

## SECTION [16 13 23.14][16341]

### MEDIUM VOLTAGE METAL-ENCLOSED SWITCHGEAR – GIS/SI

#### Square D™ CBGS-0™ Gas Insulated Switchgear with Solid Insulated Busbar by Schneider Electric

Schneider Electric Editor's Note:

This guide specification is written in accordance with the Construction Specifications Institute (CSI) Master Format. This section must be carefully reviewed and edited by the architect or the engineer to meet the requirements of the project. Coordinate this section with other specification sections within the Contract Documents and Drawings.

To properly use / edit this document, show formatting and hidden text by selecting ¶ on the menu or by typing (Ctrl+\*) simultaneously. Except for these introductory and closing paragraphs, green hidden text will not print. Text in red is optional. Red text in [brackets] denotes multiple options where one or more should be chosen. All red text should be edited and changed to black for final project conformation. In addition, these introductory paragraphs should be deleted or changed to hidden text. Additional guidance and specifications can be found at

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required including, but not limited to, manufacturing, fabrication, erection, and installation for medium voltage metal-enclosed gas-insulated switchgear (also identified as MV GIS SWGR, GIS SWGR, SWGR, MV CB) as required for the complete performance of the work, and as shown on the Drawings and as herein specified.
- B. Section Includes: The work specified in this Section includes, but shall not be limited to, the following:
  - 1. Medium voltage (38 kV and below) gas insulated switchgear with SF6 [or vacuum] circuit breakers.
- C. Related Sections: Related sections include, but shall not be limited to, the following:
  - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  - 2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
  - 3. The following information is typically depicted on the Drawings: bus configuration, bus ratings, [interrupting ratings,] circuit breaker ratings, circuit breaker protective relaying, elevation and footprint, etc. Where not shown on or able to be derived from the Drawings, the minimum requirements specified herein shall be provided.
  - 4. Refer to specification Section 26 09 17 Protective Relays and Controllers for additional requirements.
  - 5. Refer to specification Section 26 27 13.13 Power and Energy Meters for additional requirements.
  - 6. Refer to specification Section 26 27 13.16 Power Quality Meters for additional requirements.
  - 7. Refer to specification Section 26 11 13 Medium Voltage Unit Substations for additional requirements
  - 8. Refer to specification Section 13 34 23.11 Fabricated Electrical Houses for additional requirements
  - 9. Refer to specification Section 26 09 13 Electrical Power Management Systems for additional requirements

## 1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
1. ASTM International (ASTM):
    - a. ASTM B117, "Standard Practice for Operating Salt Spray (Fog) Apparatus."
    - b. ASTM D1654, "Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments."
  2. Canadian Standards Association (CSA):
    - a. CSA C22.1, "Canadian Electrical Code, Part I, Safety Standard for Electrical Installations."
    - b. CSA C22.2 No. 14, "Industrial Control Equipment."
    - c. CSA C22.2 No. 31-10, "Switchgear Assemblies."
    - d. CSA C22.2 No. 58, "High-Voltage Isolating Switches."
    - e. CAN/CSA C60044-1, "Instrument Transformers - Part 1: Current Transformers."
    - f. CAN/CSA C60044-2, "Instrument Transformers - Part 2: Inductive Voltage Transformers."
    - g. CSA TIL No. D-25, "Technical Information Letter for Pressurized Gas Insulated Switchgear (GIS)."
  3. European Standards (EN):
    - a. EN 50181, "Plug-In Type Bushings above 1 kV Up to 52 kV and from 250 A to 2,50 kA for Equipment Other Than Liquid Filled Transformers."
  4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. ANSI/IEEE C37.010, "Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis."
    - b. ANSI/IEEE C37.016, "Standard for AC High-Voltage Circuit Switchers Rated 15.5 kV through 245 kV."
    - c. ANSI/IEEE C37.04, "Standard Rating Structure for AC High-Voltage Circuit Breakers."
    - d. ANSI/IEEE C37.06, "AC High-Voltage Circuit Breakers on a Symmetrical Current Basis- Preferred Ratings and Related Required Capabilities."
    - e. ANSI/IEEE C37.09, "Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Basis."
    - f. ANSI/IEEE C37.20.3, "Metal-Enclosed Interrupter Switchgear."
    - g. ANSI/IEEE C37.20.4, "Indoor AC Switches (1 kV to 38 kV) for Use in Metal-Enclosed Switchgear."
    - h. ANSI/IEEE C37.54, "Indoor AC High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear - Conformance Test Procedures."
    - i. ANSI/IEEE C37.57, "Switchgear - Metal-Enclosed Interrupter Switchgear Assemblies - Conformance Testing."
    - j. ANSI/IEEE C37.58, "Switchgear - Indoor AC Medium-Voltage Switches for Use in Metal-Enclosed Switchgear - Conformance Test Procedures."
    - k. ANSI/IEEE C57.13, "IEEE Standard Requirements for Instrument Transformers."
  5. International Electrotechnical Commission (IEC):
    - a. IEC 60044-1, "Instrument Transformers - Part 1: Current Transformers."
    - b. IEC 60044-2, "Instrument Transformers - Part 2: Inductive Voltage Transformers."
    - c. IEC 60529, "Degrees of Protection Provided by Enclosures (IP Code)."
    - d. IEC 62271-1, "High Voltage Switchgear and Controlgear - Part 1: Common Specifications."
    - e. IEC 62271-102, "High Voltage Switchgear and Controlgear - Part 102: Alternating Current Disconnectors and Earthing Switches."

