# GENERAL

## SECTION INCLUDES

### This specification describes metal enclosed load break air interrupter switch equipment. The switch or switches shall be fused or non-fused as indicated on the plans or described in this specification. The fused or non-fused switches may be either stand alone or in a lineup as indicated on the plans.

## REFERENCES

### The equipment and components in this specification shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted).

### IEEE C37.20.3 Standard for Metal-Enclosed Interrupter (MEI) Switchgear Assemblies [Standard for Metal-Enclosed Interrupter Switchgear (1 kV–38 kV)](https://ieeexplore.ieee.org/document/6730641/)

### IEEE C37.20.4 [Standard for Indoor AC Switches (1 kV - 38 kV) for Use in Metal-Enclosed Switchgear](https://ieeexplore.ieee.org/document/8684728/)

### ANSI C37.57 Switchgear - Metal-Enclosed Interrupter Switchgear Assemblies - Conformance Testing

### ANSI C37.58 [Switchgear - Indoor AC Medium-Voltage Switches For Use In Metal-Enclosed Switchgear - Conformance Test Procedures](https://webstore.ansi.org/standards/nema/ansic37582020)

## DEFINITIONS

## SYSTEM DESCRIPTION

### The switches shall be applied on a [solidly] [low resistance] [high resistance] [ungrounded] power system nominally rated at [ ]kV.

## SUBMITTALS

### Manufacturer shall provide [3] copies of the following documents to owner for review and evaluation in accordance with general requirements of Division [1] [01] and Division [16] [26]:

#### Product Data on specified product;

#### Shop Drawings on specified product;

## INSTALLATION, OPERATION AND MAINTENANCE DATA

### Manufacturer shall provide [3] copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division [1] [01] and Division [16] [26].

## QUALITY ASSURANCE (QUALIFICATIONS)

### Manufacturer shall have specialized in the manufacture and assembly of medium voltage metal ecnlosed switchgear for [25] years.

### Medium voltage metal enclosed switchgear shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Article 1.02 of this specification.

### Equipment shall be qualified for use in seismic areas as follows:

#### High seismic loading as defined in ASCE 7-10, IBC 2021 and CBC 2022.

#### CBC-2022, Sds = 2.00g, Ip = 1.5, for z/h equal to 1 and Sds = 2.5g, Ip = 1.5, for z/h equal to 0 in accordance with ICC-ES-AC156.

#### Seismic compliance shall be qualified through shake table testing. Further extension based on experience-based data methodology is permissible. Compliance by calculation only is not acceptable. Seismic compliance shall apply to both NEMA 1 and NEMA 3R enclosures.

## DELIVERY, STORAGE, AND HANDLING

### Contractor shall store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.

### Ship each switchgear lineup in individual shipping splits for ease of handling. Each section shall be mounted on shipping skids and wrapped for protection.

### Contractor shall inspect and report concealed damage to carrier within 48 hours.

### Contractor shall store in a clean, dry space. Cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heat enclosures to prevent condensation.

### Contractor shall handle in accordance with manufacturer's recommendations to avoid damaging equipment, installed devices, and finish. [Lift only by installed lifting eyes.]

## PROJECT CONDITIONS (SITE ENVIRONMENTAL CONDITIONS)

### Follow (standards) service conditions before, during and after switchgear installation.

### Switchgear shall be located in well ventilated areas, free from excess humidity, dust and dirt and away from hazardous materials. Ambient temperature of area will be between minus 20 and plus 40 degrees C. Indoor locations shall be protected to prevent moisture from entering enclosure.

## WARRANTY

### Manufacturer warrants equipment to be free from defects in materials and workmanship for 1 year from date of installation or 18 months from date of purchase, whichever occurs first.

## FIELD MEASUREMENTS

### Contractor shall make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.

# PRODUCTS

## MANUFACTURER

### ABB products have been used as the basis for design. Other manufacturers' products of equivalent quality, dimensions and operating features may be acceptable, at the Engineer's discretion, if they comply with all requirements specified or indicated in these Contract documents.

