

# SECTION 16400 - LOW VOLTAGE ELECTRICAL SERVICE AND DISTRIBUTION

## City of San Diego, CWP Guidelines

### PART 1 - GENERAL

#### 1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing all electrical service sections, distribution switchboards, special control panels, control and terminal cabinets, control devices, circuit breakers, and all appurtenant work, complete and operable.

#### 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 16480 Motor Control

#### 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/IEEE C37.20                      Switchgear Assemblies, including Metal-Enclosed Bus
  - 2. ANSI/NEMA ICS-2                      Devices, Controllers, and Assemblies for Industrial Control
  - 3. ANSI/UL 1008                         Automatic Transfer Switches, Safety Standard for
  - 4. NEMA PB2                                Dead Front Distribution Switchboard

#### 1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300:
  - 1. Shop drawings of the service section and switchboards. After review of shop drawings of the service section by the CONSTRUCTION MANAGER, said drawings shall also be submitted to the utility company for approval prior to fabrication.
  - 2. Design test reports conducted for similar assemblies at the factory.

## 1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:
  - 1. Operating procedures.
  - 2. Maintenance procedures.
  - 3. Manufacturer's parts list, illustrations, assemblies and diagrams.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. **Materials:** All materials and equipment furnished under this Specification shall be new and shall bear the Underwriters' Laboratories label where such service is regularly available.
- B. **Equipment:** All equipment for the same purpose shall be of the same make.
- C. **Enclosure Requirements:** All outdoor equipment, fixtures, and wiring devices shall be of weatherproof construction.
- D. **Standard Products:** Materials and equipment shall be catalogue products of companies regularly engaged in the manufacture of such items, shall be the latest standard design that conforms to the specification requirements, and shall essentially duplicate material and equipment that has been in satisfactory use for several years.

### 2.2 SWITCHBOARDS

- A. Indoor construction shall be of the universal frame type using die-formed welded and bolted members. Enclosing panels shall be 14-gauge steel and shall be bolted in place. In addition, indoor construction shall conform to the following:
  - 1. Switchboard shall be totally enclosed, NEMA 1, gasketed.
  - 2. Bus bar shall be [copper] [aluminum] fully insulated. [Copper shall be silver plated at joints], [aluminum shall be tin plated on all exposed surfaces and silver plated at joints]. Bus bars shall be braced for short circuit currents of [22,000] [30,000] [42,000] [65,000] amperes minimum, or as indicated. A full length copper ground bus bar shall be provided at the bottom of the switchboard enclosure.
- B. Outdoor construction shall be as described in the previous paragraph, except that switchboard installation shall be rodent- and bird-proof. Outdoor construction shall be NEMA 3R, non-walk-in type [but sufficient enclosed aisle space shall be provided to allow draw-out circuit breakers to be withdrawn to the "test" position with the outer door closed]. An insulating compound shall be applied to the interior surface of roof panels for condensation control.
- C. Floor-standing distribution switchboards and the main service switchboard shall be catalogue products of the main circuit breaker manufacturer. Switchboards shall be shipped fully assembled and tested.

## 2.3 MAIN SERVICE SWITCHBOARD

- A. **General:** The main service switchboard shall consist of a free-standing assembly which complies with the requirements for switchboards.
- B. **Switchboard:** Switchboard shall be [front- and side-accessible] [rear- front- and side-accessible]. Switchboards shall be constructed to accommodate additional distribution sections. The switchboard shall consist of the sections described in the following paragraphs.
- C. **Service Section:** The service section shall consist of an underground pull compartment and a revenue metering compartment which comply with utility requirements. Components such as meter bases, busses, lugs, auxiliaries shall be provided.
- D. **Main Circuit Breaker Compartment:** The main circuit breaker unit shall have the ratings indicated. Service neutral shall be brought to a terminal in the main circuit breaker compartment. A disconnecting link shall be provided in a bus bar connection between the neutral terminal and the switchboard ground bus.

The main circuit breaker shall have protective features with capability of selective tripping characteristics which can be used to provide overcurrent protection from overloads, short-circuits and ground faults. [Additionally, local and remote signaling of overloads or actual fault conditions which have caused the breaker to trip shall be provided.]

Circuit breakers shall be equipped with solid-state programmers.

- E. The main circuit breaker shall be individually mounted [stationary] [draw-out] of the size and type indicated. [Manual charging] [Motorized spring charging] shall be provided where indicated.
- F. **Distribution Section:** The distribution section shall consist of [stationary], [individually mounted] [group mounted] molded case circuit breakers of the size indicated. Full length vertical bus shall be provided for each distribution section. Unless indicated otherwise, rating shall be 300-amperes.

## 2.4 SWITCHBOARD INSTRUMENTS

- A. Indicating instruments shall be approximately 4-1/2-inch square with 250-degree scales and white dials with black graduations. Case shall be semi-flush mounted with anti-glare glass. Front access zero adjustment shall be provided. Indication accuracy shall be as indicated.

