SECTION 16310 - SECONDARY UNIT SUBSTATION

City of San Diego, CWP Guidelines

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section shall include providing the unit substation as indicated, complete and operable.

B. The WORK requires that one manufacturer accept responsibility for furnishing the WORK as indicated but without altering or modifying the CONTRACTOR'S responsibilities under the Contract Documents.

C. The WORK additionally requires that the one manufacturer who accepts the indicated responsibilities shall manufacture the secondary unit substation transformer.

D. The WORK also includes coordination of design, assembly, testing, installation, and startup.

1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 16030 Electrical Tests
2. Section 16050 Basic Electrical Materials and Methods
3. Section 16300 Medium Voltage Distribution
4. Section 16422 Surge Protection for High Voltage Equipment

1.3 CODES

A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. National Electrical Code (NEC) NFPA 70

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	ANSI C37.20.3	Metal Enclosed Load Interrupter Switchgear
2.	ANSI Z55.1	Gray Finishes for Industrial Apparatus and Equipment
3.	ANSI C57.12.00	Power and Distribution Transformers
4.	NEMA ST20	Dry-Type Transformer for General Applications

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Shop drawings of all major components of the substation with weights.

2. Material lists and catalogue data such as voltage, continuous current, withstand interrupting KVA, ratings of components.

3. Manufacturer's installation instructions.

4. Complete list of special tools required for the operation and maintenance of the unit.

5. Certified design verification test results.

1.6 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:

1. Certified design verification and production test reports for each medium voltage load break switch, transition section, and step-down transformer.

2. Manufacturer's guarantee that the equipment satisfies the requirements of this Section.

3. List of recommended spare parts.

1.7 SERVICES OF MANUFACTURER

A. **Inspection, Startup, and Field Adjustment:** An authorized representative of the manufacturer shall visit the site for not less than [ ] days and witness the following:

1. Installation of the equipment.
2. Inspection, checking, and adjusting the equipment.
3. Startup and field-testing for proper operation.
4. Performing field adjustments to ensure that the equipment installation and operation comply with the Specifications.

B. **Instruction of OWNER'S Personnel**: The authorized service representative shall also instruct the OWNER'S personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment for not less than [ ] day.

PART 2 -- PRODUCTS

2.1 DESIGN REQUIREMENTS

A. The indicated secondary unit substation shall be suitable for [indoor] [outdoor] service. It shall be designed for continuous duty service at full load at the indicated location.

B. The phase-sequence of the assembled 3-phase buses and primary conductors shall be A, B, C starting from front-to-back, top-to-bottom or left-to-right as viewed from the front of the switchgear. The protective relays shall be mounted in the same order.

C. Secondary unit substation assembly shall consist of the following equipment:

1-medium voltage [load break switch] [vacuum breaker]

[1-revenue metering section]

1-medium voltage [transition section] [flanged throat] to couple the above [switch] [breaker] to the transformer below.

1-step down transformer

1-[low voltage terminal compartment] [LV flange] [busway flange]

[The above equipment shall be directly coupled to a low voltage switchgear section. This section shall include a main breaker and outgoing feeder breakers as indicated.]

2.2 SERVICE

A. The secondary unit substation shall be intended to operate as follows:

1. primary voltage [13.8KV] [4160V] 3 phase, 3W, 60 Hz incoming

2. transformer [13.8KV] [4160V] 480 V/277 V, [oil mineral] [silicone] [dry] [cast resin]

3. secondary (low voltage) outgoing480 V/277 V, 3 phase, 4W, solidly grounded

2.3 COMPONENTS

A. **Incoming Section:**

1. Incoming Section shall be furnished with [fused air-interrupter switch] [vacuum breaker] as indicated. [Switch shall be 2-position, 3-pole, manually gang operated having stored-energy mechanism for quick-make, quick-break operation.] [The vacuum breaker shall be as described in Section 16300.]