## EQUIPMENT

### ABB BreakMaster load interrupter switchgear (or approved equal).

## COMPONENTS

### Refer to Contract Drawings for actual layout and location of equipment and components; current ratings of devices, bus bars, and components; voltage ratings of devices, components and assemblies; interrupting and withstand ratings of devices, buses, and components; and other required details.

### Ratings

#### The switch lineup shall be rated: [600] [1200] [2000] amperes, nominally [5kV, 60kV BIL] [15kV, 95kV BIL], 3 - phase, 3 – wire [40kA] [61kA] momentary symmetrical. The switches shall be rated either 600 or 1200 amperes as shown on the plans. The switch lineup shall consist of the required number of main, feeder, and tie switches as shown on the plans.

#### The switch shall include barrier as required by California building code.

### Incoming Line Section

#### Incoming power to the switch lineup shall be from a [main lug section] [main switch section] [transition to ABB switchgear] [transition to MV MCC] [transition to [dry type] [liquid filled] transformer]. If the lineup is fed by cables, the size and number shall be as shown on the plans. The main lug only section shall be either 20 inches or 35 inches wide depending on the devices mounted in the section.

### Incoming Line Section

#### Incoming power to the switch lineup shall be from a [main lug section] [main switch section].

#### The main lug only section shall be either 20 inches or 35 inches wide depending on the devices mounted in the section.

#### If incoming is cable, the size and number shall be shown on plans.

### Outgoing Line Section:

#### Switchgear shall transition to [ABB switchgear] [MV MCC] [dry type transformer] [liquid filled transformer].

#### If outgoing is cable, the size and number shall be as shown on the plans.

### Construction

#### Enclosure shall be [NEMA-1, indoor] [NEMA-2, indoor drip proof] [NEMA-3R, non-walk-in].

#### Each section of the equipment lineup shall be constructed of sheet steel and shall be bolted frame construction. Each section shall be adequately braced and shall have adequate venting to prevent distortion of the cubicle doors and windows under operating conditions. Operating conditions shall include normal operations under load, short circuits, and fuse operation and interruption of short circuits up to the specified rating of the equipment.

#### [The switchgear shall be UL listed.]

#### Each switch section shall be front connected and front accessible, unless special project requirements dictate differently. Key interlock provisions shall be provided on each switch section.

#### Each section shall be constructed of 11-gauge sheet steel. This shall include doors, back panels, and side panels.

#### Each switch section shall have a front steel door with safety protected observation windows that shall allow sufficient viewing of the switch contact position. All steel doors shall have concealed hinges and bolting hardware secure the door in the closed position. A mechanical switch and door interlock shall be provided to prevent opening the door when the switch is in the "on" position.

#### Individual doors shall be provided for each switch compartment and for each fuse compartment. Rear hinged door shall be provided for special applications as noted in plans.

#### The standard indoor depth shall be 50 inches. An optional depth of 60 inches shall be available for special applications or the mounting of additional devices. Each switch section shall be 35 inches wide or 40 inches wide for motor operated switch units. Auxiliary sections may be 20, 35, or 40 inches wide. Auxiliary sections shall be furnished, if required, for metering and the mounting of potential transformers, current transformers, control power transformers and other necessary components. All sections in the lineup shall align front and rear.

#### [Split rear and side covers shall be provided for easy access.] [Provide hinged rear doors on enclosure]

#### Cable entry shall be from the [top] [bottom] [and include loop provisions]. Provisions shall be made for [1] [2] [3] [4] [5] [6] cables terminated onto ANSI [single hole] [two hole] studs.

#### Cable exit shall be from the bottom unless a transition section is included. Provisions shall be made for [1] [2] [3] [4] [5] [6] cables terminated onto ANSI [single hole] [two hole] studs.