Indicating meters shall be of the following type:

1. Main incoming circuit breaker:

- 1 - voltmeter [0-600V], single-phase, one percent accuracy

- 1 - voltmeter transfer switch with pistol grip handle to permit a single-phase voltmeter to indicate voltage between phase of a three-phase system. Switch shall have an "Off" position

- 1 - AC indicating ammeter, five amperes full scale, single-phase, 0-XXX amperes dial, one percent accuracy

1 - Ammeter transfer switch with pistol grip handle to permit a single-phase ammeter to indicate current in each phase of a three-phase system. Switch shall have an "Off" position

1 - Watt-hour demand meter with 15-minute demand register, three-phase, two-element

1 - Varmeter with 3-phase, three-wire, cross-phase, three current coils on open-delta potential transformers, coil rating five amperes

2. Distribution feeder circuit breaker:

1 - AC indicating ammeter, five amperes full scale, single-phase, XXX amperes dial, one percent accuracy

1 - Ammeter transfer switch with pistol grip handle to permit a single-phase ammeter to indicate current in each phase of a 3-phase system. Switch shall have an "Off" position

Where they are shown on the single line diagram, the following shall be provided:

1 - Watt-hour demand meter with 15-minute demand register, 3-phase, two-element

1 - Varmeter with three-phase, three-wire, cross phase, three current coils on open-delta potential transformers, coil rating 5-amperes

- B. Instrument transformers shall comply with ANSI/IEEE C37.20 and shall have standard accuracy for relaying and metering with the burdens imposed. Mechanical and thermal ratings of current transformers shall be coordinated with short circuit ratings of related circuit breakers. Potential transformers shall be mounted on a disconnecting rack and shall have primary fuse protection.
- C. Protective relays shall be mounted within draw-out cases; current measuring circuits shall be fitted with jacks to short circuit current transformers when relays are withdrawn. Relays shall have means for testing measuring circuitry with the relay in place. Relays shall be solid-state type and shall be product of the switchboard manufacturer.
- D. **Automatic Transfer Switch:** Automatic transfer (AT) switch shall be a 3-pole, double-throw, with a [definite neutral position] [in-phase monitor]; switch shall be rated at 480 volts and shall have the continuous current rating indicated. The AT switch shall be able to withstand the short circuit currents indicated or shall have the same withstand rating as the switchboard in which it is installed. The load terminals of the AT switch shall be de-energized when the AT switch is in the neutral position; [if neutral position is provided] the duration of the neutral position shall be adjustable from zero to 30 seconds. The AT switch shall comply with requirements of ANSI/UL 1008 and ANSI/NEMA ICS-2.
- E. The AT switch shall be manually operable but the manual operating mechanism shall be declutched when the electric operator becomes energized. Mechanical and electrical interlocks shall be provided to prevent simultaneous closure of the normal and emergency positions.
- F. The automatic transfer switch shall include integrated controls featuring solid state timing and sensing relays. Protective features and indicators shall include:

1. Three-phase, close-differential undervoltage protection on the Normal source; drop-out shall be adjustable from 80-85 percent; pick-up shall be adjustable from 90-95 percent.
2. Circuitry shall be provided to prevent transfer to the standby source until standby source voltage and frequency are within 90 percent of nominal values.
3. Adjustable time delay of retransfer of up to 10 minutes after the voltage of the Normal source has attained the pick-up setting indicated above on all phases.
4. The automatic transfer switch shall be equipped with indicator lamps for the Normal and standby positions. Two "dry" contacts shall be provided for the standby position and one "dry" contact for the Normal position; said contacts shall be wired to identified terminals.
5. A three-position selector switch shall control the TEST-OFF-AUTO functions; the AUTO position shall cause transfer to the emergency source and retransfer of the load on failure and subsequent restoration of the Normal source. The TEST position shall simulate failure of the Normal source for however long the switch is in the Test position.

## 2.5 TRANSFORMERS

- A. All indoor transformers shall be dry-type and shall conform to or exceed the requirements of the latest applicable IEEE, NEMA, and ANSI standards. Transformers rated 3 kva and below shall be designed not to exceed 80-degree C temperature rise; 5 kva and greater shall be designed not to exceed 115-degree C temperature rise.
- B. Transformers rated 15 kVA and above shall have four 2-1/2 percent taps, two above and two below 480 volts. Transformers shall be [floor-] [wall-mounted] type.
- C. **Isolation Transformers:** Isolation transformers shall be designed to lessen effects of transient generation into the supply power and shall act as a buffer for SCR current surges. Transformers shall have full capacity taps, four 2.5 percent taps, two above and two below primary windings. Transformers shall have a 150 degree C insulation and shall be UL listed.

