

SECTION 26 11 16 - UNIT SUBSTATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 26 00 01, "Electrical General Provisions", govern this Section.

1.2 DESCRIPTION OF WORK:

- A. -Work Included: Provide unit substation work as shown, scheduled, indicated, and as specified.

[select type]

- B. Types: The types of unit substations required for the project include, but are not limited to **[single-ended]** **[double-ended]** **[front]** **[front and rear]** accessible unit substations.

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 C39.1 Requirements for Electrical Analog Indicating Instruments.
 3. ANSI C57.13 Requirements for Instrument Transformers.
 4. NEMA KS 1 Enclosed Switches.
 5. NEMA KS 2 Bolted Pressure Contact Switches.
 6. NEMA PB 2.1 Instructions for Safe Handling, Installation, Operation and Maintenance of Dead-front Switchboards Rated 600 Volts or Less.
 7. ANSI C57.12.00 General Requirements for Distribution, Power and Regulating Transformers.
 8. ANSI C57.12.90 Test Code for Distribution, Power, and Regulating Transformers.
 9. NEMA TR1 Transformers, Regulators, and Reactors.

1.4 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
 1. Cutler-Hammer, Inc.
 2. General Electric Company.
 3. Square D Company.
 4. Siemens.
- B. UL Labels: Provide unit substation secondary **[switchgear]** **[switchboards]** which **[has]** **[have]** been UL-labeled for service entrance.
- C. NEMA Compliance: Comply with National Electrical Manufacturers' Association (NEMA) Standard SG-5 and ANSI C37.20.

1.5 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
 1. Unit substation cutsheets with all bus, transformer, and switch and overcurrent device ratings, capacities, characteristics, features, and associated accessories clearly indicated.
 2. Submit dimensioned drawings of switchboard showing accurately scaled basic units including, but not limited to, auxiliary compartments and components.
 3. Submit schematics and wiring diagrams for metering and controls.

4. Additional information as required in Section 26 00 01.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. Deliver unit substation in factory-fabricated water-resistant wrapping and mounted on shipping skids.
- B. Handle in accordance with NEMA PB2.1 to avoid damage to material components, enclosure, and finish. Unit substations shall be provided with adequate lifting means.
- C. Store in a clean, dry space and protected from the weather. Maintain factory-wrapping or provide an additional heavy canvas or plastic cover.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS:

- A. General: Except as otherwise indicated, provide **[packaged]** unit substation manufacturer's standard materials and components as indicated by his published product information, designed and constructed as recommended by the manufacturer, and as required for a complete installation.
- B. Components: Each unit substation shall consist of an incoming section, a power transformer section **[, and a]** **[with an integral]** dead front **[switchgear]** **[switchboard]** outgoing distribution section, sized and arranged as shown.

[\[select incoming section\]](#)

2.2 INCOMING SECTION:

- A. General: Provide a factory-assembled, dead front, NEMA 1 construction, front accessible, metal enclosed incoming section with a **[single]** **[double]** **[5 kV]** **[15 kV]** **[fused]** load interrupter switch assembly.
- B. Enclosure Construction: The incoming section shall be fabricated on die-formed steel base or base assembly, consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor-mounting. The framework shall be formed code gauge steel, rigidly welded and bolted together to support all coverplates, busing, and component devices during shipment and installation.
 - 1. Switch cubicle(s) shall have a single, full length, flanged front door over the switch **[and fuse]** assembly. Provision shall be made for operating the switch and storing the removable handle without opening the full length door. A high impact type viewing window shall be provided in the door over the switch to allow full view of the switch blades.
- C. Switch Operation: A quick-make quick-break manual operating mechanism shall be provided which uses heavy-duty springs to provide the opening and closing action of the switch. The spring charging mechanism shall use rigid metal linkage. The speed of opening or closing the switch shall be independent of the operator. The interrupter switch shall have separate main make and break contacts, to provide maximum endurance for fault close and interrupting duty.
- D. Safety Interlocking: The full height door shall be hinged and interlocked with the switch shaft, such that the switch must be opened before access to the fuses is possible and the door must be closed before the switch can be closed.
- E. Insulation: All insulation supporting current-carrying parts shall be porcelain or flame retardant, nontracking glass polyester.