#### [A [14”] [22”] [28”] top hat cable entrance shall be provided.]

#### [Ground studs shall be provided on the [line] [load] [line and load] side of the switch.]

#### IR ports, type [Fluke 075] [Fluke 100] shall be provided for bus inspection.

#### Provide [distribution] [intermediate] [station] class arresters rated [3] [6] [9] [10] [12] [15] [18] [21]kV. ***Note to specifier: Arresters not available for “front access only” applications.***

#### Louvered ventilation openings shall be provided as required.

#### All housings shall be chemically cleaned inside and out and then treated with a phosphoric acid, etched and cleaned. All surfaces shall be finished in ANSI 61 medium light gray. The paint finish shall be rated for 1000-hour salt spray, per ANSI C37.20.3.

#### Provide [glow tube] [1 neon] [2 neon] live line indicators. ***Note to specifier: live line indicators are not available on UL listed equipment.***

#### [Light & convenience receptacle.]

#### [Enclosure shall include hinged rear door.]

#### [Enclosure shall include a bottom plate.]

#### [Enclosure shall include metal screen barriers]

#### [Provide rodent barriers.]

#### [Enclosure shall be dust resistant]

#### Outdoor equipment shall be weather resistant, gasketed, and equipped with long life space heaters. Control power shall be from [an external source][from a CPT mounted in the lineup]. The outdoor equipment shall be provided with inside removable filters for the ventilation louvers. The roof shall be sloped for moisture runoff. A four-inch channel base shall also be provided. The outdoor construction shall be non-walk-in. The outdoor equipment shall have the same paint process as above and shall be the same color.

#### Provide space heaters on indoor equipment. Space heaters shall be fed from [local control power transformer] [remote source].

#### [Space heaters, when provided shall be thermostatically [and humidistat] controlled.]

#### Lifting angles or other suitable means for lifting shall be provided.

#### [Provide a [black] [white] [red] [blue] plastic mimic bus on the front of the lineup.]

#### [Provide tamper resistant hardware.]

#### [Provide electrical motor operators for switch operation. Motor operators shall be [Standard Close] [Quick Close] type.]

### Bus

#### The switchgear bus shall be [tin plated] [silver plated] copper. The main bus shall be fully rated and arranged for future extension. Split style lock washer bolts shall be provided on all bus joints. The main bus shall be braced to withstand the effects of a short circuit within the ratings of the equipment. Supports for the main bus shall be [glass polyester] [porcelain]. [The main bus shall be fully insulated]

#### [Provide [run back bus] [inverted run back bus].]

#### A full-length ground bus shall be provided in the equipment lineup. The ground bus shall be arranged for future extension.

#### Where bus bars are insulated to allow closer spacing, the insulation used shall be sleeve type. Joints will be [taped] [covered with molded boots] as requested in plans.

### Air Interrupter Switches

#### The air interrupter switches shall be gang operated, stored energy type, 3 - pole, single throw, 2 - position (open / close) and either 600 or 1200 amperes as shown on the plans. The switch mechanism shall be externally operable from the front or side of the cubicle. The switch mechanism shaft is driven by a [chain and sprocket] [metal to metal] linkage from the operating handle. Each switch shall utilize a spring charged mechanism for both opening and closing and shall be of the quick-make, quick-break type. The opening and close of the switch shall be independent of the speed at which the handle is moved. "Teasing" of the switch poles will not be permitted. Each switch shall be manually or electrically operated as shown on the plans.

#### Each switch shall have main and arcing contacts and be designed to provide maximum endurance for load interrupting and fault closing. The arcing contacts shall be spring-loaded on-break and shall be last in and last-out. The arcing contacts shall operate in an arc chute designed to assist in interruption and release no appreciable gases on interruption.

#### The main blades of each switch shall be made of electrolytically pure cold rolled copper. All contact points shall be heavily silver plated on the blades as well as the hinges and jaw castings. Each of these castings shall be one piece to provide maximum heat dissipation and continuous heat transfer.