- f. IEC 62271-100, "High-Voltage Switchgear and Control Gear - Part 100: Alternating Current Circuit-Breakers."
- g. IEC 62271-200, "High-Voltage Switchgear and Control Gear - Part 200: Alternating Current Metal-Enclosed Switchgear and Control Gear for Rated Voltages Above 1 kV and up to and Including 52 kV."
- 6. International Organization for Standardization (ISO):
  - a. ISO 9001, "Quality Management Systems - Requirements"
- 7. International Code Council (ICC):
  - a. ICC IBC, "International Building Code."
- 8. National Fire Protection Association (NFPA):
  - a. NFPA 70, "National Electrical Code," (NEC)
  - b. NEMA SG4—Alternating Current High Voltage Circuit Breakers
  - c. NEMA SG5—Power Switchgear Assemblies

### 1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
  - 1. MV: Medium Voltage
  - 2. GIS: Gas Insulated Switchgear
  - 3. SF6: Sulfur Hexafluoride

### 1.4 SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section [01 33 00][01300] Submittals and Section [26 00 10][16010] Electrical, in addition to those specified herein.
  - 1. Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.
  - 2. Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.
  - 3. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.
    - a. Manufacturer's catalog data indicating model numbers, equipment specifications and construction features including all furnished options, and accessories
    - b. Certification of UL conformity
  - 4. Shop Drawings: Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data. Submit shop drawings indicating outline dimensions, enclosure construction, shipping splits, lifting and supporting points, electrical single line diagram, and equipment electrical ratings.
  - 5. Wiring Diagrams: Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.
- B. Operation & Maintenance (O&M) manuals shall be provided in accordance with the minimum requirements specified in Section [01 78 23][1780] Operation and Maintenance Data, Section [26 00 10][16010] Electrical Requirements and additional requirements specified herein.

1. Manufacturer, supplier, support, and repair center specific contact information.
2. Manufacturer's standard operation and maintenance data assembled for each size and type of equipment furnished.
3. All construction, installation, schematic, and wiring diagrams updated to an as-installed and commissioned state. [All submittal information updated to an as-installed and commissioned state.
4. All configured settings/parameters for adjustable components updated to an as-installed and commissioned stated if different from the factory default. Electronic copies of configuration files shall be provided, on media acceptable to the Owner (e.g. CD, USB stick, etc.), where these configurations can be saved as an electronic file for future upload into replaced or repaired components.
5. List of furnished and recommended spare parts.
6. Statement of standard Warranty. [Statement of extended warranty options and costs.]
7. O&M manuals shall be submitted prior to arrival of equipment on site.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.
  1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
  2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.
- B. Installer Qualifications: Installer shall be a firm that shall have a minimum of [10] years of successful installation experience with projects utilizing equipment similar in type and scope to that required for this Project [and shall be approved by the manufacturer's representative].
- C. All work performed and all materials used shall be in accordance with the [National Electrical Code], [Canadian Electrical Code] and with applicable local regulations and ordinances. Equipment assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.
- C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

## 1.7 WARRANTY

- A. General: Refer to [Section 01 77 00 - Closeout Procedures] [Section 01770 - Closeout Procedures].

