgear, the breaker, can be manually engaged in the test position.

### Interlocks shall be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the operating and test positions.

### The circuit breaker compartment door shall be mechanically interlocked with the breaker levering mechanism to prevent opening of the door unless the breaker is first opened and withdrawn to Test/Disconnected position with the door closed.

### The design shall allow normal circuit breaker functions to be carried out with the door closed. Those functions include: manual open and close, manual levering to and from connected position, and manual charging of the circuit breaker closing springs. Shatter proof viewing windows shall be provided on the door to enable viewing of circuit breaker position inside the compartment, circuit breaker contact status (open/closed), and spring charged/discharged indication.

### When a remote operable electrical levering device is specified under the accessories, the design shall allow levering of the circuit breaker using such a device with the door closed.

### The breakers shall be electrically operated by the following control voltages:

#### [120-] [240-] volt AC close and AC capacitor trip.

-- OR --

#### [48-] [125-] [250-] volt DC close and [48] [125] [250] volt DC trip.

## For each breaker, provide green and red LED lights to indicate breaker open and closed status.

### AC control voltage shall be [derived from a control power transformer mounted in the switchgear] [supplied by purchaser from a remote UPS].

-- OR --

### DC control voltage shall be supplied by purchaser.

### Each circuit breaker compartment shall be provided with an integral motorized racking device accessory, equal to Eaton VCP-W MR2, with the following features:

#### Allow moving the breaker between [the connect, test and disconnect positions (applicable to 5 and 15 kV)][the connect and test/disconnect positions (applicable to 27 and 38 kV)] from a distance of up to 30 feet via a hand held pendant, with the breaker compartment door closed.

#### Breaker position shall be indicated on the pendant by LED lights. A blinking light indicates that the circuit breaker is in the motion through the selected position. A solid (non-blinking) light indicates that the circuit breaker has reached and stopped in the selected position. In case normal operation fails, the appropriate error code is displayed on the pendant in a separate 2 character LED display window.

#### The system shall be designed such that it allows manual racking of the circuit breaker using the levering crank accessory. Manual racking operation shall disable the motorized racking accessory.

#### It shall be possible to enable/disable operation of the motorized racking accessory via Purchaser’s external interlocking/permissive contacts.

#### 120 V AC power for the motorized racking accessory shall be [derived from a control power transformer mounted in the switchgear] [supplied by purchaser from an external source].

#### The hand held pendant shall also include “Open” and “Close” pushbuttons to allow remote operation of the circuit breaker.

#### Provide a discrete I/O interface module mounted in each circuit breaker control compartment for control of the motorized racking accessory via external hard-wired dry contacts, for example, via push buttons located at a remote control panel. The I/O interface module to provide output terminals for connections of remote 24 V LEDs for indication of breaker position status at the remote panel. With this I/O interface, the circuit breaker can be moved from disconnect to connect or from connect to disconnect positions from a remote control panel. Whenever the hand-held pendant is in use, the pendant becomes the master and will override the customer’s remote control signals.

-- OR --

#### Provide a discrete I/O interface module mounted in each circuit breaker control compartment, daisy chained, for control of the motorized racking accessory via Purchaser’s SCADA system using a Modbus interface. Whenever the hand-held pendant is in use, the pendant becomes the master and will override the Modbus interface.

## protective relays

### The switchgear manufacturer shall furnish and install, in the metal-clad switchgear, the quantity, type and rating of protection relays as indicated on the drawings and described hereafter in this specification.

#### Relays shall be mounted in a separate area metal barriered from medium voltage.

Note to Spec. Writer:

Select relays as required for Paragraph 2.07 B. Refer to Section 26 09 11 for detailed specification. Refer to Paragraph 2.17 to call out relay functions in Bill of Material.

### Microprocessor-Based Protective Relay

#### Eaton EDR-3000 Overcurrent Protection RelayMicroprocessor-based multi-function protective relay, ANSI device function 51/50, 51/50N or 51/50G and 86.

#### Eaton EDR-5000 Distribution Protection RelayMicroprocessor-based multi-function protective relay, ANSI device function 51/50, 51N/50N, 50BF, 25, 32, 46, 55, 67, 27, 59, 59N, 47, 79, 81O,81U and 86. Also includes metering functions.

#### Eaton ETR-4000 Transformer Protection RelayMicroprocessor-based multi-function multi-function protective relay, ANSI device function 87T, 87GD, and 50/51G for neutral. Also to be included are 51/50 & 51N/50N for primary as well as secondary windings.

#### Eaton EMR- 3000 Motor Protection Relay Microprocessor-based multi-function motor protection relay, ANSI device Function 49, 50, 51, 46, 50G, 51G, 37, 38, 66, 2/19, 74 and 86.