[\[verify ratings\]](#)
- F. Ratings: The load interrupter switch(es) shall be rated at **[5 kV]** **[15 kV]**, 600 amperes continuous and load interrupting, 40,000 amperes asymmetrical momentary and **[60 kV]** **[95 kV]** impulse withstand (BIL) rating.

[\[verify requirements\]](#)
- G. Surge Arrestors: Provide **[distribution]** **[intermediate]** **[station]** class arrestors in the incoming section and connected to the transformer primary line bus. Arrestors shall be for use on a **[4,160 volt]** **[12,470 volt]** **[13,800 volt]** **[grounded]** **[ungrounded]** system.

- H. Incoming Cables: Incoming cables shall be as specified in Section 26 05 13, "Medium Voltage Connectors and Cable", and shall have stress cone type terminators.
- I. Power Fuses: Refer to Section 26 28 12, "Medium Voltage Fuses", for power fuses.
- J. Transformer Connection: The load interrupter switch(es) shall be cable or bus connected to the transformer primary terminals by the substation manufacturer. **[Bus connecting double switches shall be rated at switch capacity for loop applications.]**
- K. **[Incoming Lugs: Provisions shall be made for loop feed lugs.]**

2.3 TRANSFORMER SECTION:

[verify transformer type/ratings]

- A. General: Provide 3-phase, 60 Hz, [ventilated] [cast resin] dry type, [80°C] [115°C] [150°C] rise, 40°C ambient, [220°C] [185°C] insulation system, [60 kV] [95 kV] primary BIL, 25 kV secondary BIL transformer sections with the kVA ratings shown on the Drawings, complete with fans and controls for increased ratings, where shown. The transformer primary shall be [4,160 volts,] [12,470 volts,] [13,800 volts,] 3 wire, with four full capacity delta connected, 2-1/2% taps, two above and two below nominal. The transformer secondary voltage shall be as noted on the Drawings, 4 wire, wye connected.
- B. High Voltage Leads: Tap leads shall be terminated at the coils and be equipped with provisions for changing taps.

[select one of the following]

- C. **[Insulation: The transformer shall be of explosion resistant, fire-resistant, air-insulated, dry type construction cooled with natural-forced air circulation through the windings. Solid insulation in the transformer shall consist of inorganic material such as porcelain, glass roving or Nomex, in combination with a sufficient quantity of high temperature binder, to provide the necessary mechanical strength for the insulation structure. Insulation shall be defined as ANSI Class H.]**

[or]

- D. **[Insulation: The transformer shall be of dry-type, cast-resin construction cooled by convection airflow over the transformer core and coil. Both primary and secondary coils shall be cast with fiberglass reinforced epoxy drawn into and completely around the winding in a vacuum chamber. Insulation material shall be compatible with the winding material. The coils shall be tested for RFI discharge to locate faulty coils early in the manufacturing process.]**
- E. Case: The transformer case shall be constructed of minimum 13 gauge steel painted ANSI No. 49 gray and shall have removable covers for access to the taps and connections, and for inspection of the core and coils.

[cast resin coils must be copper]

- F. Windings: Transformer windings shall be [copper] [aluminum].
- G. Temperature Indicator: Provide a flush-mounted dial type centigrade thermometer on the transformer case, reading core, and coil insulation temperature.
- H. Cooling Fans: Cooling fans for OA/FA operation shall be provided complete with all relays, sensors and controls required for operation, where shown.
 1. Provide solid state, temperature control system with factory pre-set, three level switching to maintain winding temperature. The system shall consist of three high accuracy thermistor sensors installed directly in the air duct of each transformer coil. Single bulb system shall not be acceptable.
 2. The sequence of operation shall be as follows:
 - a. Temperature rises to the normal, self-cooled (AA) rating, a relay shall be activated and fans shall be started.
 - b. Upon reaching next pre-set point, a second relay operates to close the circuit for an audible alarm and a red warning light.
 - c. Upon reaching the maximum temperature setting, a third relay shall be activated. This relay shall be used for a remote alarm point.

