SECTION 26 12 16
SECONDARY UNIT SUBSTATIONS

PART 1 GENERAL

1.1 SUMMARY
This section describes metal-clad, indoor or outdoor, secondary unit substations with integral primary fused disconnect switches, dry-type (indoor) or oil-filled (outdoor) transformers, main and feeder secondary circuit breakers and associated metering and accessories.
Refer to purchase order document for details on sizing and service.

1.2 REFERENCES
A. General: For all reference publications listed below, refer to editions currently adopted by federal, state, and local government agencies with jurisdiction over the project. For references that are not part of government codes, refer to most recent editions.
B. American National Standards Institute (ANSI) Publications:
3. C37.20 Switchgear Assemblies Including Metal-Enclosed Bus
4. C57.12.00, General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
5. C57.13, Requirements for Instrument Transformers
C. National Electrical Manufacturers Association (NEMA) Publications:
1. 201, Primary Unit Substations
2. 210, Secondary Unit Substations
3. TR 1, Transformers, Regulators, and Reactors
4. TR 27, Commercial, Institutional and Industrial Dry-Type Transformers
5. TP1, Guide for Determining Energy Efficiency for Distribution Transformers
E. Underwriters Laboratories, Inc. (UL) Publication: 467 Grounding and Bonding Equipment, Electrical
F. Related Work
1. FDG 33 71 73.33: Electricity Metering Guidelines
2. FDG 33 71 49: Medium Voltage Cable

G. Quality Assurance

1. Switchgear Tests: ANSI C37.20. Design, production, and conformance tests of switchgear shall be made. For power circuit breakers, after completion of interrupting tests at full rating there shall be no evidence of damage to any part, except for minor burning of arcing contacting tips. Breakers shall be satisfactory for immediate return to service at full rating without repairs or maintenance of any kind.

2. Transformer Tests: NEMA TR1 and TR 27

3. Routine Tests: Routine tests shall be made by the manufacturer on each transformer to ensure that design performance is maintained in production.

4. Design Tests: Design test reports will be accepted as proof of compliance with design test requirements.

1.3 SUBMITTALS

A. General: Manufacturers' data on the following items shall be submitted to the Project Manager:

1. Meters
2. Fuses
3. Circuit breakers
4. Switches
5. Enclosures

B. Shop Drawings:

1. Shop drawings of the following items shall be submitted to the Project Manager:
   a. Transformers
   b. Unit substations

2. Shop drawings for substations shall indicate, but shall not be limited to the following:
   a. Overall dimensions, front view and sectional views.
   b. Bus arrangements, including dimensions and ampere ratings of all bus bars.
   c. Type and spacing of bus supports.
   d. Maximum short circuit bracing.
   e. Circuit breaker type, interrupting rating, trip setting.
   f. Ratings and sizes of lugs, impedance taps, and fans.
   g. Elementary diagrams and wiring diagrams with terminals identified and with internal wiring for each item of equipment and interconnections between items indicated.
C. Field Tests Reports: Two (2) certified copies of reports of relay settings and dielectric tests shall be submitted to the Project Manager for approval.

1. Relay Setting and Testing: The Project Design Engineer and/or Design-Build Contractor shall furnish the recommended breaker/relay settings to provide coordinated protection for the power distribution system.

2. Breaker / relay testing shall be performed by an independent contractor with NETA certification.

3. The Contractor shall provide the Project Manager with two certified copies of the final breaker and relay calibration and setting report.

PART 2 PRODUCTS

2.1 General

A. The unit substation shall be complete, grounded, continuous duty, unitized integral assembly, metal clad, dead front, dead rear types, with dry-type (indoor) or oil-filled (outdoor) transformers.

B. 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.

C. Provide substations that conform to the arrangements and details shown on the drawings and to the space designated for installation.

D. Contractor shall 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.

E. The substation equipment shall have the capability to withstand and interrupt fault currents supplied by the primary connection.

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.