- B. The manufacturer shall warrant products against defects in material and workmanship for [12 months from the date of commissioning or 18 months from the date of shipment – whichever comes first.][24 months from the date of commissioning or 36 months from the date of shipment, whichever comes first, provided that the manufacturer performs functional testing, commissioning and first parameter adjusting of equipment.] During the warranty period the manufacturer shall repair or replace defective products. This warranty shall be in addition to any provided by the Contractor. The warranty shall exclude normal wear and tear under normal usage and any damage caused by abuse, modification, or improper maintenance by entities other than the manufacturer or its approved representative.
- C. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

## 1.8 SPECIAL TOOLS AND SPARE PARTS [- NOT USED]

- A. The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:
  - 1. Contact information for the closest parts stocking location to the Owner.
  - 2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
  - 3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.
- B. Spare parts shall be provided for each type and size of unit installed. At a minimum, the following shall be provided:
  - 1. Provide the minimum spare parts recommended by the manufacturer.
  - 2. Provide [1] set of each type of power and control fuse installed within equipment
- C. Any manufacturer specific special tool, not normally found in an electrician's toolbox, required to remove and install recommended or furnished spare parts shall be furnished. At a minimum the following shall be provided:
  - 1. If available from manufacture[ and required to configure equipment], provide PC-based configuration software tool and a minimum of [one] communication interface cable for each type of cable required to connect a PC-based computer to the devices specified herein for configuration and programming.
  - 2. Electronic configuration files, in a media format acceptable by the Owner (e.g. CD, USB stick, etc.), updated to an as-installed and commissioned state.
- D. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

Select one of the following for manufacturers. Basis-of-Design Product: Subject to compliance with requirements, provide Square D CBGS-0 gas insulated switchgear, by Schneider Electric.

- B. Acceptable Products: MV GIS SWGR specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for

compliance with requirements. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:

1. Square D CBGS-0 MV GIS SWGR, by Schneider Electric
2. [2<sup>nd</sup> manufacturer and model]
3. [3<sup>rd</sup> manufacturer and model]

## 2.2 GENERAL REQUIREMENTS

- A. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.
1. Without limiting the generality of other requirements of this Section, all work specified herein shall conform to or exceed the applicable requirements of the following standards; provided, that wherever the provisions of said publications are in conflict with the requirements specified herein, the more stringent requirements shall apply:
    - a. ANSI/IEEE C37.20.3.
    - b. ANSI/IEEE C37.010, ANSI/IEEE C37.04, ANSI/IEEE C37.06, ANSI/IEEE C37.09, ANSI/IEEE C37.20.4, and ANSI/IEEE C37.016.
    - c. ANSI/IEEE C37.54, ANSI/IEEE C37.57, ANSI/IEEE C37.58, and ANSI/IEEE C57.13.
    - d. NEC and CSA C22.1.
    - e. CSA C22.2 No. 14, CSA C22.2 No. 31-10, CSA C22.2 No. 58, CAN/CSA C60044-1, and CAN/CSA C60044-2.
    - f. CSA TIL No. D-25.
    - g. IEC 60044-1, IEC 60044-2, IEC 60529, IEC 62271-1, IEC 62271-102, IEC 62271-100, and IEC 62271-200.
    - h. ISO 9001.
    - i. ICC IBC.
  2. Gear shall be UL listed
- B. The gas insulated switchgear shall consist of an enclosed indoor, single bus design containing circuit breakers and the necessary accessory components, factory-assembled (except for necessary shipping splits), and operationally checked. The assembly shall be a self-supporting and floor-mounted on a level concrete pad. The integrated switchgear assembly shall withstand the effects of closing, carrying and interrupting currents up to the assigned maximum short circuit rating.
1. Refer to specification Section 13 34 23.11 Fabricated Electrical Houses for requirements of an outdoor structure.
- C. The switchgear shall be three-phase encapsulated with stainless steel housing. Bus bars shall be single phase solid insulated, screened, and grounded, outside the SF6 compartment throughout the entire switchgear.
- D. Gas compartments shall be designed as hermetically closed, sealed pressure systems. Each compartment shall be pre- filled with the SF6 gas at the rated minimum operating pressure, tested and sealed at the factory. No desiccant or other moisture absorbents in any part of the switchgear shall be installed at the site.
- E. The following information is typically depicted on the Drawings: bus configuration, bus ratings, [interrupting ratings,] circuit breaker ratings, circuit breaker protective relaying, elevation and footprint, etc. Where not shown on or able to be derived from the Drawings, the minimum requirements specified herein shall be provided.