#### Eaton EMR- 4000 Motor Protection RelayMicroprocessor-based multi-function motor protective relay, ANSI device functions 27/47, 49, 50, 51, 46, 50G, 51G, 37, 38, 55, 66, 2/19, 74 and 86.

#### Eaton EMR- 5000 Motor Protection Relay Microprocessor-based multi-function motor protection relay, ANSI device Function 27/47, 49, 50, 51, 46, 50G, 51G, 37, 38, 55, 66, 2/19, 74, 86, and 87

#### Eaton EGR-5000 Generator Protection Relay Microprocessor-based multi-function generator protection relay, ANSI device functions 51/50, 51/50N, 67, 27, 59, 25, 47, 55, 40, 81 O/U, 67, 32, 24, 87, 49, 46, and 50BF.

## Auxiliary Devices

### Ring type current transformers shall be furnished as indicated on the contract drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than those specified in IEEE C37.20.2. The standard location for the current transformers on the bus side and line side of the 5, 15 and 27 kV breaker units shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections. Shorting terminal blocks shall be furnished on the secondary of all the current transformers. Current transformers in 38kV switchgear shall be accessible from the rear of the switchgear after removal of HV connections and certain barriers.

### Voltage transformers or resistive voltage dividers shall be supplied as shown on the one-line diagram.

#### The voltage transformers shall be mounted on tilt-out trunnions or drawout drawer assemblies and equipped with current limiting primary fuses. In the withdrawn position, the fuses and the potential transformers shall be disconnected and grounded to permit safe inspection and/or replacement of the fuses. The trunnion frame shall be connected to ground by a flexible copper cable that is attached directly to the frame. The mechanism shall be arranged so that full access to potential transformers or fuses cannot be accomplished until they are disconnected from high voltage and grounded. Live parts shall be isolated when the voltage transformers are in the withdrawn position to prevent accidental contact by operating or maintenance personnel. Stationary contacts shall be silver plated copper and mounted on porcelain or glass polyester supports. Cables connected to voltage transformer primaries shall be rated for the full voltage and BIL rating of the switchgear.

#### Resistive voltage dividers can be used in place of voltage transformers. Resistive voltage dividers shall carry the same rating as the specified voltage transformers. They are to be mounted in the cable compartment of the switchgear assembly. Resistive voltage dividers must consist of 4 total non-inductive resistors (two paralleled medium voltage resistors and two paralleled low voltage resistors). When the nominal service voltage is applied, the resistive voltage divider system shall provide a 120 V signal to the auxiliary devices for protection and controls. The resistive voltage divider system shall be agnostic of the auxiliary devices to which they connect.

### A mechanical interlock shall be provided to require the secondary breaker to be open before the CPT drawer or CPT primary fuse drawer can be withdrawn.

### For 5/15kV switchgear only, each auxiliary compartment shall be provided with an integral motorized racking device accessory, equal to Eaton MR2, with the following features:

#### Allow moving the auxiliary drawer between the connect and disconnect positions from a distance of up to 30 feet via a hand held pendant, with the auxiliary compartment door closed. Where the MR2 is provided for breaker racking, the same pendant can be used for auxiliary racking.

#### Auxiliary drawer position shall be indicated on the pendant by - LED lights. A blinking light indicates that the auxiliary drawer is in the motion through the selected position. A solid (non-blinking) light indicates that the auxiliary drawer has reached and stopped in the selected position. In case normal operation fails, the appropriate error code is displayed on the pendant in a separate 2 character LED display window.

#### The system shall be designed such that it allows manual racking of the auxiliary drawer using the levering crank accessory. Manual racking operation shall disable the motorized racking accessory.

#### It shall be possible to enable/disable operation of the motorized racking accessory via  Purchaser’s external interlocking/permissive contacts.

#### 120 V AC power for the motorized racking accessory shall be [derived from a control power transformer mounted in the switchgear] [supplied by purchaser from an external source].

#### Provide a discrete I/O interface module mounted for each auxiliary drawer for control of the motorized racking accessory via external hard-wired dry contacts, for example, via push buttons located at a remote control panel. The I/O interface module to provide output terminals for connections of remote 24 V LEDs for indication of auxiliary drawer position status at the remote panel. With this I/O interface, the auxiliary drawer can be moved from disconnect to connect or from connect to disconnect positions from a remote control panel. Whenever the hand held pendant is in use, the pendant becomes the master and will override the customer’s remote control signals.