H. Contractor shall coordinate the high and low voltage sections with their associated transformers. Sections shall be fabricated by a single manufacturer.

I. Bolts, nuts and washers shall be rustproof metal, corrosion resistant (zinc chrome plated).

J. All access covers for normal inspection and maintenance shall be hinged.

K. The arc-flash rating per NFPA 70E shall be clearly labeled on all accessible sections.

L. All components shall be rated for Seismic Zone 4 earthquake forces. CBC for Zip Code 94305.
2.2 Incoming Section:
A. Incoming circuit shall be connected to transformer through a fused medium voltage air interrupter switch.
B. Provide viewing window(s) for the fused primary switch and a set of spare primary fuses.
C. Air interrupter switch shall be manually group-operated, three-pole, single-throw, fused load-interrupting device. Air interrupter switch shall have adequate interrupting and fault close ratings.
D. Conductor terminations shall be clamp-type terminals with provisions for single feed and arranged for proper conduit entry.
E. Fuses shall be current-limiting type coordinated to the transformer provided.
F. Interrupter switch shall have locking provisions.
G. Independently support each cable by a clamp to a structural support within 6 inches of the termination to relieve any strain imposed by cable weight or movement. See FDG 33 71 49 for type of primary cable used.
H. Transition section shall be included with incoming section if required for proper connection and alignment. Connections shall be adequately sized and braced to withstand specified available fault current.

2.3 Transformer Section:
A. Transformers shall be ventilated dry-type indoor or oil-filled outdoor, self-cooled, 60 hertz, 3-phase, 4160 or 12470 volts primary-connected delta to 120/208 or 277/480 volts secondary-connected wye.
B. Transformers shall be rated for operation without forced-air cooling. If forced-air cooling fans are provided, shall have automatic temperature control relay.
C. Low-voltage neutral bushings shall be provided on units having wye-connected low-voltage windings.
D. Transformer shall have corrosion-resistant diagrammatic nameplate.
E. In addition to the requirements of NEMA, transformer shall be designed according to ANSI C57.12.01.
F. Taps (de-energized operation): Taps shall be provided. Transformer shall deliver rated kVA at any tap setting. Taps shall be two each 2-1/2 percent full capacity above and two each 2-1/2 percent below rated voltage.
G. Transformer shall be equipped with NEMA standard maintenance devices.

2.4 Outgoing Section:
A. Outgoing section shall consist of low-voltage power circuit breaker or molded-case circuit breaker switchgear.
B. Main secondary breaker shall be interlocked with primary switch to prevent operation of primary switch when main secondary breaker is closed. Each steel unit forming part of switchgear structure shall be a self-contained housing having individual breaker or
instrument compartments, full-height rear compartment for buses, instrument transformers, and outgoing cable connections. The structure shall be designed so that future additions, if required, may be added. Engraved circuit designation plate shall be provided on each individual circuit breaker compartment door.

C. Phase Buses and Connections:
   1. Bus structure shall be mounted on insulated supports of high-impact, non-tracking insulating material and braced to withstand the mechanical forces exerted during short circuit conditions.
   2. Bus bars shall be high conductivity copper or aluminum with plated joints. Bus bar connections shall be made from main buses to incoming circuit breaker.
   3. Secondary circuits including heater circuits shall be wired to terminal blocks. Terminal blocks shall be readily accessible for making external connections as required. Neutral bus shall be sized one-hundred percent (100%) of full load amperes.

D. Copper ground bus shall be provided secured to each vertical structure and extending the entire length of switchgear and shall effectively ground all non-current-carrying metal, including circuit breakers, air interrupting switches, switchgear housing, etc. Ground bus shall be sized to meet the requirements of the NEC, with driven ground rods and cable connections to complete the station ground.

E. Main secondary breaker shall be insulated case type, manually or electrically operated and shall have an interrupting rating not less than the available fault level. Breaker shall be equipped with solid state trip device having long-time, short-time, instantaneous, and where required, ground fault tripping characteristics so that branch breakers will normally trip first on overload and at lower fault-current levels.