2. The switch shall be rated as follows:

Voltage:	[15,000] [5,000] volts
Continuous current:	[600] [200] amperes
Closing and Interrupting Current:	600 amperes
Momentary withstand:	40,000 amperes
BIL	[95] [60] kV

3. All poles shall be suitably barriered, insulated and provided with arcing chutes and arcing contacts.

4. Switch shall be key interlocked with main circuit breaker of the switchgear served.

5. Mechanical interlock shall be provided to prevent opening of the switch access door unless the switch is open and to prevent closing of the switch unless the door is closed.

6. Switch shall have ample space for terminating three-single conductor [15 kV] [5 kV] shielded cables.

7. Outdoor vertical sections shall be rated NEMA 3R and shall have a sloped weatherproof roof. All openings shall be screened to prevent the entrance of small animals and barriered to inhibit the entrance of sand, etc. Switch enclosure shall contain thermostatically controlled space heater sized to prevent moisture condensation. Heater shall operate at 115 V AC wired to the control power source in the low voltage switchgear.

8. Power fuses shall be mounted in the switch or in a separate compartment with hinged door interlocked mechanically, or by key interlock, with the switch compartment door(s) to prevent opening of the fuse compartment when either switch is closed. Power fuses shall be current limiting type coordinated with the main secondary circuit breakers and transformer's rating.

9. Lightning and surge arresters shall be provided at primary switch. Surge arresters shall be in accordance with Section 16422.

$# _____

NTS: Select one of the two transformer section subparagraphs which follow.

_____ #$

[B. **Transformer Section (Liquid):**

1. Transformer shall be of the type, voltage and rating indicated. Askarel-insulated transformers shall not be furnished. Transformers with a high fire point insulator liquid shall conform to the NEC.

2. Transformers shall conform to ANSI C57.12.00 and shall have all applicable standard accessories.

3. Transformers shall be fan cooled (OA/FA).

4. Transformer shall be [mineral oil] [silicone] [high flash point] [less flammable] [high fire point liquid] filled in accordance with the latest edition of the NEC.

5. Transformers shall be dual temperature rated (55/65 degrees C). One single pole double throw alarm contact shall be provided for each of the following, wired to a common alarm junction box:

   a. Liquid Level Alarm
   b. Temperature Alarm
   c. Pressure Relief Alarm

   Taps shall be brought to an externally operated manual tap changer for no-load operation.

6. Transformers shall have the following:

   a. Enclosure for Fan Control Equipment
   b. Low Voltage Neutral Terminal

c. Accessible solid grounded pad
d. Pressure vacuum gauge
e. Pulling eyes, jacking provisions, instruction nameplates, and lifting lugs
f. Temperature gauge

7. Transformers shall be provided with fans, controllers, temperature switch, control power transformer, inter-connecting wiring and overcurrent devices required to form a completely self-contained fan cooling package. The control power transformer may be located in the switchgear section, in which case the inter-connecting wiring to the fan cooling equipment shall be field installed.

8. The transformers shall have the following ratings:

KVA rating	As indicated
Type	OA/FA
Phase	3
Temperature rise	55/65 degrees C
Frequency	60 Hz
Primary voltage	[13.8 KV] [4160 V] Delta
Secondary voltage	480/277 V Solid Grounded Wye
Impedance	[5.75% $\pm$ 7.5%]
Taps	Four 2-1/2 percent taps, 2 above and 2 below rated primary voltage. External tap changer control for no load operation only.
BIL	HV: [60 KV] [95 KV] minimum LV: 30 KV minimum]

[B. Transformer Section (Dry):

1. Transformer shall be of the type, voltage and rating indicated. Insulation system shall be rated 220 degrees C in accordance with NEMA ST20.

2. Transformer shall conform to ANSI C57.12.00 and shall have all applicable standard accessories.

3. All transformers shall be fan cooled (AA/FA).

4. Transformer shall be provided with one single pole double throw alarm contact and a temperature indicator mounted on the unit. Taps shall be brought to terminals provided with removable access panels. Ventilation openings shall be screened and vibration isolation pads provided.