OR --

#### Provide a discrete I/O interface module for each auxiliary drawer, daisy chained, for control of the motorized racking accessory via Purchaser’s SCADA system using a Modbus interface. Whenever the hand held pendant is in use, the pendant becomes the master and will override the Modbus interface

### Where indicated on the drawings, provide surge protection.

Note to Spec Writer:

For all applications where a MV breaker is close-coupled or connected with less than 75 feet of cables to primary side of a power transformer, Eaton strongly recommends that the transformer be protected against high frequency voltage transients caused by interaction of the transformer, switching device, and the power system. The surge protection device selected should be located and connected at the transformer primary terminals or it can be located inside the switchgear and connected on the transformer side of the primary breaker. If the surge protection is not already included at the power transformer, Eaton can provide surge arresters plus transient surge protection device such as Protec Z to be installed and located within the switchgear. A custom engineered RC snubber can also be provided.

For all other applications, refer to Eaton’s surge protection recommendations given in Eaton’s Consulting Application Guide, Tab 5.

## Utility Metering

### Where shown on drawings, provide separate barriered-off utility metering compartment or structure complete with hinged sealable door. Bus work shall include provisions for mounting utility company current transformers and potential transformers as required by the utility company. Utility metering compartment can be standard (non-arc resistant) metal-enclosed design, and not required to have been tested for internal arc-short circuit current withstand.

## OWNER Metering

### Provide owner metering devices where shown on the drawings. Where indicated provide a separate owner metering compartment with front hinged doors. Include associated instrument transformers.

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

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

### Microprocessor-Based Metering System

Note to Spec. Writer:

Select devices as required for Paragraph 2.10 D. Refer to Section 26 27 13.11 for detailed specification.

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

#### The included communications components shall be [Eaton Power Xpert Ethernet Switch(es)] [Eaton Power Xpert Gateway(s)], which [is] [are] specified in Section 26 09 13.13]

#### The communication system network shall be Eaton PowerXpert Architecture

## Enclosures

### The switchgear described in these specifications shall be indoor construction, with devices arranged as shown on contract drawings.

### The switchgear shall be installed inside an electrical room. An arc wall or enclosed arc-plenum with arc duct exit, as applicable shall be furnished for installation above the switchgear. Arc-duct exit location(s) shall be as shown on the drawings. Arc exhaust shall be vented from the arc-plenum to the exit location via arc-duct as shown on the drawings. Contractor shall install arc wall or arc-plenum, as applicable, in the field.

-- OR --

### The switchgear shall be installed inside an outdoor Integrated Power Assembly-IPA. Auxiliary power required for the IPA auxiliary loads [is to be supplied from a suitably sized control power transformer supplied within the switchgear] [will be supplied from an external power source]. Refer to specification 26 05 91 for outdoor IPA requirements. The switchgear shall include an arc exhaust plenum with arc duct exit(s) as needed for the application. An end piece with suitable louver assembly shall be provided at the end of the exit duct(s) outside the IPA wall to prevent ingress of snow/rain into the duct under normal operation. The switchgear supplier and IPA supplier shall be responsible for all mechanical and electrical coordination between the switchgear and the IPA.

### When switchgear is installed in an outdoor IPA, [120 V][240 V] AC auxiliary power for switchgear space heaters shall be [provided by the purchase] [derived from CPT(s) included within the switchgear as shown on the drawings]. Space heaters shall be rated for twice the operating voltage for longer life.

## 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 for each switchgear lineup giving information in accordance with IEEE Std C37.20.2-1999, section 7.4.1 and IEEE C37.20.7, section 6.3. Circuit nameplates shall be provided with circuit designations as shown on purchaser’s single-line diagrams.

### 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

### The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

## Accessories

### The switchgear manufacturer shall furnish accessories for test, inspection, maintenance, and operation, including:

#### One – Maintenance tool for manually charging the breaker closing spring and manually opening the shutter

#### One – Levering crank for moving the breaker between test and connected positions

#### One – Test jumper for electrically operating the breaker while out of its compartment

#### One – Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails, when applicable

#### One – Set of rail extensions, when applicable

#### One – Portable lifting device for lifting the breaker on or off the rails (5, 15 and 27 kV only)

#### One – Ramp for rolling breaker mounted in lower compartment directly onto the floor (5, 15 and 27 kV only)

#### One – Test cabinet for testing electrically operated breakers outside housing

#### One – “Dockable” transport dolly for moving breaker about outside its compartment (5, 15 and 27 kV only)

#### One – [ simple portable electrical levering-in device with 15 feet of extension cable] [Universal Remote Power Racking Device, RPR-2]

#### One – Manual Ground and Test device, 1200/2000 A

#### One – Manual Ground and Test device, 3000 A

## partial discharge testing

### The switchgear shall be corona free and shall be tested for partial discharges in accordance with IEEE C37.20.2, 6.6.1. The corona discharges measured during the tests shall be less than 100 picocoulombs.

