SECTION 26 13 16.10
MEDIUM VOLTAGE METAL-ENCLOSED LOAD INTERRUPTER SWITCHGEAR (AIR INTERRUPTER SWITCHES)

This specification is written for 5 kV through 38 kV free-standing or close-coupled metal-enclosed switchgear with load interrupter switches.

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Medium voltage metal-enclosed switchgear with air load interrupter switches.

1.02 REFERENCES
A. ANSI/IEEE C37.20.3 - Standard for Metal-Enclosed Interrupter Switchgear.
B. ANSI/IEEE C37.20.4 - Standard for Indoor AC Medium Voltage Switches used in Metal-Enclosed Switchgear.
E. ANSI Z55.1 - Gray Finishes for Industrial Apparatus and Equipment.
F. NEMA
G. IEC 420 High-Voltage Alternating Current Switch-Fuse Combinations (Applicable sections to ensure proper coordination of the switch-fuse combination when fuses are utilized for opening the switch automatically).
H. CAN/CSA C22.2 No. 31 Switchgear Assemblies.
I. CAN/CSA C22.2 No. 193 High Voltage Full-Load Interrupter Switches.

1.03 SUBMITTALS
A. The metal-enclosed switchgear assembly shall be in accordance with the contract documents, applicable codes whichever is the most stringent.
B. The manufacturer shall furnish a detailed Bill of Material and complete set of drawings as follows:
   1. Detailed front elevation.
   2. Single Line
   3. Base Plan
   4. Schematics
   5. Wiring Diagrams
C. The manufacturer shall furnish comprehensive instruction manuals covering the installation of the switchgear and the operation of its various components.

1.04 QUALITY ASSURANCE
A. Manufacturer: Company specializing in medium voltage metal-enclosed switchgear with at least five years documented experience. The manufacturer of the switchgear must be the same as the manufacturer of the load interrupter switch.
B. [Equipment shall be equipped with [service entrance label] [and] [UL label for metal-enclosed type switchgear assemblies] when UL recognized components are specified.]

1.05 DELIVERY, STORAGE, AND HANDLING
The following paragraphs apply only to the installing contractor.
A. Accept equipment on site and inspect for shipping damage.
B. Protect equipment from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within enclosure in accordance with manufacturer's instructions.

PART 2 PRODUCT

2.01 MANUFACTURERS
A. Switchgear: The metal-enclosed load interrupter switchgear shall be Square D type HVL or approved equal.

Select the appropriate Fuse description

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B. Fuses (Select 1 or 2)

1. [The switchgear shall be equipped with a FuseLogic system to provide single-phase protection with the following features:]
   a. Direct acting, (5 kV up to 150 A and 15 kV up to 65 A "E" rated fuses) fuse tripping, to automatically open the manually operated load interrupter switch in the event of a blown fuse. For fuses rated higher than those shown, system shall be shunt trip operated directly from blown fuse contacts (control power required). Blocking the closing of the switch shall further prevent potential single-phasing conditions when a fuse is blown or if a fuse is not installed.
   b. Prevention of potential single-phase conditions by blocking the closing of the [manually] [motor] operated load interrupter switch when a fuse is blown or if a fuse is not installed.
   c. [Three Form C auxiliary switches (1 per phase) for phase blown/missing fuse indication.] [One Form C auxiliary switch (1 for all 3 phases) for blown/missing fuse indication.]
   d. Fuses shall be fixed in position in a non-disconnect fuse mounting with provisions for removal and replacement from the front of the gear.
   e. Fuses shall be UL Listed.
   f. The blown fuse indicator shall be an "Extended Travel" type with a minimum of 1 inch of travel.

