PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Enclosed circuit breakers.
B. Panelboards and load centers.

1.02 RELATED SECTIONS

A. Motor control centers are specified in Section 26 24 19, Motor-Control Centers.

1.03 MEASUREMENT AND PAYMENT

A. General: Circuit breakers and panelboards, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump-sum price for Electrical Work as indicated in the Bid Schedule of the Bid Form.

1.04 REFERENCES

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

1. ASTM B187/B187M Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes

B. National Electrical Manufacturers Association (NEMA):

1. NEMA AB 1 Molded Case Circuit Breakers
2. NEMA PB 1 Panelboards
3. NEMA PB 1.1 General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less
4. NEMA PB 1.2 Application Guide for Ground-Fault Protective Devices for Equipment

C. Underwriters Laboratories Inc. (UL):

1. UL 50 Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
2. UL 67 Standard for Safety Panelboards
3. UL 489 Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breakers Enclosures
D. InterNational Electrical Testing Association (NETA):
   1. NETA ATS    Acceptance Testing Specifications for Electrical Power Distribution

E. National Fire Protection Association (NFPA):
   1. NFPA 70     National Electric Code
   2. NFPA 70E    Standard for Electrical Safety in Workplace

F. Federal Specifications
   1. FS W-C-375  Circuit Breakers, Molded Case, Branch Circuit and Service
   2. FS W-P-115  Power Distribution Panel

1.05 REGULATORY REQUIREMENTS

A. Refer to Section 20 70 26, Common Materials and Methods for Electrical Systems, for requirements.

B. California Code of Regulations (CCR):
   1. Title 24, Part 2  California Building Code
   2. Title 24, Part 3  California Electrical Code

1.06 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

   1. Refer to local utility electrical service requirements for meter centers.

B. Product Data: Submit manufacturers’ product data for specified equipment and materials. Include the following information for each item:

   1. Manufacturer’s model number or item identification;

   2. UL listing and rating;

   3. Critical dimensions and mounting arrangement; and

   4. Replacement parts list.
C. Shop Drawings: Submit Shop Drawings and electrical diagrams as follows:

1. Enclosures: Drawings showing materials and methods of construction, door arrangement, conduit hub and knockout locations, and identification of intended panelboard or load center.

2. Circuit Breakers: Drawings showing circuit for which intended, voltage ratings, insulation level, current rating, interrupting ratings, and time-current curves.

3. Panelboards and Load Centers: Drawings showing base material, general arrangement, location, and identification of each circuit breaker and the circuit breaker information specified above, location and identification of terminals, location of barriers, applicable UL 67 information, wiring diagrams, and identification of the enclosure for which intended.

D. Test Reports: Submit copies of certified reports of factory and field tests performed in accordance with the applicable referenced standards and specification requirements.

1.07 QUALITY ASSURANCE

A. Select a manufacturer who has been regularly engaged in the manufacture of similar equipment and has met UL requirements.

B. Conform to UL 489, NEMA PB 1, and California Electrical Code, as applicable.

C. Products shall be tested, approved, and labeled/listed by UL.

D. Electrical equipment and material shall be new and within one year of manufacture, complying with the latest codes and standards. Used, re-built, refurbished and re-manufactured electrical materials shall not be used.

E. Components of the same type, size, rating, functional characteristics, and manufacture shall be interchangeable.

1.08 DELIVERY, STORAGE AND HANDLING

A. Provide markings on each circuit breaker, panelboard, and load center in accordance with the referenced standard. Each item shall be UL labeled.

B. Ship each unit securely wrapped, packaged, and labeled for safe handling in shipment and to avoid damage or distortion.

C. Store circuit breakers, panelboards, and load centers in secure and dry storage facility.
PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Enclosed Circuit Breakers:

1. Provide UL 489, molded case, quick make quick break bolt on type, with thermal magnetic type overload trip, interchangeable unit for frame rated 125 A and above. Breakers shall include the following requirements as indicated:
   a. Number of poles;
   b. Rated voltage and continuous current;
   c. Rated interrupting current; and
   d. Trip setting.

2. Molded Case Protective Devices

   a. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.

   b. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes.

   c. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated.

   d. Circuit breakers 15 to 100 ampere frame shall be provided with fixed thermal-magnetic trip units.

   e. Circuit breakers 225 ampere frame and above shall be provided with field-changeable, field-adjustable thermal-magnetic trip units with inverse time-current characteristics. Trip mechanisms shall be provided with instantaneous, long time pickup, and short time pickup.

   f. Circuit breakers 400 ampere frame and above shall be provided with microprocessor-based RMS sensing trip units with features noted on the Contract Drawings. Trip mechanisms shall be provided with instantaneous, long time pickup, long time delay, short time pickup, short time delay, I2t function, ground fault pickup, ground fault delay.

   g. Circuit breakers for HVAC and refrigeration unit equipment shall be listed by UL as Type HACR.
3. When circuit breakers are located in spaces other than the main electrical distribution system equipment rooms and used to protect conductors serving emergency equipment motors (such as fans, dampers, and pumps), emergency lighting, and communications equipment, they shall not be tripped by the thermal element. Thermal element contact shall be used to indicate an alarm condition.

a. Circuit breakers for tunnel lighting and power panel shall have auxiliary contacts. These contacts shall be paralleled to provide a common “panel trouble” alarm locally and to Central Control.

B. Panelboards and Load Centers: NEMA PB 1 or UL 67, with the following additional requirements:

1. Circuit Breakers

   a. Molded Case Circuit Breakers: NEMA AB 1, FS W-C-375; Provide bolt-on type circuit breakers with integral thermal and instantaneous magnetic trip in each pole (common trip type). Provide circuit breakers, UL listed as Type HACR, for air conditioning equipment branch circuits. Provide circuit breakers, UL listed as Type SWD, for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where specified on panelboard schedules as indicated.

   b. Trip Unit:

      1) Instantaneous magnetic trips shall be accessible and adjustable from the front of the breaker on frame size 100 amperes.