## Partial discharge sensing equipment

### The switchgear shall be equipped with factory installed partial discharge sensors and relay for continuous monitoring of the partial discharges under normal operation. The partial discharge sensing shall identify potential insulation problems (insulation degradation) by trending of PD data over time so that corrective actions can be planned and implemented before permanent insulation deterioration develops.

### The PD sensing and monitoring system shall consist of sensors and relay(s) specifically developed for such applications. Provide Eaton Corporation’s type RFCT sensors and InsulGard relay(s), or previously approved equivalent. One RFCT sensor shall be installed over floating stress shields of specially designed bus or line side primary bushings, at every two vertical section for detection of partial discharges within the switchgear compartments. An RFCT sensor shall also be provided for installation around ground shields of the incoming and outgoing power cable terminations for detection of PD activity in the cables up to 100 feet from the switchgear. Output signals from each RFCT shall be factory wired to PD monitoring relay for continuous monitoring. In lieu of RFCTs, coupling capacitor type PD sensors may be used for PD sensing in 27 and 38 kV switchgear equipment

## Bills of Material

### The metal-clad switchgear auxiliary section for control and instrumentation shall include the following:

#### [Two – Line-to-line] [Three – Line-to-ground] voltage transformers

#### Three – Current transformers

#### One – \_\_\_\_\_ kVA [Single-phase] [Three-phase] control power transformer

#### One – Microprocessor-based metering system

#### Additional requirements as shown on the plans.

### The metal-clad switchgear main circuit breaker section for control of a main circuit breaker shall include the following:

#### One – Drawout power circuit breaker rated \_\_\_\_ amperes

#### Three – Current transformers, single secondary

#### One – Circuit breaker control switch with red and green indicating lights

#### One – Microprocessor-based three-phase and ground overcurrent relay, ANSI device number 51/50/N

#### One – Nameplate

#### One – Microprocessor-based metering system

#### One – Set of cable lugs.

### The metal-clad switchgear tie breaker section for control of a tie breaker shall include the following:

#### One – Drawout power circuit breaker rated \_\_\_\_\_\_ amperes

#### Three – Current transformers, single secondary

#### One – Circuit breaker control switch with red and green indicating lights

#### One – Microprocessor-based three-phase and ground overcurrent relay, ANSI device number 51/50/N

#### One – Nameplate

#### One – Microprocessor-based metering system.

### Each metal-clad switchgear feeder breaker section for control of a feeder circuit breaker shall include the following:

#### One – Drawout power circuit breaker rated \_\_\_\_\_\_ amperes

#### Three – Current transformers, single secondary

#### One – Circuit breaker control switch with red and green indicating lights

#### One – Microprocessor-based 3-phase and ground relay, ANSI device number [51/50/N – residual connection] [51/50/G – zero sequence connection]

#### One – Nameplate

#### One – Microprocessor-based metering system

#### One – Set of cable lugs

#### One – Zero sequence current transformer when 51/50/G-zero sequence connection is specified.

# Execution

## Factory Testing

### The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of IEEE standards.

#### Alignment test with master cell to verify all interfaces and interchangeability

#### Circuit breakers operated over the range of minimum to maximum control voltage

#### Factory setting of contact gap

#### One-minute dielectric test per IEEE standards

#### Final inspections and quality checks

### The following production test shall be performed on each breaker housing:

#### Alignment test with master breaker to verify interfaces

#### One-minute dielectric test per IEEE standards on primary and secondary circuits

#### Partial discharge tests, when applicable.

#### Operation of wiring, relays and other devices verified by an operational sequence test

#### Final inspection and quality check.

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

### The owner’s representative shall witness factory tests as outlined under 3.02.B above.

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

#### All travel, logding, meals and incidental expenses associated with owner’s test witness shall be owner’s responsibility.

## Field Quality Control

### Provide the services of a qualified factory-trained manufacturer’s representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of \_\_\_\_\_ working days. The manufacturer’s representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

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

## Manufacturer’s Certification

### A qualified factory-trained manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer’s recommendations.

### The Contractor shall provide three (3) copies of the manufacturer’s representative’s certification.

## Training

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

### A manufacturer’s qualified representative shall conduct the training session. Training program shall include instructions on the assembly, circuit breaker, protective devices, and other major components.

## Installation

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

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

## Field Adjustments

### The relays shall be set in the field by [The Contractor in accordance with settings designated by the engineer.] [The Contractor in accordance with settings designated in a coordination study of the system as required elsewhere in the contract documents.] [A qualified representative of the manufacturer, retained by the Contractor, in accordance with settings designated in a coordinated study of the system as required elsewhere in the contract documents.]

## Field Testing