## 2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Circuit breakers having a frame size of 150-amperes or less shall be molded-case type with thermal magnetic non-interchangeable, trip-free, sealed trip units. Breaker contact material shall be a non-weldable silver alloy. Breakers shall have arc-extinguishing chutes. Ground fault tripping, where required, shall be as indicated below.
- B. Circuit breakers with a frame size of 225 amperes to 600 amperes shall be molded case with interchangeable thermal and adjustable magnetic trip elements. Ground fault protection shall be provided by means of a core balance transformer encircling all feeder leads. The transformer shall energize a surface-mounted, solid-state relay, adjustable from 10-20 percent of phase current with an adjustable time delay of zero to 36 cycles. Ground fault protection shall include a test panel containing indication and test tripping circuits.
- C. Circuit breakers with a frame size more than 600 amperes shall be molded case as described in the foregoing paragraph, except if power circuit breakers are indicated. Molded case circuit breakers shall have an integral, solid state over-current trip unit and line

current sensors. Trip units shall have adjustable long time tripping in the range of 60 to 100 percent of continuous rating, instantaneous tripping adjustable in the range of 300 to 1000 percent of continuous rating, and ground fault tripping adjustable in the range of 20 to 60 percent of continuous rating with adjustable delay of approximately 5 to 40 cycles.

- D. Power circuit breakers shall be [draw-out] [stationary]; power circuit breakers shall be [air break units] [insulated case units]. Draw-out mechanism shall be 4-position: connected, test, disconnect and remove. The circuit breaker element shall be able to assume the connected, test, and disconnected positions with the circuit breaker cubicle door closed.
- E. Interlocks shall be provided to assure that the circuit breaker element is open before movement from a position is possible; stored energy mechanism shall be discharged automatically upon removal of the circuit breaker element from its cubicle. Charging of stored energy springs shall be [manual] [motorized]; closing of the main power contacts shall automatically charge the tripping springs. A manual trip button, position indicators, and status of stored energy mechanism shall be fitted to the front panel.
- F. Power circuit breakers shall be equipped with an integral solid-state 3-phase tripping unit as described above.
- G. Circuit breaker interlocking shall include an anti-pumping circuit.
- H. [An external power source shall not be required for circuit breaker tripping]. [A bell alarm switch shall be provided to close only on circuit breaker overload].
- I. Circuit breaker accessories shall include [floor standing dolly hoist] [switchgear mounted traveling lift-out hoist].

## 2.7 MANUFACTURERS

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

- 1. Solid state programmers for circuit breakers:

- General Electric Micro-Versatrip
  - Square D Micrologic Trip System

- 2. Indicating meters

- Voltmeter

- Westinghouse Type KA-251
    - General Electric Type AB-40

- Voltmeter transfer switch

- Westinghouse Type W
    - General Electric Type SB-1

- AC indicating ammeter

- Westinghouse Type KA-241
    - General Electric Type AB-40

Ammeter transfer switch

Westinghouse Type W  
General Electric Type SB-1

Water-hour demand meter

Westinghouse Type CB  
General Electric Type DSM 63

Varmeter

Westinghouse Type KP-261  
General Electric Type AB-40

3. Automatic transfer switch

ASCO  
Russelectric  
Westinghouse  
Zenith

4. Transformers

General Electric  
Westinghouse  
Square D

5. Molded case, insulated case and power circuit breakers

Westinghouse Pow-R-Gear  
General Electric Power Break  
Square D

6. Switchboard

General Electric, AV-Line  
Westinghouse, Pow-R-Line C

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION - GENERAL**

- A. All electrical equipment materials shall be installed securely in place. Equipment shall be mounted parallel and perpendicular to the walls, floors, and ceilings.
- B. All anchors and fasteners shall be types designed for the intended purpose and shall be capable of adequately, safely, and permanently securing the material in place. Screws shall be used on wood surfaces, masonry anchors in concrete or brick, toggle bolts on hollow walls, machine screws, bolts, or welded studs on steel. Nails shall be used only for temporary attachment or support.

- C. Omissions or conflicts on Drawings or between Drawings and Specifications shall be brought to the attention of the CONSTRUCTION MANAGER for clarification before proceeding with the work.
- D. The CONTRACTOR shall make all necessary provisions throughout the site to receive all equipment as construction progresses and shall provide adequate backing, supports, inserts, and anchor bolts for the hanging and support of all electrical cabinets, enclosures, conduit, panelboards, and switches, and shall provide sleeves through walls, floors, or foundations where electrical lines are required to penetrate.
- E. Floor standing equipment shall be leveled with shims as required to maintain horizontal surfaces within 1/32-inch per horizontal foot; after leveling, equipment shall be anchored, then grouted so that no space is existing between concrete and equipment support beams.

### 3.2 PREPARATION AND FINISH

- A. All equipment cabinets or enclosures furnished under this Section shall have a finish which conforms to Section 16480.

### 3.3 TESTING

- A. All WORK shall be tested per Section 16030.

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