2. [Current limiting fuses][Boric acid fuses: (Boric acid cannot be used in conjunction with FuseLogic system)]
   a. Fuses shall be [current limiting, non-expulsion type of self-contained design to limit the available fault current stresses on the system.] [Boric acid, expulsion type, fuse holders with replaceable refills or fuse units, complete with muffler exhaust control.]
   b. Fuses shall be affixed in position in a non-disconnect fuse mounting with provisions for removal and replacement from the front of the gear.
   c. Fuse Rating: "E" rated, size [to be determined later] [as scheduled on drawings].
   d. Voltage Class: [5.5] [15.0] [25.8] [38.0] kV.
   e. Interrupting Rating: As stated above to achieve the integrated interrupting rating; [_____] amps, rms symmetrical.

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2.02 LOAD INTERRUPTER SWITCHGEAR ASSEMBLY

A. The metal-enclosed switchgear with load interrupter switches shall consist of a [single section] [multiple section line-up], and be of [indoor] [outdoor non-walk-in] [outdoor - housed in an outdoor POWER-ZONE center] type construction. The sections shall contain the load interrupter switches and the necessary accessory components. The equipment shall be factory-assembled (except for necessary shipping splits) and operationally checked. The assembly shall be a self-supporting, floor mounted bay [and shall be securely bolted to the transformer to form an integrated structure].

B. [If Square D Company's, FuseLogic system is specified, automatic fuse tripping of the switch-fuse combination shall be tested to the applicable sections of IEC 420 to ensure proper coordination. A time delay relay may be required for certain fuse ratings to ensure that any fault current present has decayed to a value the load interrupter switch can safely interrupt.]

C. In establishing the requirements for the enclosure design, consideration shall be given to such relevant factors as controlled access, tamper resistance, protection from ingress of rodents and insects, and the possibility of arcing faults within the enclosure.

D. [Switchgear rated 600 amps continuous shall not require ventilation openings to aid in cooling of the associated components.]

E. The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.

F. A viewing window shall be installed in the switch enclosure and located so as to enable visible inspection of the switch blades and blown fuse indicators from outside the enclosure.

G. System Voltage: [_____] kV, 3-phase, [solidly grounded] [resistor grounded through a [_____] ohm resistor] [ungrounded], [3-phase, 3-wire] [3-phase, 4-wire][with] [without] neutral bus.

H. Operating Frequency: [50] [60] Hz.

I. Maximum Short Circuit Current: [_____] kA rms symmetrical.

J. Maximum Design Voltage: [4.76] [15.0] [25.8] [29.0] [38.0] kV.

K. Basic Impulse Level (BIL): [60] [95] [125] [150] kV.

L. Power Frequency Withstand: [19] [36] [60] [80] kV.

M. Short-Time Current (two second): [25] [38] [48] kA.

N. in Bus Ampacity: [600] [1200] [2000] amps, continuous.

O. Integrated Short Circuit Rating: [12.5] [14] [25] [40] [50] [63] kA, rms symmetrical.
The above integrated short circuit ratings represent some of the most commonly used ratings. However, they will vary according to the type, brand, and size of fuse. Contact the manufacturer for the integrated rating with the particular fuse chosen.

2.03 COMPONENTS
A. Load Interrupter Switch (Select 1 or 2)

Select the appropriate mechanism description

1. [Over-Center Mechanism]
   a. The load interrupter switch shall be rated at [600] [1200] amperes continuous and interrupting; fixed mounted on NEMA class A-20 [glass reinforced polyester] [porcelain] standoff insulators; [manually] [and motor] operated; quick-make, quick-break with the speed of operation independent of the operator. [Electrical operation of the device requires a [120 VAC] [125 VDC] source.] To provide for dependable operation, the device shall not rely on chains or cables to drive the blade assemblies open and closed. The spring operator assembly shall be isolated from high voltage and coupled through a direct drive shaft.

2. [Stored-Energy Mechanism]
   a. The load interrupter switch shall be rated at [600] [1200] amperes continuous and interrupting; and fixed mounted on NEMA class A-20 [glass reinforced polyester] [porcelain] standoff insulators. The stored-energy, manually operated mechanism shall be equipped with separate opening and closing springs. The opening spring shall be charged prior to the closing spring. Operation of the load interrupter switch shall be by means of a close/open lever. Operation shall be quick-make, quick-break with the speed of operation independent of the operator. The mechanism shall be equipped with [FuseLogic] [an opening coil] [a closing coil] and operated from a [120 VAC] [125 VDC] source. To provide for dependable operation, the device shall not rely on chains or cables to drive the blade assemblies open and closed. The spring operator assembly shall be isolated from high voltage and coupled through a direct drive shaft.