#### The rating of the interrupter switches shall be [600A, 5kV, 60kV BIL, 40kA momentary, 40kA fault close asymmetrical] [600A, 5kV, 60kV BIL, 61kA momentary, 61kA fault close asymmetrical] [1200A, 5kV, 60kV BIL, 40kA momentary, 40kA fault close asymmetrical] [1200A, 5kV, 60kV BIL, 61kA momentary, 61kA fault close asymmetrical] [600A, 5kV, 95kV BIL, 40kA momentary, 40kA fault close asymmetrical] [600A, 5kV, 95kV BIL, 61kA momentary, 61kA fault close asymmetrical] [1200A, 5kV, 95kV BIL, 40kA momentary, 40kA fault close asymmetrical] [1200A, 5kV, 95kV BIL, 61kA momentary, 61kA fault close asymmetrical] [600A, 15kV, 95kV BIL, 40kA momentary, 40kA fault close asymmetrical] [600A, 15kV, 95kV BIL, 61kA momentary, 61kA fault close asymmetrical] [1200A, 15kV, 95kV BIL, 40kA momentary, 40kA fault close asymmetrical] [1200A, 15kV, 95kV BIL, 61kA momentary, 61kA fault close asymmetrical]. When used with fuses the ratings shall be dependent upon the specified fuse characteristics.

#### The switch shall conform to or exceed ANSI/IEEE Standards for high-voltage air switches and switchgear assemblies C37.20.3, C37.20.4, C37.57 and C37.58. Upon request, test certificates shall be provided confirming published interrupting, short-time, momentary, BIL, dielectric and fault-closing ratings.

#### Switches used as tie switches shall be non-fused. Switches used as mains or feeders may be either fused or non-fused as indicated on the plans.

#### All components of each switch shall be completely checked and operated in compliance with documented quality assurance procedure to ensure that all parts function as intended after manufacture and assembly. Production testing shall consist of power frequency withstand and mechanical operations.

#### Interphase barriers shall be provided for each switch. Horizontal barriers between the switch and cable terminals or fuse supports (when required) shall be provided.

#### Provision shall be included for locking the switch in the open or closed position. The door shall be mechanically interlocked with the air interrupter switch to prevent closing the switch with the door open and to prevent opening the door with the switch closed.

#### [Switch handle shall be connected via direct drive]

#### Switch operating handles shall be externally mounted [removable] [non-removable] (except for electric operators), self leveling, and padlockable with multiple padlocks in either the open or closed position. OPEN/CLOSE indicators shall advise operators of the switch position.

### Switch Accessories

#### [Auxiliary contacts, 3NO/3NC]

#### [Mechanical type operations counter]

#### [Shunt trip, rated [110 VAC] [125 VDC]]

#### [Spare fuse holder]

#### [Blown fuse indication]

#### [Blown fuse trip]

### Fuses shall be self-contained [current limiting] [boric acid] type to provide fast clean interruption. They shall be coordinated to meet the overload and short circuit rating specified and shall have the continuous rating shown on the plans.

### Each lineup shall be provided with a permanent non-corrosive nameplate. All units shall have appropriate hazardous danger signs prominently displayed on the exterior and interior of each section.

### Provisions for terminations shall be [NEMA drill only terminals] [compression lugs] [mechanical lugs].

### [Provide wire markers on all control wiring]

### [Provide key interlocks as indicated on drawings.]

### Metering

#### Provide an electronic power meter where indicated on the drawings. Three phase metering and power quality analysis shall be provided by a power quality meter, GE PQM II or approved equal.

#### Metering shall include A, V, W, Wh, Wcost, var, varh, VA, VAh, Hz, and PF in True RMS or displacement (fundamental) quantities.

#### Power analysis features shall include an event recorder, waveform capture, trace memory, harmonic spectrum display (through the 62nd harmonic with total harmonic distortion) and a data logger function. All analysis data shall be non-volatile.

#### Four switch inputs shall be provided which can be programmed for relay activation, counters, logic, demand sync, reset and alarms. Four output relays shall be provided which can be programmed to activate on alarms, setpoints, switch inputs, kWh pulse, trace memory triggers or communications control. These output relays shall also be able to use demand metering values of A, VAR, W and VA to control load shedding.

#### PLC interface shall be provided via four isolated 4-20mA outputs programmable from measured and calculated parameters.

