**SECTION 26 13 16**

**MEDIUM-VOLTAGE FUSIBLE INTERRUPTER SWITCHGEAR**

**BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/21**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

***This specification is written for 5 kV and 15 kV free-standing units. The Engineer shall consider how the Contractor will get the proposed switchgear into an existing room. Door, corridor and stairway clearances need to be considered.***

***Items shown in square brackets [ ] are options that the Engineer shall include or not include depending on the specific project.***

**PART 1 - GENERAL**

**SCOPE**

The work under this section includes indoor metal enclosed air interrupter switchgear. Included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 References

 Submittals

 Operation and Maintenance Data

 Quality Assurance

 Delivery, Storage, and Handling

 Extra Manuals

PART 2 - PRODUCTS

 Assembly

 Air Interrupter Switches

 Accessories

 Enclosure and Fabrication

 Factory Finishing

 Medium Voltage Fuses

 Labeling

 Locks

PART 3 - EXECUTION

 Examination

 Installation

 Field Quality Control

 Construction Verification Items

 Agency Training

**RELATED WORK**

Applicable provisions of Division 1 govern work under this Section.

Section 26 05 13 – Medium-Voltage Cables

Section 26 18 23 – Medium-Voltage Surge Arresters

Section 26 08 00 - Commissioning of Electrical

Section 01 91 01 or 01 91 02 – Commissioning Process

**REFERENCES**

The metal enclosed switchgear assembly shall conform to the most recent edition of the following standards.

ANSI/IEEE C37.20.3 - Standard for Metal-Enclosed Interrupter Switchgear.

ANSI/IEEE C37.20.4 - AC Switches for use in Metal Enclosed Switchgear.

ANSI/IEEE C37.22 - Preferred Ratings and Related Capabilities for Indoor AC Medium Voltage Switches Used in Metal Enclosed Switchgear.

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

ANSI/IEEE C37.58 - Indoor AC Medium Voltage Switches for Use in Metal Enclosed Switchgear – Conformance Test Procedures.

**SUBMITTALS**

Furnish third party certified test abstracts for all air interrupter switchgear proposed for use on this project. The certified test abstracts shall contain, as a minimum, the manufacturer's current engineering sales brochure showing all equipment proposed with model numbers (if available), and a summary of test procedures (described below) and resultant values actually recorded during the tests. The test procedure and resultant values summary shall contain model numbers (if available) similar to those listed in the current engineering sales brochure.

The following tests shall be performed on assemblies similar to those proposed for this project. Assemblies shall be complete with enclosure and all internal components such as switch, fuses (where required), ground pads, ground rods, metal and insulating barriers, etc.

1. Short-time current testing, to include rated momentary and short-time withstand tests as defined in ANSI/IEEE C37.20.3 and C37.20.4.
2. Rated continuous current and temperature rise testing as defined in ANSI/IEEE C37.20.3 and C37.20.4.
3. Dielectric testing to include impulse withstand and 60 Hz tests as defined in ANSI/IEEE C37.20.3
4. Load current interrupting testing as defined in ANSI/IEEE C37.20.4 and C37.22.
5. Fault closing tests within the enclosure: three phase testing on the switch and single phase testing on the fuses as defined in ANSI/IEEE C37.20.4.
6. Finish testing as defined in ANSI/IEEE C37.20.3. Samples must be prepared by the equipment manufacturer, not by the coating vendor, using production painting equipment with production paint applied on production substrates identical to that used for this project's equipment.

Submit the following shop drawings.

1. Outline dimensions, enclosure construction, shipping splits, lifting and supporting points.
2. Conduit and cable entrance locations.
3. Electrical single line diagram.
4. Key interlock flow diagram (if applicable).
5. Equipment electrical ratings.
6. Certification of ratings of the integrated metal-enclosed switchgear assembly consisting of the basic switch and fuse (where required) components in combination with the enclosure.
7. Product data for components and accessories.
8. Manufacturer's installation instructions.
9. Fuse curves for proposed fuses (if applicable).

# OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

* 1. Fuse replacement instructions
	2. Equipment adjustment instructions
	3. Lubrication instructions

**QUALITY ASSURANCE**

Enclosure Manufacturer: Company specializing in medium voltage interrupter switch enclosures with five years documented experience.