- F. Performance Requirements - The parts and components of the MV metal-enclosed switchgear shall be rated as follows, unless otherwise specified on drawings:
  1. System voltage shall be [\_\_\_\_] kV nominal, three-phase [grounded][ungrounded], 60 hertz.
  2. Maximum design voltage shall be [4.76][15.0][27.0][38.0] kV.
  3. Impulse withstand (basic impulse level) shall be [60][95][125][150] kV.
  4. Rated peak withstand current shall be [65][82] kA.
  5. Rated short-time withstand current shall be [25][31.5] kA.
  6. Power frequency withstand shall be [19][36][60][70] kV, 1 minute test.
  7. Main bus ampacity shall be [600][1200][2000] amperes, continuous.
  8. Momentary current ratings shall be equal to the circuit breaker close and latch rating.
- G. Operations, service procedures, and cable connections shall be performed from the front side of the switchgear.
- H. The switchgear shall be equipped with shielded Solid Insulated Single Busbar System.
- I. In the case of a section needing replacement, a single section shall be detached and removed without moving the adjacent sections and without requiring gas handling on-site.
- J. Gas compartments shall be equipped with a gas pressure monitoring system. It shall provide two limit values (pre warning and basic warning) and a visual indicator located on the front of the section shall display the status of each compartment. Auxiliary contacts shall be provided for remote indication of the warning levels. The device shall be self-monitoring.
- K. To reduce risk of leakage and avoid gas handling, the pressure monitoring system shall employ a gas pressure gauge outfitted with auxiliary contacts to monitor gas pressure inside each tank.
- L. Circuit breaker compartment shall be segregated from cubicle to cubicle by means of gas tight barriers. Each gas-filled compartment shall be monitored independently of the others.
- M. Each gas compartment shall be provided with pressure relief device to limit the pressure in the event of an internal fault. The pressure relief device shall be designed such that discharges resulting for internal faults shall be directed away from locations where personnel may be present.
- N. The check of voltage presence shall be done with an electronic and integrated voltage detecting system.
  1. The indication shall be tapped from a capacitive voltage divider in the cable connection compartment.
  2. The maintenance free voltage detection system shall work without any external energy and shall monitor its connected test circuits continuously.
  3. For phase comparison, suitable connections shall be provided, which shall have to be covered during general use.

## 2.3 COMPONENTS

- A. Stationary Structure:
  1. The switchgear shall consist of sections, including, but not limited to, breaker compartments and auxiliary compartments assembled to form a rigid self-supporting completely enclosed structure providing steel barriers between sections.
  2. Sheet steel used shall be minimum 11 gauge. Cell width shall be 23.6 inches (600 mm) to 47.2 inches (1200 mm). Cell depth shall be 55.1 inches (1400 mm) as the base offering. Provisions shall be made so that switch gear lineups shall be able to be extended on either end without gas works.