#### Transducer monitoring shall be provided via a 4-20mA input.

#### Local user interface shall include a keypad and display for entering all setpoints and reading all measured values, and LED indicators for output relays, communication status and alarm status.

#### An RS232 computer interface port shall be located on the front panel. Two RS485 and one RS232 communication ports shall be provided for simultaneous access using ModBus® RTU protocol. Windows® based software shall be provided to enable setpoint programming.

### Instrument Transformers

#### Current transformers with shorting terminal block shall be provided. Current ratings shall be as indicated on drawings.

#### Provide potential transformers with fused primary, stationary mounted, rated and configured as indicated on drawings.

### Control Power

#### Control power shall be [125 VDC] [120VAC] [240VAC] [from an external source] [from a CPT mounted in the lineup].

#### Where indicated on drawings, provide a stationary mounted control power transformer, rated 5 kVA. ***Note to specifier: CPT not available for “front access only” applications.***

### [Asset Health Monitoring] (Note: Standard is no asset health monitoring)

1. Switchgear shall be equipped for 24x7 monitoring of the temperature at all incoming and outgoing primary cable connections using the ABB SwitchgearMD™ [wireless] [infrared] monitoring systems. *(Note: If partial discharge is required, then only wireless can be selected. Standard offering is infrared.)*
2. Switchgear shall be equipped for 24x7 monitoring of internal humidity.
3. [Switchgear shall be equipped for 24x7 monitoring of partial discharge activity in designated compartments.] *(Note: Partial Discharge monitoring is optional. Must use wireless monitoring system if PD detection is required. Standard is monitoring of the cable connection temperatures and switchgear humidity only.)*
4. [Main bus and non-cable lug pad joints to be monitored for temperature.] *(Note: Standard is monitoring of incoming/outgoing cable connections only.)*
5. Monitoring system shall trigger alarms based on configurable thresholds.
6. Monitored data will be displayed on an HMI unit mounted on the door of an instrument compartment.
7. [Monitored data to be made available to a remote system such as a SCADA or a Data Historian.] *(Note: Standard is no data made available to remote systems.)*

### [Active Arc Mitigation] (Note: Standard is no active arc mitigation)

1. Arc Flash Mitigation using the ABB REA Arc Detection System

Provide a complete arc flash mitigation system suitable for attachment to the switchgear as indicated on the design documents for the protection of the equipment against the effects of internal arcs, to ensure personnel safety and to minimize damage and outage to the equipment.

The arc flash mitigation system shall be designed and constructed for indoor installation and operated under the following conditions:

1. Altitude: up to 1,000 m above sea level
2. Ambient air temperature: -10ºC to 55 ºC
3. Relative humidity: up to 90% non-condensing

The arc monitoring unit (arc flash detector) shall detect the occurrence of short-circuit arcing my means of arc detectors/sensors and current sensing units and immediately transmit a tripping signal to trip and lock out all relevant circuit breakers connected to the affected main bus.

1. The arc monitoring unit power supply shall be [Vn = 110/120/220/240 V AC] , [Vn=110/125/220/250 V DC], Or [Vn = 24/48/60 V DC]
2. Fiber optic detectors without galvanic wires shall be used.
3. Current sensing units:
	* Current setting for 3-phase: 0.5 ….. 6.0 x In, where In is 1A or 5A
	* Current setting for ground unit: 0.05….0.6 x In where In is 1A or 5A
4. Indicators to include:

Fault indication and location

Relay self-supervision of internal electronics, fiber optic loop check supervision, communication link supervision

Operating time from detection to initiate circuit-breaker tripping shall be not more than 2.5 msec.

The arc flash mitigation system shall not respond to interfering light sources, electro-magnetic influences, vibration and touching. Automatic or manually adjustable ambient light compensation shall be provided.

The protection principle of the arc flash mitigation system shall consist of two (2) important criteria: Light intensity and simultaneous overcurrent. Note: It shall be possible to select light intensity only.