Switch Manufacturer: Company specializing in medium voltage interrupter switch components with five years documented experience.

Fuse Manufacturer: Company specializing in medium voltage fuses and fuse components with five years documented experience.

The manufacturer/assembler of the overall switchgear assembly shall be completely and solely responsible for the performance of the basic components as well as the complete integrated assembly as rated.

**DELIVERY, STORAGE, AND HANDLING**

Store and protect products.

Accept switchgear on site and inspect for damage.

Protect switchgear from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within enclosure in accordance with manufacturer's instructions.

**EXTRA MATERIALS**

Provide one 15kV hot stick, 6’ length with prong type switch stick head, designed for pulling fuses.

Provide one set of spare fuses for each set installed. Place these spare fuses in the metal pocket inside the front door of each fused switch assembly.

**PART 2 - PRODUCTS**

**ASSEMBLY**

Each metal enclosed air interrupter switchgear unit shall consist of an indoor enclosure containing air interrupter switch, power fuses (where indicated on the drawings), and the necessary accessory components, all completely factory-assembled and operationally checked.

The switchgear shall be a floor mounted, self-supporting unit.

The complete assembly shall meet the performance requirements and be constructed in accordance with applicable provisions of the most recent edition of ANSI/IEEE C37.20.3, ANSI/IEEE C37.20.4, ANSI/IEEE C37.22, ANSI/IEEE C37.57, ANSI/IEEE C37.58, all requirements of these specifications, and the fuse (where required) and switch component manufacturer’s requirements. Provide adequate electrical clearances and adequate space per above standards for fuse handling.

This integrated switchgear assembly -- interrupter switch, power fuses (where required), and enclosure -- shall safely withstand the effects of closing, carrying and interrupting all available currents up to the assigned maximum short-circuit rating.

The ratings of the switchgear assembly shall be the same as the ratings listed below for the air interrupter switches and fuses (where required).

**AIR INTERRUPTER SWITCHES**

Two position (open-closed) load interrupter switches as shown on the drawings.

Nominal Voltage: [5] [15] kV, three phase, 60 Hz.

Actual System Operating Voltage: [4.16] [12.47] [13.8] kV, three phase, 60 Hz.

Maximum Design Voltage: [4.76] [15.0] kV.

Basic Impulse Level: [60] [95] kV.

Main Bus Ampacity: [600] [\_\_\_\_] amperes, continuous.

Short Circuit Rating: 25,000 symmetrical amperes at rated nominal voltage.

Fault Close Rating: 40,000 rms asymmetrical amperes.

The interrupter switch with power fuses (where required) shall have the capability established by test to perform switching duties which include interrupting load current, magnetizing current, and cable-charging current.

Switches shall be external-handle operated. A quick-make, quick-break mechanism, not defeatable under normal operation, shall make operation of the switch blades independent of the speed of the manual operating handle or power operator. The handle shall have a linkage with the blades such that the handle positively indicates the blade position in the two extreme positions (open or closed).

Insulator standoffs shall be constructed of cycloaliphatic epoxy, porcelain, or glass reinforced polyester.

**ACCESSORIES**

[Provide one MOV type surge arrester for each phase and mount in cubicle in such a manner that the connecting leads (phase and ground) are as short as possible. Preferably, the arrester should be mounted immediately adjacent to or on the ground bus and a short lead (12" or less) should run from the arrester to the switch line side termination pads. See specification section 26 18 23 for specifications for surge arresters.]

Incoming Cable Terminations: Two hole pads drilled to NEMA and ANSI/IEEE standards. Provisions shall be made for using bolted pad adapters for four holes if more than two cables are being terminated on the pads.

Operating Handle: Provide a permanently mounted operating handle, lockable in both positions. Interlock assembly and fuse compartment door, if furnished, to prevent opening the doors with switch in CLOSED position and to prevent closing the switch when the doors are open.

***The following paragraph shall only be used if this switch is installed in an outdoor or unconditioned environment.***

Space Heaters: For [120] [ ] volt external source, sized by switchgear manufacturer. All lower voltage wiring (120 or 208 volts) shall be isolated from the main switch compartment with metal barriers.