3. The sections shall be divided by metal barriers into the following separate compartments:
    - a. Circuit breaker(s), instrument, main bus, auxiliary device, and cable. Each feeder section shall have one circuit breaker compartment.
  4. Assemblies shall have a design lifetime of at least 30 years.
  5. The design leakage rate of the equipment shall not exceed 0.1 percent per year. Topping of gas shall not be required for the lifetime of the equipment (minimum 30 years).
  6. Operator shall be protected against direct contact with live parts. Supervision and operation of the switchgear shall be possible with front doors closed.
- B. Circuit Breaker Compartment: The circuit breaker compartment shall be designed to use the Schneider Electric line of [SF6][vacuum] circuit breakers. The circuit breakers shall be fixed mounted in a sealed for life SF6 gas compartment.
- C. Cable Compartment/Ground Bus:
1. Cable connections shall be made using fully insulated plug-on cable terminations according to EN 50181, Type C by Euromold, Nexans, Tyco, etc.
  2. A continuous horizontal copper ground bus rated a minimum of 300 amperes shall be provided at the bottom of the assembly extending through this compartment for the full length of the switchgear.
  3. The cable compartment shall be able to accept standard customer requirements for cable terminations. Cable supports shall be provided to avoid undue strain on the cable termination. Cable entry shall be from the bottom of the switchgear. All terminations shall be accessible from the front of the switchgear. Space shall be allowed for the mounting of lightning arrestors.
  4. Provision for cable testing in front of the switchgear without disconnection of the cable shall be included.
  5. Inside the cable compartment, adequate provisions shall be provided for grounding the screen and/or armoring of each cable independently.
  6. It shall be possible to equip the cable termination with grounding stud for direct visual grounding.
  7. The number of cables, size, and type for each section shall be shown on the Drawings **or provided as appendix [XX] to this Section** and with complete cable datasheet.
- D. Main Bus Compartment:
1. The main bus shall be single phase solid insulated, screened, and grounded, outside the SF6 compartment throughout the whole lineup.
  2. For section replacement and extension, the connection links shall be easily removable without moving the adjacent section and shall not require any gas handling on-site.
- E. Three-Position Switch:
1. The circuit breaker compartment shall contain the circuit breaker and three-position switch. The three-position switch shall be branch circuit on-off and prepared for ground.
  2. Setting of the three-position disconnect shall be as follows:
    - a. On: The connection between the bus bar and the circuit breaker shall be closed.
    - b. Off: The connection between the bus bar and circuit breaker shall be open.
    - c. Grounded: The contacts shall be linked with the grounding contact.
  3. The three-position switch shall be equipped with auxiliary contacts as required for interlocking and remote indication.
  4. **Provisions for padlocks on the mechanical pushbutton of the three-position switch shall be supplied.**



5. The isolation and ground switch shall be rated for a minimum of 1000 mechanical operations.
6. The switch shall be externally operated with provisions for locking in all three positions.
7. The three-position switch contacts shall be visible via a plug-in camera system to allow an operator to visually confirm all three positions. The camera view shall show all phase contacts of the switch in the same view.

F. Circuit Breakers:

1. The circuit breakers shall be rated [\_\_\_\_\_] nominal volts, [4760][8250][15,000][24,500][34,500] maximum volts, 60 hertz, with a continuous current rating of [600][1200][2000] amperes and a maximum symmetrical interrupting rating of [25][31.5] kA system. The circuit breaker shall be fixed mounted with one [SF6][vacuum] interrupter per phase inside an inaccessible circuit breaker compartment. All three [SF6][vacuum] interrupters shall be actuated together via one shaft from the circuit breaker mechanism.
2. The circuit breaker shall have a minimum life of 10,000 open-close mechanical operations at nominal current and 100 operations at short circuit breaking current.
3. The circuit breaker shall be operated by means of a stored energy mechanism which shall be normally charged by a universal motor but shall also be able to be charged by the manual handle supplied for manual emergency closing or testing. The closing speed of the moving contacts shall be independent of both the control voltage and the operator.
  - a. Maximum symmetrical kA interrupting ratings shall be based on Table 1 of ANSI/IEEE C37.06.
4. The SF6 circuit breaker should be equipped with an SF6 pressure switch with two alarms to signal any drop in pressure. The function of these alarms should be as follows:
  - a. 1st alarm indicates a low pressure inside the breaker. It is only an indication.
  - b. 2nd alarm indicates a very low pressure. When this level is reached, there are two options: the circuit breaker trips and locks or the breaker locks in close position.
5. Interrupter design shall limit the chopping current to below 5 amperes to eliminate the need for surge protection against switching transients. Chopping current shall be measured, noted, and referenced for engineering purposes.
6. The operating mechanism for the circuit breaker shall be located in a separate compartment behind the operator interface section allowing access from the front of the switchgear while the primary equipment is in service.
7. The operating mechanism and moving parts associated shall be serviceable from the front of the section.
8. An interlocking system shall be provided to prevent access to the cable compartment while the circuit breaker is in the on position. In addition, the operating crank shall only be able to be inserted/removed when the defined end positions have been reached. The circuit breaker shall not be able to be actuated with the crank inserted for the isolation or grounding procedure.
9. There shall be no maintenance required to the live parts of the breaker during the lifetime of the section.
10. The circuit breaker control voltage shall be [48][110][125] volts DC, 110/120 volts AC. Provide one capacitor trip unit for each circuit breaker when AC control power is required.

G. Interlocks:

1. To ensure maximum safety for operating personnel, the switchgear shall have complete mechanical interlocking system. The system shall ensure by internal interlocks, that no incorrect action shall be able to be initiated to the switching devices due to an operator error.
2. It shall not be possible to ground the entire bus bar unless all three position switches are in the open stage. It shall not be possible to close any of the three-position switches when the complete bus bar assembly is grounded.

3. Interlocks shall be provided to prevent grounding with any incoming feeder in the service position; back feeding via cable transformer feeders and/or voltage transformers.
4. If the three-position switch is motorized an additional cylinder lock shall be installed to release either manual or electrical actuation of the mechanism.
5. Direct switching from grounded to closed position shall not be possible.
6. Actuating cranks shall not be removable when the disconnecting and/or grounding switches are between the on or off positions.
7. Simultaneous operation of switching elements shall not be possible.
8. A manual mode shall be available in the event of auxiliary supply failure.
9. The insertion of manual levels and cranks shall automatically disconnect the auxiliary voltage for mechanism motors.
10. The circuit breaker shall not be operable if the three-position disconnecting/grounding switch is in an intermediate position.

H. Instrument Transformers:

1. Each cable compartment shall have the provision for front accessible mounting current transformers (ANSI standard relay accuracy). The current transformer assembly shall be insulated for the full voltage rating of the switchgear. The current transformers wiring shall be Type SIS #12 AWG. Relaying and metering accuracy shall conform to ANSI standards.
2. Two types of transformers will be accepted. Both types must be manufactured according to the relevant standard.
  - a. Ring type current transformers: Ring type, place in the cable compartment or around the busbar; Not primary connected
  - b. Low power ring type current transformers: Ring type, placed in the cable compartment; not primary connected; Burden of 0.5 VA. (Low power according to actual state electronic relays). Secondary current of 1 or 5A.
3. Current transformers shall be bus bar and/or cable compartment mounted.
4. Zero sequence current transformers shall be of ANSI relay class, window type construction.
5. Voltage transformers shall be mounted with primary current-limiting fuses and shall have ratio as indicated. The transformers shall have mechanical rating equal to the momentary rating of the circuit breakers and shall have metering accuracy per ANSI standards.
6. Voltage transformers shall be bus bar and/or cable compartment mounted.
7. Voltage transformers shall be provided with an internal two-position disconnecting device operable from the front of the switchgear.

I. Control Wiring:

1. The switchgear shall be wired with Type SIS #14 AWG, except where larger size wire is specified. The switchgear shall be provided with terminal blocks for outgoing control connections. Wire markers shall be provided for each end of all control wires.

## 2.4 CONSTRUCTION

- A. Each equipment bay shall be a separately constructed cubicle assembled to form a rigid freestanding unit. Minimum sheet metal thickness shall be 11 gage steel on exterior surfaces. Adjacent bays shall be securely bolted together to form an integrated rigid structure. The rear covers shall be removable to assist installation and maintenance of bus and cables. Each individual unit shall be braced to prevent distortion.

- B. The MV GIS 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.
- C. The switchgear shall be arc resistant IAC (Internal Arc Classification) for accessibility degree A, Front Lateral and Rear (AFLR), 31.5kA, 1s, in accordance with IEC 62271-200 standard. Accessibility degree A stands for an installation in an enclosed electrical operating area and only accessible to authorized staff. Successful test evidence shall be enclosed with the offer.
- D. Arc containment device housing shall be designed to contain the arcing within the device and vent gases through ducted plenums located on the back of the switchgear.
- E. The exhaust and chimney assembly shall exit the switchgear from the top.
- F. In the case of an internal arc, rapid return to service of the adjacent intact sections is to be proven. A single section shall be detached and removed without moving the adjacent sections and without requiring gas handling on-site.