F. Secondary feeder breakers shall be insulated case or molded-case type with suitable interrupting rating. Breakers shall have a quick-make, quick-break operating mechanism and shall be equipped with ambient-compensated thermal magnetic or solid state trip device having long-time delay, instantaneous pickup, and ground fault pickup where required. Circuit breaker shall trip free of the handle, and the handle position shall indicate whether the breaker is "on", "off", or "tripped". Circuit breaker shall be mounted so that when removed, bussing will not be disturbed. An overload in one phase shall cause all three phases to trip.

G. Space shall be provided for future installation of an additional twenty percent (20%) of feeder breakers.

2.5 Metering
   A. Refer to FDG 33 71 73.33 for metering requirements.
   B. The metering compartment at the main breaker shall be equipped with hinged door and barriers from any energized 480V or 208V main bussing.
   C. Provide analog ammeters for the secondary main breaker and all feeder breakers.
   D. Main breaker status shall be connected to Customer’s SCADA system through digital input of revenue meter.
2.6 Ground Fault Protection

Ground fault protective devices consisting of current transformers, fault protection relays with time delay suitable for protecting circuit components against phase to ground faults, and a system monitor panel shall be provided for 480/277 volt systems.

A. Special care shall be used in grounding the neutral so as not to defeat the proper operation of ground fault protective devices.

B. Ground fault protection may be internal with circuit breakers.

2.7 Strip Heaters

Strip heaters, rated 240 volts but connected to 120 volts, shall be provided in each switchgear section for outdoor substations. Heaters shall be of sufficient capacity to control moisture condensation in compartments and be controlled by thermostat or humidistat located inside secondary switchgear section. Thermostats shall be industrial type, with range of 60°F to 90°F, and shall operate on temperature fall. Humidistats shall have a range of thirty percent (30%) to sixty percent (60%) relative humidity.

2.8 Nameplates

Laminated plastic nameplates shall be provided for each relay, switch, and device to identify its function, and where applicable, its position.

A. Laminated plastic shall be 1/8-inch thick plastic, black with white center core. Surface shall be matte finish. All corners shall be square.

B. Lettering shall be accurately aligned and engraved into the white core.

C. Nameplates shall be fastened with a minimum of two machine screws. Adhesive fasteners shall not be used.

2.9 Terminal Boards

Identified terminal boards with engraved plastic terminal strips shall be provided for all external wiring between components and for all internal wiring between removable assemblies. Terminal board identification shall be identical in all similar units. External wiring shall be color coded consistently for all similar terminal boards.

2.10 Paint and Finish

A. Indoor

Substation shall be thoroughly cleaned, phosphate treated and painted at the factory with rust-inhibiting paint and baked enamel or lacquer light gray finish or color specified in purchase document.

B. Outdoor

Finish the substation according to ANSI standard (C57.12.28/29) for surface preparation, primer, and paint durability. Exterior color: Kelly Moore 1245-407 acrylic low sheen “carbon” or approved equal.
PART 3 EXECUTION

3.1 INSTALLATION

A. General: Electrical installations shall conform to ANSI C2, NFPA 70, and the requirements specified herein.

B. Substation Grounding: A bare copper grounding electrode not smaller than 4/0 AWG shall be provided not less than 24 inches below grade connecting to ground rods. Grounding electrode shall be at least 25 feet long. At least two each ten (10) foot by ¾-inch ground rods shall be provided, with one in the primary switch section and one in the secondary section.

C. Space Requirements: Space shall be provided on all sides of equipment to allow proper ventilation, permit passage of personnel, and to provide clearance for equipment and maintenance.

D. Anchorage: Anchor equipment in accordance with Section 26 05 00 3.6.A.1.

3.2 FIELD QUALITY CONTROL

A. General Testing: The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition.

B. Equipment and Apparatus Tests: Unless specific factory-witnessed tests are specified, tests normally made by the manufacturer will be acceptable for all equipment and apparatus.

END OF SECTION