3. The fan cooling control panel shall consist of:
 - a. Digital read-out of the unit temperature and identify the phase with highest temperature when "Phase-Scan" button is pressed.
 - b. Green "Power-On" light, with an "Alarm Test" position, and amber "Fans On" light with a manual/automatic selector switch, and a red "High Temperature" light with an alarm silencing switch.
 - c. Silencing switch shall silence the alarm, but allow the red light to remain on until the temperature decreases to normal.
4. Multiple cooling fans are to be installed at the bottom of each coil, front and rear; minimum six fans for 3-phase units.
- I. Isolators: The core and coil assembly shall rest on rubber isolators to isolate normal core vibrations from the transformer case.
- J. Impedance: Transformer impedance shall be 5.75% at normal rating and frequency within a manufacturing tolerance of $\pm 7.5\%$.
- K. Testing: The following factory tests shall be performed in accordance with NEMA TR27:
 1. Resistance measurements.
 2. Ratio tests.
 3. Polarity and phase relation tests.
 4. Excitation loss.
 5. Impedance and load loss.
 6. Applied potential tests.
 7. Induced potential tests.
 8. Temperature tests shall be made on one unit only and shall be made only where there is not available a record of a temperature test on a duplicate unit. Temperature tests shall be made at both natural and forced air ratings.

2.4 [SWITCHGEAR] [SWITCHBOARD] OUTGOING DISTRIBUTION SECTION:

- A. Refer to Section [26 23 12 "Low Voltage Switchgear"] [26 24 13, "Low Voltage Switchboards"], for specifications for the outgoing distribution [switchgear] [switchboard] sections.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNIT SUBSTATIONS:

- A. General: Install unit substations where shown, in accordance with the manufacturer's written instructions and recognized industry practices to ensure that the unit substations comply with the requirements and serve 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 unit substations.
- C. Tightness: Torque bus connections and tighten mechanical fasteners.
- D. Fuses: Install fuses of the ratings shown, in each unit substation, as applicable.
- E. Concrete Pads: Install unit substations on a reinforced concrete housekeeping pad. The housekeeping pad shall extend 3" beyond the housing of the substation, unless shown otherwise. Furnish the exact position of any blockouts, dimensions, and location of the housekeeping pads in a timely manner so as to prevent delay of the concrete work. Refer to Section 26 05 01, "Electrical Basic Materials and Methods", for additional requirements.
- F. Adjustment: Adjust operating mechanisms for free mechanical movement.
- G. Finish: Touch-up scratched or marred surfaces to match original finish.

3.2 TESTING:

- A. Pre-Energization Checks: Prior to energization, check unit substations for continuity of circuits and for short circuits.

- B. Unit Substation Insulation Resistance Test: Perform bus insulation resistance testing in accordance with **[Section 26 23 12, "Low Voltage Switchgear".]** **[Section 26 24 13, "Low Voltage Switchboards".]**
- C. Ground Fault Protection System Test: Following completion of the construction work and prior to final acceptance testing, perform ground fault protection system field testing in accordance with **[Section 26 23 12, "Low Voltage Switchgear".]** **[Section 26 24 13, "Low Voltage Switchboards".]**
- D. Transformer Testing: Perform transformer testing in accordance with Section 26 22 00, "Low Voltage Transformers".
- E. 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 unit substation tested, date and time of test, relative humidity, temperature, and weather conditions.
- F. Thermographic Testing: Refer to Section 26 01 25, "Electrical Testing", for thermographic testing.

3.3 IDENTIFICATION:

- A. Refer to Section 26 05 01 for nameplates identification, and warning signs.
- B. **[Mimic Bus: Provide a mimic bus on each unit substation to show busing, connections and devices in single line form on an engraved nameplate securely attached to the front of the unit substation or shall be painted directly on the unit substation.]**

END OF SECTION 26 11 16