5. The unit shall be of explosion resistant, fire resistant, air insulated, dry type construction. The unit shall be cooled by the natural circulation of air through windings.

6. Transformers shall have the following:

   a. Enclosure for fan control equipment
   b. Low voltage neutral terminal
   c. Accessible solid grounded pad
   d. Pulling eyes, jacking provisions, instruction nameplates, and lifting lugs
   e. Temperature gauge

7. Transformer shall be provided with fans, controllers, temperature switch, control power transformer, inter-connecting wiring and overcurrent devices required to form a completely self-contained fan cooling package. The control power transformer may be located in the switchgear section, in which case the inter-connecting wiring to the fan cooling equipment shall be field installed.

8. The transformers shall have the following ratings:

KVA rating	As indicated
Type	AA/FA
Phase	3
Temperature rise	[80 degrees C] [115 degrees C] [150 degrees C]
Frequency	60 Hz
Primary voltage	[13.8 KV] [4160 V] Delta
Secondary voltage	480/277 V Solid Grounded Wye
Impedance	[5.75% $\pm$ 7.5%]
Taps	Four 2-1/2 percent taps, 2 above and 2 below rated high voltage. External tap changer control for no load operation only.
Sound level	Not to exceed maximum average sound level in DB as defined by NEMA TR-27.
BIL	HV: [50 KV] [20 KV] minimum LV: 10 KV minimum

C. **Metering and Transition Section:**

1. A metering section which conforms to all utility requirements shall be provided where indicated.

2. A transition section shall be provided to connect the primary terminal to the transformer section.

D. **Outgoing Section - Switchgear:** The outgoing section of the Unit Substation shall consist of low voltage switchgear. Components for outgoing Unit Substation sections and separate switchgear sections shall conform to the requirements herein.

1. Low-Voltage Main and Bus Power Circuit Breakers

   a. Breakers shall conform to ANSI and NEMA Standards.

   b. Low-voltage power circuit breakers shall be insulated case, [the five cycle oilless type], three-pole, single-throw, draw-out with frame size and trip setting as shown.

   c. Trip units shall be solid-state type providing adjustable long time, short time, instantaneous and ground fault protection.

   d. All circuit breakers shall have mechanically trip-free operating mechanisms of the stored energy type, and shall be provided with self-aligning primary and secondary disconnecting devices, trip button, position indicator, mechanically operated devices as listed hereinafter, and other specified accessories. Electrically-operated circuit breakers shall also be equipped with electrically trip-free operating mechanisms.

   e. Manually operated breakers shall be charged from the handle. Electrically operated breakers shall operate at 120 v or 240 vac.

   f. Short circuit interrupting rating of the breakers shall be not less than [30,000] [42,000] [50,000] [65,000] amperes symmetrical.

   g. Tie breakers shall be supplied [with] [without] trip units.

   h. Auxiliary switch contacts shall be adjustable to either the normally open or normally closed position.

   i. Mechanical interlocks shall be provided to prevent the removable element from being moved to or from the operating position with the circuit breaker closed and to prevent the circuit breaker being closed unless primary disconnecting devices are fully engaged or separated a safe distance.

E. **Secondary Terminal**:

1. Secondary terminal shall be provided for an interface between the outgoing busway specified herein and the secondary terminals of the transformer. Secondary terminal shall be air-insulated and shall contain [braided] [solid] bus connection to the busway adapter terminals.

F. **Busway**:

1. A busway shall be provided to connect the outdoor substation transformer to the lineup of double ended indoor switchgear. Busway sections shall bear UL label. Busway and components shall be built in accordance with the latest ANSI C37.23 and other application standards.