 ***Add the following requirement if the switchgear is to be used on a looped system with an existing key interlock scheme. Identify the switches to be key interlocked on the Drawings.***

[Switchgear shall be equipped with key interlocks capable of preventing the paralleling of the source interrupter switches as shown on the drawings. The key interlocks shall be used in the operation of the distribution system to require that one switch is open in a typical two source distribution loop. The interlock keying must match and be fully interchangeable with the existing key interlock scheme on the existing distribution loop. Provide a key in each key cylinder.]

**ENCLOSURE AND FABRICATION**

Construction: Each bay shall be structurally independent. Side and rear sheets shall be welded to the frame or bolted such that the sheets cannot be loosened or removed from the exterior of the assembly.

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

Width: [\_\_\_\_\_] inches, maximum including space required for handle operation and access to interlocks.

Material: Enclosure shall be of 11-gauge steel sheet meeting the requirements of ANSI/IEEE C37.20.3. Doors shall be of same material and of bulkhead type construction.

If switch enclosure is not large enough to permit cable terminations to be completely enclosed within the enclosure, provide galvanized sheet metal extensions on the switch top and/or sides as necessary to accommodate terminations. Cable bending radii shall, as a minimum, be per NEC requirements. There shall be no sharp points or edges within the extension box.

Front Access Only: Access to the enclosure shall be from the front only, allowing placement of the metal-enclosed switchgear assembly tight against a wall. Switchgear requiring removal of rear or side panels to access connections or components is not acceptable.

Phase Barriers: Insulating glass reinforced polyester phase barriers (1/8” minimum) shall be provided between switch blade phases, between the side phase blades and the wall of the enclosure, and between fuses and fuse mountings.

Doors: Provide the following:

1. Locking: Door handles and hinged panels shall have provisions for padlocking.
2. Interlocking: Doors providing access to interrupter switches and/or to power fuses shall be mechanically interlocked to guard against opening the doors if the interrupter switch is closed, and to guard against closing the interrupter switch if the door is open.
3. Hinges: Doors shall have a minimum of three concealed hinges or piano style hinges.
4. Latches: Doors shall be provided with sturdy, high-strength latches. Door holders shall hold the door open at least 90° from the closed position.
5. Window: An inspection window, gasket mounted, shall be provided on all doors accessing interrupter switches to enable the operator to visually determine the position of the switch blades.

Louvers: Louvers shall be provided at top and bottom on the front of each bay. The louvers shall have appropriate screen protection to prevent the ingress of insects, rodents and other foreign objects.

Insulator standoffs: Constructed of cycloaliphatic epoxy, porcelain, or glass reinforced polyester.

Main Bus: Copper with silver-plated connections.

Ground Bus and Stirrups: Copper with silver-plated connections. Include continuous copper ground bus through full length of switchgear assembly, securely connected to frame of each cubicle with appropriate bolts and washers. Provide “towel bar” type grounding stirrups inside the front access door and near each load, line, and fuse terminal.

**FACTORY FINISHING**

Clean surfaces before applying paint. All surfaces shall be given a phosphatizing bath.

An iron-oxide, zinc-chromate, epoxy or powder anti-corrosion primer shall be applied to all non-stainless steel structural surfaces, supporting surfaces and enclosure surfaces including those surfaces that may become inaccessible.

Apply finish coat of high-bake semi-gloss enamel, polyester powder, acrylic or acrylic urethane.

At the completion of the finishing process, the complete finish shall be maintained at an average thickness of 2 mils.

The finish color shall be manufacturer’s standard light gray, ANSI No. 49, No. 61, or similar.

***The consultant shall delete the following paragraphs on medium voltage fuses if only non-fused switchgear units are to be used.***

**MEDIUM VOLTAGE FUSES**

Fuse Rating: Size as scheduled on drawings.

Voltage: [4.16] [12.47] [13.8] kV.

Interrupting Rating: 25,000 amperes RMS, symmetrical for X/R=15.