The system shall perform the proper protection even if all outgoing feeders are supplied by one incoming feeder by closing the bus tie breaker. If the internal arc occurs at any point I the bus section fed through the bus tie breaker, only the affected bus section shall be removed from service. In the case of an internal arc on the busbar section with fault current supplied from an outgoing feeder, the arc flash mitigation system shall perform complete busbar protection according to applicable scheme using light only without supervision of fault current detectors.

The system shall be complete with control and indicating devices, and testing facilities for routine functional testing of the protection system while switchgear is energized.

The arc monitoring unit with current sensing shall provide three-phase over current measurement, switchgear existing current transformers shall provide the current inputs for the current sensing unit. The current sensing unit shall block circuit breaker tripping via the arc-monitoring unit at load currents below a preset value. Integrated circuit breaker failure protection shall be provided.

Fault current supervision (fault detectors) of the optical system shall be switch selectable.

The system shall be capable of indicating the affected cubicle as well as selective tripping by using the appropriate extension unit.

The manufacturer shall have a minimum of 5 years’ experience in the design, manufacturing and testing of the Arc Flash Mitigation System.

The Arc Flash Mitigation system shall be UL recognized.

The manufacturer shall submit complete drawings of the arc mitigation system components and drawings showing the placement of system components, routing of sensor cables and network communication cables in the switchgear sections.

The manufacturer shall furnish operating and maintenance manuals covering installation, operations and servicing procedures for the Arc Flash Mitigation System.

1. Approved equipment for use in REA arc flash mitigation systems are:
2. Arc detection monitoring unit REA 101 (Master Unit) with integrated current sensing unit. This unit will communicate with REA 105 units via a network connection cable for tripping of associated circuit breakers.
3. Arc detection unit REA 105 for fast fault tripping of compartment feeder breaker upon compartment detector/sensor cable detection of arc flash or upon signal from the REA 101. To include one dry contact output for alarming.
4. Detection/sensor cables shall be fiber optic light sensitive cable with a maximum length of 65 meters.
5. Network connection cables shall be at least Cat 5E communication cables with RJ-45 connectors.
6. Cables between REA 101 devices shall be optolink transmitting and receiving cables for transmitting light or current trip threshold signals.

## FINISH

### All steel surfaces shall be chemically cleaned prior to painting.

### Exterior paint color shall be ANSI 61 Light Gray over phosphate - type rust inhibitor.

# EXECUTION

## FACTORY TESTING

### The equipment shall be factory assembled in its entirety and tested in accordance with production testing requirements in IEEE C37.20.2 prior to shipment.

### Factory Witness Testing *(Note: Standard is no factory witness testing)*

* + - 1. [Factory witness testing shall be included in the price of the switchgear.]
			2. [Factory witness testing shall allow up to 3 members the applicable number of days to witness the factory tests as listed above.]
			3. [Buyer must be made aware of factory test dates in advance to facilitate arrangement of travel plans.]

## EXAMINATION

### The following procedures shall be performed by the Contractor.

#### Examine installation area to assure there is enough clearance to install switchboard.

#### Check concrete pads for uniformity and level surface.

#### Verify that equipment is ready to install.

#### Verify field measurements are as [shown on Drawings] [instructed by manufacturer].

#### Verify that required utilities are available, in proper location and ready for use.

#### Beginning of installation means installer accepts conditions.

## INSTALLATION

### Installation shall be performed by the Contractor.

#### Install per manufacturer's instructions.

#### Install required safety labels.

## FIELD TESTING AND COMMISSIONING

### All testing and commissioning is to be performed per the latest NETA and/or local requirements.

### When SwitchgearMDTM system is installed, the T&C contractor, owner or operator must record baseline data from temperature, humidity and partial discharge sensors at least 4 but no more than 24 hours after energization

## TRAINING

* + 1. [Manufacturer to provide x hours of switchgear operations training.] *(Note: Training is not included as standard.)*
		2. [Provide x hours of SwitchgearMD™ asset health monitoring training.] *(Note: This training is only required if SwitchgearMD is specified. Eight (8) hours training minimum is recommended.)*

END OF SECTION