2. The manufacturer of the secondary unit substation transformer shall be the manufacturer of the busway.

3. The busway shall be rated for continuous operation, in any position at [1600] [2000] [2500] [3000] amperes, 480 volts, [3][4] wires with ground bus. Bus bars shall be fabricated from 100 percent conductivity bar type copper with silver plated joints. Bus

bars shall be capable of withstanding the stress of [65,000] [100,000] symmetrical amp fault for 3 cycles duration. Busway shall be non-ventilated.

4. Outdoor bus runs shall be designed to be supported from below by structural steel. The manufacturer shall provide mounting provisions and supply all necessary information to the CONTRACTOR for the design of these supporting devices.

5. Provide wall flanges, vapor barriers, expansion joints, elbow and equipment terminations. Provide all connecting hardware, splice plates, steel connections to terminal equipment. Connection to transformers shall be of flexible connectors.

G. **Finish**:

1. Substation shall be finished to manufacturer's standard except that the finish color shall be ANSI 61 and thickness of finish system shall be 3 mils, minimum.

2.4 FACTORY TESTS

A. Products shall be tested at the factory for compliance with the following requirements:

1. Medium Voltage Load Break Switch and Transition Section: Design verification tests shall be conducted on one medium voltage load break switch of rating essentially similar to that indicated. Test results shall be certified. The design testing program shall conform to ANSI C37.20.3 and shall include the following tests:

Basic impulse level.
Momentary withstand capability.
Short time withstand capability.
Fault closing.
Mechanical life tests.
Rigidity.
Bus bracing.
Venting.
Load interruption at various loads and power factors including magnetizing current of the transformer.

2. Production tests shall be conducted on each medium voltage load break switch and the transition section provided and certificates for each test shall be submitted. The production testing program shall conform to ANSI Standard C37.20.3 and shall include the following tests:

Dielectric test at power frequency for 1-minute.
Contact resistance measurement for all three phases.
A check of safety interlocks.
Visual and mechanical inspection.

3. Step-down Transformer:

a. Design verification tests shall be conducted on one step-down transformer essentially similar to that indicated. Test results shall be certified.

b. Production tests shall be conducted on each step-down transformer provided and certificates for each test shall be submitted. The production testing

program shall conform to ANSI Test Code C57.12.00 and shall include the following tests:

Sound level measurements.
Resistance measurements of all windings.
Ratio tests on all tap connections.
Polarity and phase relation tests.
No-load loss.
Exciting current measurement.
Impedance and load loss measurements.
Applied potential test.
Induced potential test.
Temperature tests at OA or AA and FA ratings. Temperature tests previously performed on a duplicate unit will be acceptable in lieu of the temperature test on the unit to be supplied.

2.5 NAMEPLATES, TOOLS, AND SPARE PARTS

A. **Tools**: The WORK includes special tools necessary for maintenance and repair; tools shall be stored in tool boxes identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. **Spare Parts**: The WORK includes the following spare parts:

3 primary fuses

Spare parts shall be identified with the equipment number by means of neat stencil on a nonconductive surface.

2.6 MANUFACTURERS

A. Products of the type indicated shall be manufactured by one of the following (or equal):

1. Fused air-interrupter switch

Westinghouse Type WL1
General Electric
S&C

2. Transformer

Square-D
Westinghouse
General Electric

3. Low voltage switchgear

Westinghouse
General Electric
Square-D

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall install the secondary unit substation in accordance with manufacturer's installation instructions and as indicated. Substation shall be energized under the guidance of the substation manufacturer's field engineer.

B. Prior to energizing, all equipment shall be cleaned, inspected for loose connections, checked for electrical and mechanical operations and phase-sequence, and all circuits made free of any shorts or ground connections following field testing.

C. The CONTRACTOR shall sample the insulating liquid and then submit the sample for water content analysis to CONSTRUCTION MANAGER prior to energization.

D. CONTRACTOR shall anchor substation in conformance with "Anchoring" criteria stated in Section 16050.

3.2 FIELD TESTING

A. Field testing shall be in accordance with Section 16030 for the individual components of the substation.

** END OF SECTION **