***The following paragraph is written for standard fusing. If current limiting fuses are needed, delete this paragraph and insert one written specifically for that purpose.***

Fuses: Expulsion type with fusible element and boric acid extinguishing medium, capable of safely detecting and interrupting all faults up to the short-circuit interrupting rating of the switchgear assembly. All arcing accompanying fuse operation shall be contained within the fuse, and arc products and gases generated during fuse operation shall be vented through exhaust-control chambers to eliminate discharge of ionized gases. The coordination for this project is based on standard speed fuse characteristics. See drawings for exact fuse sizes and speeds.

Fuse Holders: Disconnect style with easily accessible pull-ring, hook stick operable. Non-disconnect style holders are not acceptable.

Fuse Holder Latch: Pull-ring operable, stainless steel to provide positive, secure engagement of holder.

Lower End Fitting: Hinged lower fitting providing self guiding action for fuse unit during opening and closing.

Mounting contacts: Constructed such that each contact consists of separate side by side strips of copper to improve terminal contact.

Insulator standoffs: Constructed of cycloaliphatic epoxy, porcelain, or glass reinforced polyester.

Furnish one spare set of three fuses for each cubicle. These fuses shall be stored in a metal spare fuse holder on the inside of door to each fuse compartment in the cubicle.

**LABELING**

Warning Signs shall be provided as follows:

1. All external doors shall be provided with "Danger - High Voltage - Keep Out" signs.
2. The inside of each door shall be provided with a "Danger - High Voltage - Keep Out - Qualified Persons Only" sign(s).
3. The inside of each door providing access to a medium voltage switch shall be provided with a sign indicating that "Warning - Switch Blades May Be Energized in Any Position."
4. The inside of each door providing access to medium voltage fuses shall be provided with a sign indicating that "Warning - Power Fuses May Be Energized in Any Switch Position."

Nameplates, Ratings Labels, and Connection Diagrams:

Each lineup of switchgear shall have the following information engraved on an identification plate(s) mounted on the outside at one location on the front:

1. A nameplate indicating the manufacturer's name, catalog number, and model number.
2. A ratings label indicating the following: voltage ratings; main bus continuous ratings; short-circuit ratings (amperes, rms symmetrical and MVA three-phase symmetrical at rated nominal voltage); and interrupter switch ratings including duty-cycle fault-closing capability and amperes, short-time, rms (momentary, asymmetrical and one-second, symmetrical)
3. A one-line or three-line connection diagram showing interrupter switches, fuses (where required), and bus.
4. Each section shall have an identification nameplate identifying cubicle number, load served, voltage rating, current rating, and fuse size.

**LOCKS**

Provide padlocks on all switchgear when installed. Padlocks shall match user agency's present padlock type and be keyed per user agency's requirements.

Provide user agency with two keys for each padlock.

All units shall be furnished with enough padlocks to completely lock each unit.

**PART 3 - EXECUTION**

**EXAMINATION**

Visually inspect switchgear for evidence of damage and verify that surfaces are ready to receive work.

Visually inspect to confirm all items and accessories are in accordance with specifications and drawings.

Verify field measurements and clearances are as shown on Drawings.

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

Beginning of installation means installer accepts existing surface conditions.

**INSTALLATION**

Install in accordance with manufacturer's instructions, applicable requirements of NEC, and in accordance with recognized industry practices.

[Use 15 kV jumper cable to connect primary surge arresters. Jumper cable and shall not pass closer than 2" to any grounded metal surface and shall be less than 18". See specification section 26 05 13 for 15 kV jumper cable specifications.]

Floor mounted switches shall rest on a 3.5" high concrete pad.

**FIELD QUALITY CONTROL**

The following field inspection and testing will be performed by the Contractor. Additional electrical testing will be performed by a separate contractor furnished by the DFD.

Visually inspect for physical damage.

Perform mechanical operator tests in accordance with manufacturer's instructions. Check blade alignment and arc interrupter operations.

Check torque of all bolted connections, including cable terminations.

Touch-up paint all chips and scratches with switchgear manufacturer-supplied paint and leave remaining paint (one pint minimum) with user agency.

**CONSTRUCTION VERIFICATION**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

**AGENCY TRAINING**

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION