

## University of Houston Master Specification

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### SECTION 26 1313 – MEDIUM VOLTAGE SWITCHGEAR

Maintain Section format, including the UH master spec designation and version date in the center columns of the header and footer. Complete the header and footer with Project information.

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the terms "Architect" and "Engineer." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
  - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
  - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

##### 1.2 DESCRIPTION OF WORK

- A. Work Included: Provide 5/15 kV switchgear work as shown, scheduled, indicated, and as specified. [Switchgear and relaying shall be submitted to the Power Company for approval.]
- B. Types: The types of switchgear required for the Project include, but are not limited to, 5/15 kV metal enclosed power distribution switchgear.

##### 1.3 STANDARDS

- A. Products shall be designed, manufactured, tested, and installed in compliance with the following standards:
  - 1. ANSI C12 Code for Electricity Metering.
  - 2. ANSI C57.13 Requirements for Instrument Transformers.
  - 3. ANSI C37.90a Surge Withstand Capability Test.
  - 4. ANSI 37.20.2 Metal Clad Switchgear Assemblies.
  - 5. ANSI C37.20.7 Testing Switchgear Rated up to 52kV for Internal Arcing Faults.
  - 6. ANSI C37.54 Conformance Test Procedures of A.C. High Voltage Circuit Breakers.
  - 7. ANSI C37.55 Conformance Test Procedures of Metal-Clad Switchgear Assemblies.
  - 8. NFPA-70 Medium Voltage Switchgear.
  - 9. [UL1670 High Voltage AC Breakers and Metal Clad Switchgear].

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### 1.4 QUALITY ASSURANCE

- A. Manufacturers: Provide products complying with these Specifications and produced by one of the following:
  - 1. ABB.
  - 2. Square D Company.
  - 3. Eaton.
  - 4. Powell Electric
- B. NEMA Compliance: Comply with applicable National Electrical Manufacturers' Association (NEMA) Standards.
- C. Interrupting Ratings: Short circuit analysis and coordination study specified in Section 26 0573 "Power Systems Studies" shall be completed and submitted with switchgear submittal to confirm interrupting rating of submitted equipment is adequate for the point of application in the electrical distribution.

#### **[VERIFY IF AVAILABLE]**

- D. **[UL Labels: Provide switchgear that has been UL-labeled for service entrance.]**

### 1.5 SUBMITTALS

- A. Shop Drawing submittals shall include, but not be limited to, the following:
  - 1. Manufacturer's product data of metal enclosed switchgear and all related components.
  - 2. Dimensioned Drawings of metal enclosed switchgear showing accurately scaled basic units including, but not necessarily limited to, auxiliary compartments, unit components and combination units.
  - 3. Schematics and wiring diagrams for metering and controls.
  - 4. Furnish, upon request, manufacturer's certification of rating of the basic breaker, switch and fusing components and the integrated metal-enclosed interrupter switchgear assembly.
  - 5. Short circuit analysis and coordination study specified in Section 26 0573 "Power Systems Studies" shall be completed and submitted with switchgear submittal to confirm interrupting rating of submitted equipment is adequate for the point of application in the electrical distribution.
  - 6. Additional information as specified in Section 26 0001 "Electrical General Provisions."

### 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver switchgear in factory-fabricated water resistant wrapping.
- B. Maintain factory-wrapping or provide an additional heavy canvas or plastic cover.
- C. Store switchgear in a clean and dry space and protected from weather.
- D. Handle switchgear carefully to avoid damage to material components, enclosure and finish.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND COMPONENTS

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- A. General: Except as otherwise indicated, provide switchgear manufacturer's standard materials and components as indicated by its published product information, designed and constructed as recommended by the manufacturer, and as required for a complete installation.
- B. Unless otherwise specified, all new 5/15 kV installations shall be Arc resistant meeting the requirements of IEEE C37.20.7.

### 2.2 5/15 KV METAL-CLAD SWITCHGEAR

- A. Unless otherwise specified, all new 5/15 kV switchgear installations shall be Arc resistant meeting the requirements of IEEE C37.20.7. 5/15 kV Arc resistant switchgear shall be a minimum Type 2B. Medium voltage switchgear shall be indoor metal clad and electrically operated with horizontal draw-out vacuum circuit breakers. Outdoor installations require approval by Owner. Unless approved otherwise by Owner, all of the following shall be required:
  - 1. Remote racking and operating of the circuit shall be used to reduce the personal exposure to Arc flash events.
  - 2. Modification of existing switchgear shall review and incorporate Arc mitigating technology; however, Arc mitigating shall not be used in place of Arc resistant switchgear for new installations unless approved by Owner.
  - 3. Switchgear ampacities shall be based on natural cooling only.
  - 4. For Arc resistant switchgear, plenums are required to be installed, regardless if they may be installed without a plenum, and the plenum building/room exit shall be directed away from personnel egress doors.
  - 5. The plenum building access shall have a minimum of 3 foot circumferential safe area around the exterior plenum exhausts. No equipment shall be installed in these areas, and hazard signs shall be installed below the exterior plenum exhaust areas.
- B. Indicating Instruments: Provide indicating instruments as specified, scheduled, or as shown on the Drawings.
  - 1. Electronic Metering Device: Provide electronic metering devices to meter the main **[bus [device] [and branch devices]** as scheduled or shown on the Drawings. Device shall be Shark 250 V4 with digital output display or approved equal.
    - a. The electronic metering device shall have a six digit LED readout that allows local display of the following electrical parameters:
      - 1) Voltmeter, phase to phase and phase to neutral.
      - 2) Current, per phase RMS and 3 phase average.
      - 3) Demand current, per phase.
      - 4) Power factor, per phase and 3 phase total.
      - 5) Real power, 3 phase total.
      - 6) Reactive power, 3 phase total.
      - 7) Apparent power, 3 phase total.
      - 8) Energy (MWH).
      - 9) Reactive Energy (MVARH).
      - 10) Frequency.

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- 11) Average demand real power.
- b. The electronic metering device shall have the following additional features and characteristics.
  - 1) Built-in communications capability which will allow multipoint communication to a remote PC via an RS 485/RS 422 communications port and ethernet TCP/IP communication capability.
  - 2) Adjustable demand interval (5-60 minutes).
  - 3) Nonvolatile memory for storing all historical data.
  - 4) **[A "waveform capture" function to store voltage and current waveforms in memory for analysis via the communications port.]**
- c. Setup of the electronic metering device shall be accomplished from the front of the device. It shall not be necessary to open the front of the enclosure to reach rear-mounted dip-switches. Setup parameters shall include CT ratio, PT ratio, system type (3 wire or 4 wire) and demand interval.
- d. All setup and reset functions shall be key switch or password protected to prevent unauthorized or accidental change of value.
- e. The accuracy of the electronic metering device in percent of full scale for various readouts shall be as follows:
  - 1) Current and voltage measurements  $\pm 0.1\%$ .
  - 2) Power and energy  $\pm 0.15\%$ .
  - 3) Frequency  $\pm 0.0075\%$ .
  - 4) Power factor  $\pm 0.2\%$ .
  - 5) Data update time 1S.
- f. **[External contact monitoring shall be provided for [four] [eight] digital contact inputs. Contacts shall be factory-wired to monitor main and tie breaker position. The remaining contacts shall be spare for future use.]**
- g. **[The electronic metering device shall be monitored by the Building Control and Automation System (BCAS) provided under Division 25 via the unit RS 485 port. Monitoring shall include analog kWh usage, analog demand, digital position of main and tie breakers, and digital alarms for [\_\_\_\_\_To be selected\_\_\_\_\_]. The BCAS PC interface shall also be able to access the metering device waveform capture and analysis functions.]**
- C. Lightning Arrestors: Provide distribution class lightning arrestors mounted in the switchgear enclosure and connected to the incoming service leads.
- D. Interlocks: Provide **[kirk-key] [electrical]** interlock on circuit breakers as indicated. **[Provide one key for locks.] [Use auxiliary contacts located on circuit breakers for interlock.]**
- E. Control Wiring: All voltage signals shall be a minimum #12 Type SIS and all CT wiring shall be a minimum of #10 Type SIS. #14 Type SIS shall only be used if required by the protective relay manufacturer that does not allow #12 Type SIS. All CT wiring shall have ring lugs.
- F. Space Heaters: Provide space heaters in all metal-clad switchgear to prevent condensation. In addition, all space heaters shall have thermostat control with a manual push button to verify operation of the space heater. The space heater circuit shall have a digital ammeter installed.

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- G. All switchgear lineups shall have an incoming line PT and bus PT installed unless otherwise approved.
- H. Switchgear control voltage shall be **[48VDC][Other]**.
- I. Power to all electronic relays shall be 120VAC from an emergency power source unless otherwise noted.
- J. Power bus shall be silver plated.
- K. Remote control of circuit breaker: A handheld control station to allow the breaker to be opened and closed shall be provided with a cord length at a minimum of 25 feet. Remote racking device shall be provided. Breaker lift truck and any other specialty tools/lift equipment shall be provided with every installation.
- L. A mimic bus on the exterior of the switchgear shall be provided unless otherwise specified.

### 2.3 FACTORY TESTING

- A. General: The switchgear including mechanical functionality of all doors/hinged panels/etc., overcurrent devices, circuit breakers, PTs, CTs, switchgear phasing, relays, meters, controls, insulation integrity, all other testing as required by the standards and manufacturer's standard, and interlocks shall be factory-tested to certify proper operation.

### 2.4 BREAKER AND PROTECTIVE RELAYING

- A. Switchgear installation shall be Main Tie Tie Main for all installations unless otherwise noted.
- B. Main Breaker Section: The main breaker ampacity shall be sized at a minimum the same as the switchgear ampacity rating.
- C. Feeder breakers ampacity rating can be sized lower than the switchgear ampacity rating using standard ampacity sizes.
- D. General Purpose Feeder (GPF): The metal clad switchgear for control of a feeder circuit shall include, but not be limited to:
  - 1. One **[4160 volt] [7200 volt] [12,470 volt] [13,800 volt] [vacuum] [or] [SF6]** power circuit breaker, **[1200] [2000]** amperes continuous **[60] [95]** kV BIL, **[25] [40] [50] [63] kA** interrupting capacity, 3 pole, with electrically-operated, stored-energy mechanism.
  - 2. One set of insulated bus, 3 phase, 3 wire, **[1200] [2000] [3000]** amperes.
  - 3. One multifunction microprocessor based relay and at a minimum SEL 7 series or equivalent shall be provided **[or equal approved by the Owner, Engineer [and Power Company]]**. All microprocessor relaying shall have at minimum TCP/IP communication capability.
  - 4. Three **[single] [multi-ratio]** secondary current transformers with 5A secondary current. CT class shall be sized and selected to avoid saturation. All CT accuracy class calculations shall be provided to the Architect/Engineer and Owner for review and approval. All CT's shall be wired to CT shorting blocks.
  - 5. One breaker control switch.
  - 6. Switchgear indicating lights shall have at a minimum of three LED indicating lights: Red "Breaker Closed", Green "Breaker Open", and Amber "Breaker Trip". All other indicating lights that are required shall be reviewed and approved by the Owner.
  - 7. One breaker closing 2 pole pull-out type fuse block.

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8. One breaker tripping 2 pole pull-out type fuse block.
9. One provision for power conductor terminations as shown on the Drawings.
10. Phase current transformers (CT) shall be provided with an established accuracy class of C10 or greater. The Architect/Engineer shall provide CT sizing and accuracy class calculations to the Owner for approval.
11. Test switches equivalent to ABB FT-1 shall be provided for each microprocessor relay and installed in proximity to the relay. The test switches shall be labeled. At a minimum, the trip contact and CTs and PTs shall be wired to the test switch to the relay.
12. One breaker disagreement indicating lamp.
13. All switchgear breaker shall have ground fault protection provided utilizing a zero sequence 50:5 BYZ C10 CT or better accuracy class.
14. Three surge arresters.
15. **[One voltage/current circuit monitor.]**
16. **[One ammeter transfer switch.]**
17. **[One ammeter.]**
18. **[One electronic metering device.]**
19. All circuit breakers shall a trip coil monitoring device installation with a blue light installed that verifies that the circuit breaker trip coil is healthy.
20. All switchgear lineups shall have a minimum of one SEL 2407 GPS clock or equivalent with externally mounted GPS antenna with the GPS signal routed to each microprocessor relay.
21. If automatic residual auto transfer scheme is specified, the system shall be provided using microprocessor based logic relay system equivalent to SEL residual automatic transfer scheme using Mirror bits communication.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF SWITCHGEAR

- A. General: Install switchgear where shown, in accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the switchgear complies with the requirements and serves the intended purposes.
- B. Standards: Comply with the requirements of NEMA and NEC standards and applicable portions of NECA's "Standard of Installation", for installation of switchgear.
- C. Tightness: Torque bus connections and tighten mechanical fasteners. All torque connections shall be performed using a calibrated torque wrench and every bolt shall be paint panned. All torqued connections that cannot be field verified shall have photos and a signature sheet stating that all of the torque connections have been completed.
- D. Fuses: Install fuses, of the ratings shown, in each circuit breaker.
- E. Concrete Pads: Install switchgear on a reinforced concrete housekeeping pad. The housekeeping pad shall extend 3 inches beyond the housing of the switchgear unless shown otherwise. Furnish the exact position of any block outs, dimensions, and location of the housekeeping pads in a timely manner so as to prevent delay of the concrete work. Pad shall

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be configured for use of a portable breaker lifting device. Refer to Section 26 0501 "Basic Materials and Methods" for additional requirements.

- F. Adjustment: Adjust operating mechanisms for free mechanical movement.
- G. The switchgear ground bus shall be connected at a minimum of two locations to the ground grid with a minimum conductor sized per NEC Article 250. The switchgear frame shall be bonded to the ground grid with a minimum sized bonding per NEC Article 250.

### 3.2 TESTING

- A. Pre energization Checks: Prior to energization, check switchgear for continuity of circuits; confirm that insulation resistance testing has been performed with test results above the NEMA acceptable values and approved by Engineer; and verify that all protective devices, including but not limited to protective relay, CTs, PTs, etc., have been function tested and electrically tested with approved protective settings per Engineer approval. All other items shall be submitted to Engineer for review and approval with the complete list of testing sent to Owner for approval.
- B. Switchgear Insulation Resistance Test: Each switchgear line up bus shall have its insulation resistance tested after the installation is complete except for line and load side connections. Tests shall be made using a DC insulation resistance tester capable of 10 kV DC. Control circuit wiring shall be insulation resistance tested at a maximum of 500V DC or equivalent test instrument at a voltage of not less than 1000 volts dc. Resistance shall be measured from phase to-phase and from phase to-ground.
- C. Overcurrent and Ground Fault Protection System Test: Following completion of the construction work and prior to final acceptance testing, the overcurrent and ground fault protection systems shall be field-tested with a test-set checking the calibration of each relay, including verifying the current transformer and potential transformers are wired correctly to each relay (e.g., relay testing shall have test voltage/current sent through the CT/PT into the relay.) Final relay settings shall be provided by the Engineer and the relays shall be tested using the final elements while testing from CT to relay. Engineer shall supply the relay coordination for all relay settings for review and approval to Owner. Submit the results from the electrical engineering analysis software indicating proper coordination with upstream and downstream devices. Contractor shall submit two copies to the power company for its use. Contractor shall notify the Engineer and Owner one week in advance of the test so that the Engineer and Owner may be present. Coordinate final overcurrent and time setting with the power company and Engineer. Any relay settings modification required shall be reviewed and approved by the Engineer with submittal to the Owner.
- D. Submittals: Contractor shall furnish all instruments and personnel required for tests. Submit four copies of certified test results to Engineer for review. Test reports shall include switchgear tested, date and time of test, relative humidity, temperature, and weather conditions.
- E. Thermographic Testing: Refer to Section 26 0125 "Electrical Testing" for thermographic testing.
- F. DC high potential test shall be performed per NETA acceptance test standard (ATS).
- G. All switchgear equipment and components shall be tested including the mechanical and electrical functioning of every breaker and system.
- H. A minimum of one physical and one electronic redlined, field verified set of switchgear drawings shall be provided to the Engineer and Owner.

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**3.3 IDENTIFICATION**

- A. General: Refer to Section 26 0553 "Identification for Electrical Systems" for nameplates, identification and warning signs.

END OF SECTION 26 1313

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