B. Switches shall separate current carrying paths and arcing interruption paths.
C. Switch blades shall be mounted on insulators that are attached to grounded metal barriers. Switches that utilize blades mounted on a common shaft with insulation from blade to blade rather than blade to ground are unacceptable.
D. The switch operating handle shall be permanently attached to the outside front of the switchgear and ready for immediate use, except for outdoor applications where the front of the switchgear shall be covered by a full-height solid door. Removable handles are not acceptable. The handle must operate in the conventional fashion with the switch closed with the handle in the up position and the switch open with the handle in the down position. Provisions shall be available for padlocking the switch in either the open or closed position.
E. Voltage and Short Circuit Ratings: Match ratings specified for assembly.
F. Momentary Rating: [40] [61] [80] kA, rms asymmetrical.
G. Fault Closing: [40] [61] kA, rms asymmetrical.

2.04 ACCESSORIES
A. Surge Arresters (metal-oxide type): [Distribution] [Intermediate] [Station] class, rated [_____] kV, [_____] MCOV; one per phase.
B. Incoming Cable Termination: [Cable Lug] [Pothead] [Roof bushing].
C. Provide [double clamping lugs] [compression lugs] [mechanical lugs] for terminating cables onto the switchgear terminal pads.
D. Space Heaters: For [120] [240] VAC external source, sized by the manufacturer, with [thermostats] [humidistat].
E. Mechanical Interlocks: The high-voltage compartment door shall be interlocked to prevent opening with the load interrupter in the closed position. The interlock must be directly attached to the operating mechanism and should not rely on long cables and linkages.
F. Key Interlocks: [_____]
G. Voltage and Current Transformer Options:
   [Each] bay containing a circuit interrupter shall include the following [as shown on the drawings]:
   1. Current Transformers, [donut type for use with shielded cable] [bar type], [_____] Ratio.
   2. Potential Transformers, 120 VAC secondary.
   3. Control Power Transformer, single phase, with primary disconnect fuse, 240/120 VAC secondary, [5] [10]
H. Metering Options:

1. Each bay containing a circuit interrupter shall include the following [as shown on the drawings]:
   a. PowerLogic Circuit Monitor, [with digital display][with waveform capture][stand-alone] wired for communications to other devices.
   b. Ammeter with Selector Switch, [1%] [2%] Accuracy.
   c. Voltmeter with Selector Switch, [1%] [2%] Accuracy.
   d. MegaWatt Meter
   f. MegaVAR Meter
   g. Power Factor Meter
   h. Frequency Meter
   i. Watt-hour Meter, [2] [2.5] element
   j. Other: [ ]

I. Automatic Load Transfer Control:

1. An automatic load transfer system shall be provided for a [Main-Main (Common-Bus Primary-Selective System)] [Main-Tie-Main (Split-Bus Primary-Selective System)] arrangement. The system shall automatically control motor operated load interrupter switches to provide transfer of the medium-voltage circuit to an alternate circuit upon loss of voltage of the normal source(s). Potential transformers feeding phase balance and undervoltage relays are provided to continuously monitor all three phases on both sources.

2. The system shall consist of a Modicon programmable logic controller or a relay system, potential transformers, control power transfer contactor, control selector switches, two-, three-phase, phase-balance/undervoltage (47N/27) relays, and status indicating lights.