## 2.5 FINISHES

- A. Factory Finishing:
  1. Ferrous steel components of the switchboards shall be protected with zinc phosphate, unless made of stainless steel.
  2. Paint color shall be RAL 9002. Paint film shall be uniform in color and free from blisters, sags, flaking, and peeling.
  3. Adequacy of paint finish to inhibit the buildup of rust on ferrous metal materials shall be tested and evaluated per Paragraphs 6.2.8.1-7 of ANSI/IEEE C37.20.3. Salt spray withstand tests in accordance with ASTM D1654 and ASTM B117 shall be performed on a periodic basis to provide conformance with the corrosion resistance standard of at least 600 hours minimum (indoor equipment).

## 2.6 PROTECTIVE RELAYS

- A. Provide a protective relay for each circuit breaker as specified in Section 26 09 17 Protective Relays and Controllers and as indicated on Drawings. Protective relays shall meet the minimum requirements for the circuit breaker application (main, feeder, busbar, capacitor, transformer, generator, etc.) with the protection types (ANSI/IEEE C37.2 device numbers) and protection levels (basic, standard, advanced) specified or shown.

## 2.7 METERING

- A. Provide a power meter for each circuit breaker application as follows:
  1. MV Mains: The metering device used to monitor the medium voltage mains for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall be an Advanced Power Quality Meter as specified in Section 26 27 13.16 Power Quality Meters.
  2. MV Feeders: The metering device used to monitor the medium voltage feeders for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall be a Power Quality Meter as specified in Section 26 27 13.16 Power Quality Meters.
  3. Utility Revenue: The revenue grade metering device used to monitor incoming utility medium voltage mains for grid revenue, substation automation, network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall be a Utility Revenue Power Quality Meter as specified in Section 26 27 13.16 Power Quality Meters.

4. Transfer Switches: The metering device used to monitor transfer switches for purposes of automated generator test documentation such as Emergency Power Supply System (EPSS) Test Automation, shall be a Power Quality Meter as specified in Section 26 27 13.16 Power Quality Meters.
5. Generators: The metering device used to monitor generators for purposes of automated generator test documentation[, Emergency Power Supply System (EPSS) Test Automation] shall be an Advanced Power Quality Meter as specified in Section 26 27 13.16 Power Quality Meters.

## 2.8 MARKINGS AND LABELING

- A. All identification and warning labels and nameplates exterior to the switchgear shall be resistant to weather, UV, and their intended installation environment.
- B. Equipment shall be provided with an engraved nameplate identifying the project specific equipment tag and service description.
- C. Warning labels and nameplates shall be present at access locations to advise personnel of possible hazards. The equipment shall be marked in accordance with UL, NFPA 70 NEC, NFPA 70E, and other applicable standards.

## 2.9 ELECTRICAL POWER MANAGEMENT SYSTEM [-NOT USED]

- A. The equipment specified herein shall provide the necessary communications connectivity and functionality of an Electrical Power Management System (EPMS). This shall include, but not be limited, to the following:
  1. Communications connectivity using the specified Ethernet network and protocols of the EPMS and related EPMS connected devices and equipment necessary to provide functionality. Devices may be connected through a communications gateway as shown or specified; otherwise Ethernet and protocol connectivity shall be provided within the equipment. Equipment sections with multiple connected devices and assemblies of bolted adjacent bays shall include an internal inter-wired communications network for a singular connection to the EPMS network for power monitoring, equipment status and alarms.
  2. Compliance with Cyber security requirements.
  3. Remote EPMS application functionality for equipment configuration [and operational control]; electrical power monitoring; power quality monitoring, compliance and correction; and alarm monitoring with event log.
  4. Refer to the Electrical Power Management System specification section for additional requirements.
- B. Native software compatibility shall be fully factory-tested, and shall include the following characteristics:
  1. Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data. Data displayed shall include the following:
  2. Pre-mapping of registers to standard measurement names without the need for additional configuration or internal device registers.
  3. Automatic collection and logging of device data by EPMS software without additional configuration. Historical data logged shall include the following.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of specifications Section [26 00 10][16010], Section [26 08 00][16080] and Drawings.
- B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
  - 1. Verify that required utilities (i.e., control voltage for heater circuits on outdoor switchgear) are available, in proper location, and ready for use.
- D. **Pre-Installation Conference:** Prior to commencing the installation, an onsite pre-installation conference shall review the material selections, installation procedures, and coordination with other trades. Attendees shall include, but shall not be limited to, the Contractor, the Installer, manufacturer's representatives, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Engineer
- A. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
- B. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- C. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

