

**SECTION 26 11 16**  
**SECONDARY UNIT SUBSTATIONS**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

This section specifies the furnishing, installation, and connection of the secondary unit substation, complete and ready for operation.

**1.2 RELATED WORK**

- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 71, ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY: Electrical coordination study of overcurrent protection devices.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and outlet boxes.
- D. Section 26 05 13, MEDIUM-VOLTAGE CABLES: Medium voltage cables.
- E. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Low voltage cable and wiring.
- F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- G. Section 26 18 41, MEDIUM-VOLTAGE SWITCHES: Medium-voltage switches for use in secondary unit substations.
- H. Section 26 23 00, LOW-VOLTAGE SWITCHGEAR: Secondary distribution switchgear.

**1.3 QUALITY ASSURANCE**

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

**1.4 FACTORY TESTS**

- A. Substations shall be thoroughly tested at the factory to assure that there are no electrical or mechanical defects. Tests shall be conducted as per UL and ANSI Standards. Factory tests shall be certified. The following tests shall be performed:
  - 1. Medium Voltage Section: Refer to Section 26 18 41, MEDIUM-VOLTAGE SWITCHES.
  - 2. Transformer Section:
    - a. Perform insulation-resistance tests winding-to-winding and each winding-to-ground.
    - b. Perform turns-ratio tests at all tap positions.

3. Low Voltage Section: Refer to Section 26 23 00, LOW VOLTAGE SWITCHGEAR.

### **1.5 SUBMITTALS**

Submit in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS:

A. Shop Drawings:

1. Include sufficient information, clearly presented, to determine compliance with drawings and specifications.
2. Include electrical ratings, dimensions, mounting details, winding materials, required clearances, terminations, fuses (if required), safety features, weight, decibel rating, temperature rise, nominal impedance, regulation, no load and full load losses, wiring and connection diagrams, front, side and rear elevations, sectional views, coordination curves, transformer no-load and full-load losses, accessories and nameplate data.

B. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts. It shall also include installation, operating instructions, maintenance, trouble shooting and repair procedures and technical literature pertaining to all components or instruments provided.
2. Two weeks prior to final inspection, submit four copies of the final up-dated maintenance and operating manuals to the Resident Engineer.

C. Tests:

1. Submit, simultaneously with the shop drawings, certification that the following tests were performed at the factory: insulation-resistance tests, high-potential tests,

D. Certificates:

1. Two weeks prior to final inspection, submit four copies of the following to the Resident Engineer:
  - a. Certification by the Contractor that the substations have been properly installed, adjusted, and tested, including final circuit breaker settings.
  - b. Certified copies of all of the factory design and production tests, field test data sheets and reports for the substations.

### **1.6 APPLICABLE PUBLICATIONS**

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata), form a part of this specification to the

extent referenced. Publications are referenced in the text by basic designation only.

B. American Concrete Institute (ACI):

ACI 318.....Building Code Requirements for Structural  
Concrete.

C. American Society for Testing and Materials (ASTM):

D3487.....Standard Specification for Mineral Insulating  
Oil Used in Electrical Apparatus.

D. Institute of Electrical and Electronic Engineers (IEEE):

C37.121 .....American National Standard for Switchgear— Unit  
Substations— Requirements

C62.11.....Metal Oxide Surge Arresters for AC Power  
Circuits

C62.41.....Surge Voltage in Low Voltage AC Power circuits

C57.12.00.....Standard General Requirements for Liquid-  
Immersed Distribution, Power, and Regulating  
Transformers

C57.12.01.....Standard General Requirements for Dry-Type  
Distribution and Power Transformers Including  
Those with Solid Cast and/or Resin Encapsulated  
Windings

E. National Fire Protection Association (NFPA):

70.....National Electrical Code (NEC):

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Secondary unit substation shall be in accordance with ASTM, ANSI, IEEE, NEC, and as shown on the drawings.
- B. The secondary unit substation shall be a complete, grounded, continuous-duty, unitized integral assembly; metal clad, dead-front, dead-rear type; with dry transformer. Substation shall be designed for indoor service with ventilation openings. External doors shall have provisions for padlocking.
- C. Ratings shall be not less than required by the NEC and not less than shown on the drawings. Short circuit current ratings shall be not less than the maximum short circuit currents available, where the substation is being installed, as shown on the drawings.
- D. Provide substations that conform to the arrangements and details shown on the drawings and to the space designated for installation.

- E. Coordinate the components of the substations and their arrangements electrically and mechanically. Coordinate all circuit entrances into the substations, including methods of entrance and connections.
- F. Incorporate interlocking as shown on the drawings and as required for the safe operation of the substations.
- G. The substation shall be assembled and prewired by the manufacturer at the factory. Substation shall be subassembled and shipped in complete sections ready for connection at the site. Where practicable, substation shall be shipped as one unit.
- H. Substation shall be thoroughly cleaned, phosphate treated and painted at the factory with rust-inhibiting paint and baked enamel or lacquer light gray finish.