3. The potential transformers shall also provide 120 VAC control power for the motor operators and the logic control. Other accessories for the system include:
   a. 1- Auto/Manual selector switch with indicating lights.
   b. 1- Hold Return/Auto Return selector switch with indicating lights.
   c. 1- Closed Transition/Open Transition selector switch with indicating lights.
   d. 1- Preferred Source selector switch with indicating lights (main-main system).
   e. 2- Undervoltage test push buttons.
   f. 2- Close push buttons with indicating lights.
   g. 2- Open push buttons with indicating lights.

4. Sequence of operation:

   Select the appropriate description

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   a. Main - Main System:
      1) The normal conditions shall be with one source (designated as preferred) closed and with the other source (designate as the alternate) open but available to provide power. A transfer is initiated after a [six (6)] [_____] second time delay upon detection of a phase unbalance and/or undervoltage condition on the preferred source. The normal source switch will open within three (3)cycles after the time delay. The alternate source switch will close within twelve (12) seconds after the time delay. The re-transfer will occur after the voltage on the normal source returns and stabilizes for a [five (5)] [_____] minute time delay. The time registers are adjustable by the use of a hand-held programmer.

   b. Main - Tie - Main System:
      1) The normal condition shall be with the two Main sources closed and the Tie open. A transfer is initiated after a [six (6)] [_____] second time delay upon detection of a phase unbalance and/or undervoltage condition on either of the sources. The affected source switch will open within three (3) cycles after the time delay. The tie switch will close within twelve (12) seconds after the time delay. The re-transfer will occur after the voltage on the affected source returns and stabilizes for a [five (5)] [_____] minute time delay. The time registers are adjustable by the use of a hand held programmer.

2.05 FABRICATION

A. Construction: [Indoor.] [Outdoor, non-walk-in.] Each equipment bay shall be a separately constructed cubicle assembled to form a rigid free standing unit. Minimum sheet metal thickness shall be 11 gauge steel on all
exterior surfaces. Adjacent bays shall be securely bolted together to form an integrated rigid structure. To assist installation and maintenance of bus and cables, [the rear covers shall be removable] [provide split rear doors with a padlockable handle and three-point latching]. Each individual unit shall be braced to prevent distortion.

B. A viewing window shall be installed in a fixed panel of the enclosure to enable visual inspection of the disconnect blades from outside the enclosure.

C. All torqued bolts that are used for bus joints or for insulators and direct support of any current carrying parts shall be marked with a bead of highly visible bright orange "torque seal", that will readily show when a bolt has loosened.

D. The high voltage fuses (when required) and non-disconnect type fuse mountings, shall be accessible only through a separate door mechanically interlocked with the load interrupter switch, so the load interrupter switch is opened before the door is opened and that the switch cannot be closed when the door is open. Switchgear designs with full height doors for access to the fuses shall have a solid grounded metal barrier with a viewing window covering the area of the main cross bus and/or line side of the load interrupter switch. Screened or penetrable barriers which may allow intentional or inadvertent contact with energized parts shall not be permitted.

E. No energized parts should be within normal reach of the opened doorway. Four full-length vertical barriers of 3/16-inch thick glass-reinforced polyester, NEMA grade GPO-3, minimum, shall isolate the three phases of the load interrupter switch and fuses from each other and from the enclosure.

F. Height: [_____] inches, maximum including auxiliary support members on top and bottom.

Choose the appropriate height from the table below based on indoor or outdoor and voltage class.

<table>
<thead>
<tr>
<th>Maximum Voltage</th>
<th>Indoor Single / Multiple</th>
<th>Outdoor Single / Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.76 and 15.0 kV</td>
<td>90 in</td>
<td>97 in</td>
</tr>
<tr>
<td>25.8 and 29.0 kV</td>
<td>105/114 in</td>
<td>112/121 in</td>
</tr>
<tr>
<td>38.0 kV</td>
<td>105/120 in</td>
<td>112/127 in</td>
</tr>
</tbody>
</table>

G. Main Bus shall be [tin-plated aluminum] [silver-plated copper] [tin-plated copper], [non-insulated] [insulated] rated [600] [1200] [2000]amps, and is to be supported from the top of the enclosure on NEMA class A-20 [glass reinforced polyester] [porcelain] standoff insulators.