### 3.2 FACTORY ACCEPTANCE TESTING [- NOT USED]

### 3.3 FIELD QUALITY CONTROL [- NOT USED]

- A. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory-trained manufacturer's field service representative. This manufacturer's field service technician shall provide all material, equipment, labor and technical supervision to perform inspection, testing and adjustments to ensure equipment is installed, adjusted, and tested in accordance with the manufacturer's recommendations and is ready for operation. The manufacturer's field service technician shall replace damaged or malfunctioning equipment and report to the Engineer any discrepancies or issues with the installation.
- B. The manufacturer's representative shall, upon satisfactory completion of inspection and testing, attach a label to all serviced devices indicating the date serviced and testing company responsible.

### 3.4 INSTALLATION [- NOT USED]

- A. Install cables, as provided by the switchgear manufacturer, to connect the primary surge arresters.
- B. Bending of high voltage cables shall be avoided or minimized. Necessary bends shall meet at least the minimum radii specified by the cable manufacturer.
- C. Perform low frequency withstand (Hi-Pot) tests according to ANSI/IEEE C37.20.3, Paragraph 9.2.

### 3.5 FIELD TESTING AND COMMISSIONING [- NOT USED]

#### A. Operational Readiness Testing

1. The Contractor shall inspect and test furnished equipment and associated systems for conformance to the contract documents, including equipment manufacture's recommendations, and readiness for operation. The test shall include the following as a minimum:
  - a. Visually inspect for physical damage and proper installation
  - b. Perform tests in accordance with manufacturer's instructions
  - c. Perform tests to ensure compliance with Contract Documents
  - d. Perform tests that equipment is ready for operation
  - e. Touch-up paint all chips and scratches with manufacturer-supplied paint and transfer remaining paint to Owner
2. Contractor shall submit an operational readiness test report documenting all test results, including all assumptions, conditions, allowances and corrections made during the test. **The report shall provide a listing of all modifications and adjustments made onsite to include any settings / parameters not identified as factory defaults within the equipment's O&M documentation.** The test report shall include a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.

#### B. Functional Demonstration Testing

1. **Prior to scheduling functional demonstration testing the Contractor shall submit a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.**
2. **The Contractor shall completely demonstrate the functionality and performance of the equipment and associated systems in the presence of Owner and Engineer, observing and documenting complete compliance with the Contract Documents.**
3. **The Contractor shall submit a written report documenting successful completion of functional demonstrating testing including all assumptions, conditions, allowances and corrections made during the test.**

### 3.6 TRAINING [- NOT USED]

- #### A. O&M Training: Onsite training specific to the equipment furnished shall be provided to the Owner's staff by a factory trained manufacturer's representative. Training duration shall be sufficiently adequate to cover the operation and maintenance of the equipment and shall consist of not less than [1][2 repeated] session(s) with [4] hours of onsite classroom and hands-on instruction for a minimum of [4] attendees per session.

1. **The instructor shall provide sufficient time and detail in each session to cover the following as a minimum:**
  - a. **Theory of operation**
  - b. **Major components of equipment**
  - c. **Operation of equipment**
  - d. **Configurations of equipment**
  - e. **Maintenance, troubleshooting and repair**

- f. Replacement of component level parts
2. [The submitted O&M manuals shall be used for training.][Manuals and documentation shall be provided to each participant for training.]

**END OF SECTION [26 13 23.14][16341]**

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