## **2.2 MEDIUM VOLTAGE SECTION**

- A. Housing shall be of indoor type.
- B. Preformed Terminations:
  - 1. May be used for cables.
  - 2. Shall conform to the requirements in Section 26 05 13, MEDIUM-VOLTAGE CABLES.
  - 3. Independently support each cable by a clamp to a structural support within 6 inches (152.4mm) of the termination to relieve any strain imposed by cable weight or movement.

## **2.3 DRY TYPE TRANSFORMERS**

- A. Shall comply with IEEE C57.12.01, and IEEE C57.12.50 for dry-type transformers rated up to 500 kVA, and IEEE C57.12.51 for dry-type transformers rated 501 kVA and larger.
- B. Provide a cast coil type transformer with primary and secondary windings individually cast in epoxy. Resin-encapsulated windings are not acceptable. Transformer[s] shall have an insulation system rated 185 degrees C, with an 80 degree C average winding temperature rise above a 40 degrees C maximum ambient.
- C. Transformer shall be rated as shown on drawings, 95 kV BIL primary and 10 kV BIL secondary.
- D. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Locate tap adjustments on the face of the medium voltage coil. Adjustments shall be accessible by removing the front panel and shall be made when the transformer is de-energized.
- E. Dry type transformer shall have the following accessories.
  - 1. Winding temperature indicator.
  - 2. Auxiliary cooling equipment and controls.

- a. Transformer shall be forced-air-cooled. Forced-air-cooling fans shall have automatic temperature control relay and winding temperature indicator with sequence contacts.

## **2.4 LOW VOLTAGE SECTION**

- A. Refer to Section 26 23 00, LOW-VOLTAGE SWITCHGEAR.

## **2.5 AUXILIARIES**

- A. Install additional components as shown on the drawings or otherwise required for the substations.
- B. Provide warning signs for the enclosures of secondary unit substations having a nominal rating exceeding 600 volts.
  - 1. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.29, such as for secondary unit substations, provide self-adhesive warning signs on the outside of the medium voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 inches by 10 inches (178mm by 255mm) with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch (50mm) high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background.
  - 2. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 inches by 10 inches (355mm by 255mm) with the legend "DANGER MEDIUM VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch (75mm) high white letters on a red and black field.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install the secondary unit substation in accordance with the NEC, as shown on the drawings, and as recommended by the manufacturer.
- B. Anchor secondary unit substation to the slab with plated 1/2 inch [12.5mm] minimum anchor bolts, or as recommended by the manufacturer.
- C. Interior Location. Mount secondary unit substation on concrete slab. Unless otherwise indicated, the slab shall be at least 4 inches [100mm] thick. The top of the concrete slab shall be approximately 4 inches [100mm] above finished floor. Edges above floor shall have 1/2 inch [12.5mm] chamfer. The slab shall be of adequate size to project at least 8 inches [200mm] beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 3 inches [75mm] above slab

surface. Concrete work shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

- D. Substation Grounding: Provide bare copper cable not smaller than No. 4/0 AWG not less than 24 inches (610mm) below grade interconnecting the indicated ground rods. Surge arrester and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with bare copper conductors, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends. Substation transformer neutral connections shall not be smaller than No. 1/0 AWG. Fence and equipment connections shall not be smaller than No. 4 AWG. Ground fence at each gate post and cornerpost and at intervals not exceeding 10 feet (3050mm). Bond each gate section to the fence post through a 1/8 inch by one inch (3mm by 25mm) flexible braided copper strap and clamps.

### 3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform tests in accordance with the manufacturer's recommendations. Include the following visual and mechanical inspections.
- B. Medium Voltage Section
  - 1. Refer to Section 26 18 41, MEDIUM-VOLTAGE SWITCHES.
- C. Transformers - (Dry-Type)
  - 1. Compare equipment nameplate information with specifications and approved shop drawings.
  - 2. Inspect physical and mechanical condition.
  - 3. Verify that control and alarm settings on temperature indicators are as specified.
  - 4. Verify that cooling fans operate correctly and that fans have correct overcurrent protection.
  - 5. Inspect all field-installed bolted electrical connections, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization under load.
  - 6. Perform specific inspections and mechanical tests as recommended by manufacturer.
  - 7. Verify that resilient mounts are free and shipping brackets have been removed.
  - 8. Verify that winding core, frame, and enclosure groundings are correct.
  - 9. Verify the presence of transformer surge arresters.
  - 10. Verify that the tap-changer is set at specified ratio.

11. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

E. Low Voltage Section

1. Refer to Section 26 23 00, LOW VOLTAGE SWITCHGEAR.

**3.3 FOLLOW-UP VERIFICATION**

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the secondary unit substations are in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device.

**3.4 INSTRUCTIONS AND FINAL INSPECTION**

- A. A complete set of operating instructions for the secondary unit substations shall be laminated or mounted under plexiglass and installed in a frame on the wall of switchgear assembly.
- B. Conduct a final inspection, in the presence of the Resident Engineer, to assure that the switchgear operates properly in all respects.
- C. Furnish the services of a factory-trained engineer for two, 4-hour training periods for instructing personnel in the maintenance and operation of the equipment, on the dates requested by the Resident Engineer.

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