H. [For single bays, include a ground pad with lug.] [For multiple bay lineups, include continuous ground bus through the switchgear assembly, securely connected to the steel frame of each cubicle.]

I. Main bus and ground bus shall be drilled to allow for future extensions. Cutout areas with removable bolted on covers shall allow for future extension of the main bus. A knock-out shall be removable for the extension of the ground bus.

Use the following paragraph for outdoor applications only.

J. Outdoor units shall be designed with a sloped, drip-proof roof. The cubicles must have a door-in-door construction. The outer door shall be a bulkhead type door with three-point latching and vault type handle with provisions for padlocking. Cubicles are to be designed to allow front and rear access and shall not require the routing of line side or load side connections in front of the switch/fuse compartment.

K. The metal-enclosed switchgear shall be fully assembled, inspected and tested at the factory prior to shipment. Large line-ups shall be split to permit normal shipping and handling as well as for ease of rejoining at the job site.

2.06 FACTORY FINISHING

A. All steel parts, except galvanized (if used), shall be cleaned and a zinc-phosphate (outdoor equipment) or iron phosphate (indoor equipment) pre-treatment applied prior to paint application.

B. Paint color shall be [ANSI-61 (light gray); ANSI-49 (medium light gray)] TGIC polyester powder, applied electrostatically through air. Following paint application, parts shall be baked to produce a hard durable finish. The average thickness of the paint film shall be 2.0 mils. Paint film shall be uniform in color and free from blisters, sags, flaking and peeling.

C. Adequacy of paint finish to inhibit the buildup of rust on ferrous metal materials shall be tested and evaluated per paragraphs 5.2.8.1-7 of ANSI C37.20.3-1987. Salt spray withstand tests in accordance with paragraph 5.2.8.4 shall be performed on a periodic basis to provide conformance to this corrosion resistance standard of at least 2500 hours minimum (outdoor equipment) or 600 hours minimum (indoor equipment).

PART 3 EXECUTION
The following paragraphs in this article represent work that is to be performed by the installing contractor. If this specification is written for the switchgear manufacturer only, eliminate these sections.

3.01 EXAMINATION
A. Visually inspect switchgear for evidence of damage and verify that surfaces are ready to receive work.
B. Visually inspect to confirm that all items and accessories are in accordance with specifications and drawings.
C. Verify field measurements are as [shown on Drawings] [shown on shop drawings] [instructed by manufacturer].
D. Verify that required utilities (e.g. control voltage for heater circuits on outdoor switchgear) are available, in proper location, and ready for use.
E. Beginning of installation means installer accepts existing surface conditions.

3.02 INSTALLATION
A. Install in accordance with manufacturer's instructions, applicable requirements of the NEC and in accordance with recognized industry practices.
B. [Use jumper cables, as provided by the switchgear manufacturer, to connect the primary surge arrester.] 
C. Bending of high-voltage cables should be avoided or minimized. All necessary bends should meet at least the minimum radii specified by the cable manufacturer.

3.03 FIELD QUALITY CONTROL
A. Field inspection and testing will be performed by [the installing contractor] [a separate contractor furnished by the owner].
B. Visually inspect for physical damage.
C. Perform mechanical operator tests in accordance with manufacturer's instructions. Check blade alignment and arc interrupter operations of each load interrupter switch.
D. Check torque of all bolted connections, including cable terminations, either by observing the bead of indicating compound to confirm that it is still intact, or with a torque wrench to confirm the joint is tightened to the manufacturer's specifications.
E. Touch-up paint all chips and scratches with manufacturer-supplied paint and leave remaining paint with Owner.
F. Verify key interlock operation.
G. Perform insulation resistance test on each phase to ground and each phase to phase. Record results.
H. Perform low-frequency withstand tests according to ANSI/IEEE C37.20.3, paragraph 5.5.
I. Perform contact resistance test across each switch blade; report any contact resistance in excess of 50 micro-ohms.

END OF SECTION