      2) Trip units shall be interchangeable and adjustable for trip pick up and delay settings on frame size 225 amperes.

      3) Breakers sized 400 amperes and higher shall be equipped with solid state trip units with long-time, short-time, instantaneous, and ground fault (LSIG) tripping characteristics.

   c. Breakers shall be rigidly mounted, separately removable and independent of trim plates for their support. Breakers shall be bolt on type.

   d. Breakers shall be industrial grade with a minimum pole width of 1-inch (25.4 mm) and a minimum height of 5-1/2-inches (139.7 mm). Miniature circuit breakers or breakers having a pole width of 1/2-inch are not acceptable.

   e. The minimum symmetrical interrupting rating for molded-case circuit breakers shall be as specified on the panelboard schedule as indicated. Series rated breakers are not acceptable.
2. Enclosure: NEMA or UL rated based on site conditions fabricated from galvanized steel, stainless steel, or other corrosion-resistant treated metal such as primed and painted steel, surface mounted unless otherwise indicated, tamperproof, with the following additional requirements:

   a. Gutter size:

<table>
<thead>
<tr>
<th>Main Bus Rating Amperes</th>
<th>End Gutter Size (Inches)</th>
<th>Side Gutter Size (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>225 and below</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>400 and over</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

   b. Provide interior components mounted on reinforced steel backplate for rigid support and accurate alignment.

   c. Provide device or mechanism for enclosure grounding.

3. Hardware and Trim:

   a. Panelboards shall be designed for surface or flush mounting in unsecured areas as indicated, and shall contain a hinged door fitted with a combination latch and door lock, accommodating a master key. Provide one flat key tumbler cylinder type, nickel plated door lock conforming to the station masterkey system, two keys per lock.

   b. Nameplates or other permanent identification shall be provided for each circuit breaker, which shall mount adjacent to the individual circuit breakers, as required by UL.

   c. Panel schedule with acrylic plastic face, 8-1/2 inches by 11 inches, shall be provided and mounted on the back of the door.

   d. Flush-mounted panelboards shall be provided, with means to plumb and align the front of the panel with respect to the adjacent finished surfaces.

   e. Unless otherwise specified, finish shall be a metallic surface thoroughly cleaned, degreased, primed with an approved corrosion-inhibitive primer, and then finished with heavy-duty, industrial-grade polyurethane enamel.

4. Bus Bars: ASTM B187/B187M, 98 percent conductivity copper, with silver plated contact surface, and the following additional requirements:

   a. Provide neutral bus of the same rating as that of phase bus. Provide neutral bus rating of 200 percent of the phase bus for loads creating harmonics.

   b. Provide main lugs or main circuit breaker of rating as indicated.

   c. Provide a grounding bus.

5. Each panelboard or load center shall have a main circuit breaker with same continuous rating as main bus ampere rating when the panelboard or the load center is located in the space other than that within the sight of the location of the feeder protective device on supply side.
6. Nameplates: Provide nameplates showing panelboard number. Nameplates shall conform to the requirements of Section 20 70 26, Common Materials and Methods for Electrical Systems.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install panelboards and load centers at locations indicated with the top 6 feet, 6 inches above the floor and the bottom not less than 12 inches above the floor, unless specifically indicated otherwise. Use multi-sectional panelboards and load centers to meet these spacings if necessary. Line up tops of trims to present neat appearance.

B. Mount panelboards and load centers in place with front straight and plumb, and anchor in accordance with applicable requirements of the California Building Code.

C. When a feeder serves more than one panelboard or panelboard section, install a separate junction box or provide adequate gutter area for termination of feeders and bus taps.

D. Provide circuit breakers of proper ratings for all branch circuits. Connect branch circuit wires as indicated. Connect neutral wires of branch circuits to the neutral bar of the same panelboard as the branch circuit.

E. Make conduit connections in accordance with Section 20 50 13, Raceways for Facility Services.

F. Make cable connections in accordance with Section 26 05 24, Low Voltage Wires and Cables.

G. Ground panelboards and load centers in accordance with Section 26 05 26, Grounding and Bonding for Electrical Systems.

H. Bus connections shall be made only by means of machine screws into threaded holes, or with through-bolts with washers and nuts. Connections shall be provided with lockwashers for mechanical locking.

3.02 PANEL SCHEDULE INSERT

A. Provide each panelboard and load center with a typewritten circuit directory located on the inside of the enclosure.

B. For each panelboard, include the panel name and schedule. Schedule shall include the following:

1. Panelboard type.

2. Number of phases.
3. Main bus ampacity.
4. Main circuit breaker trip rating.
5. Branch circuit breaker arrangement.
7. Flush or surface mounting.
8. Enclosure type.
10. Location.

### 3.03 FIELD QUALITY CONTROL

**A.** Perform the following tests per the NETA procedures under observation of the Engineer. Furnish equipment and instruments required to perform the tests.

1. Test circuits for connections in accordance with the wiring diagram.
2. Perform insulation resistance to ground in accordance with NETA ATS. In absence of manufacturer’s published data, use NETA ATS Table 100.1.
3. Test panelboard and load center enclosures for continuity to the grounding system.
4. Test operation of circuits and controls. When testing, operate each control a minimum of ten times and each circuit continuously for a minimum of 1/2-hour.
5. Test that each panel has a balanced load.
6. Maintain a log of all tests.

**END OF SECTION 26 24 24**