SECTION 26 23 00 - METAL-ENCLOSED DRAWOUT SWITCHGEAR - LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a deadfront type, low voltage metal-enclosed switchgear assembly utilizing drawout power circuit breakers for the Main Switchboard in each terminal.

1.2 REFERENCES

A. The low voltage metal-enclosed switchgear assembly and all components shall be designed, manufactured and tested in accordance with the following latest applicable standards:
   1. ANSI-C37.20 - Switchgear assemblies
   2. ANSI-C37.13 - Low voltage power circuit breakers
   3. ANSI-C37.17 - Trip devices
   4. NEMA SG-5 - Switchgear assemblies
   5. NEMA SG-3 - Low voltage power circuit breakers
   6. UL 1558
   7. UL 819

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to LAWA:
   1. Master drawing index
   2. Front view and plan view of the assembly
   3. Three-line diagram
   4. Schematic diagram
   5. Nameplate schedule
   6. Component list
   7. Conduit space locations within the assembly
   8. Assembly ratings including:
      a. Short-circuit rating
      b. Voltage
      c. Continuous current rating
   9. Major component ratings including:
      a. Voltage
      b. Continuous current rating

c. Interrupting ratings

10. Cable terminal sizes
11. Product data sheets

B. Where applicable, the following additional information shall be submitted to LAWA:

1. Busway connection
2. Composite front view and plan view of close-coupled assemblies
3. Key interlock scheme drawing and sequence of operations
4. Mimic bus size and color

C. Submit shop drawings after Short Circuit and Overcurrent Protective Device Coordination Study is approved. Shop drawings submitted without approved study will be returned and not reviewed.

D. AIC ratings of all submitted equipment must conform to the approved Short Circuit and Overcurrent Protective Device Coordination Study, minimum 100,000AIC.

1.4 SUBMITTALS - FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
2. Wiring diagrams
3. Certified production test reports
4. Installation information
5. Seismic certification as specified

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten 10 years. When requested by LAWA, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component. Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals. It shall also include original shop drawings, and recommended maintenance, Manufacturer's Certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Cutler-Hammer.**

B. **Square D.**

C. **General Electric.**

D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.2 RATINGS

A. The entire assembly shall be suitable for 600 volts maximum ac service.

B. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 100,000 amperes symmetrical at rated voltage.

C. The bus system shall have a minimum ANSI short-circuit withstand rating of 100,000 amperes symmetrical tested in accordance with ANSI C37.20.1 and UL1558.

D. All circuit breakers shall have a minimum symmetrical interrupting capacity of 100,000 amperes. To ensure a fully selective system, all circuit breakers shall have 30 cycle short-time withstand ratings equal to their symmetrical interrupting ratings through 85,000 amperes, regardless of whether equipped with instantaneous trip protection or not.

E. All ratings shall be tested to the requirements of ANSI C37.20.1, C37.50 and C37.51 and UL witnessed and approved.

2.3 CONSTRUCTION

A. The switchgear shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide ventilators located on the top of the switchgear over the breaker and bus compartments to ensure adequate ventilation within the enclosure. Hinged rear doors, complete with provisions for padlocking, shall be provided.

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills providing the floor is level to 1/8 inch per 3-foot distance in any direction. Provisions shall be made for jacking of shipping groups, for removal of skids or insertion of equipment rollers. Base of assembly shall be suitable for rolling directly on pipes without skids. The base shall be equipped with slots in the base frame members to accommodate the use of pry bars for moving the equipment to its final position.

C. Each vertical steel unit forming part of the switchgear line-up shall be a self-contained housing having one or more individual breaker or instrument compartments, a centralized bus compartment and a rear cable compartment. Each individual circuit breaker compartment, or cell, shall be segregated from adjacent compartments and sections by means of steel barriers to the maximum extent possible. It shall be equipped with drawout rails and primary and secondary disconnecting contacts. Removable hinge pins shall be provided on the breaker compartment door hinges. Current transformers for feeder instrumentation, where shown on the plans, shall be located within the appropriate breaker cells and be front accessible and removable.

D. The stationary part of the primary disconnecting devices for each power circuit breaker shall be breaker mounted and consist of a set of contacts extending to the rear through a glass polyester insulating support barrier; corresponding moving finger contacts, suitably spaced, shall be furnished on the power circuit breaker studs which engage in only the connected position. The assembly shall provide multiple silver-to-silver full floating high pressure point contacts with uniform pressure on each finger maintained by springs. Each circuit shall include the necessary three-phase bus connections between the section bus and the breaker line side studs. Load studs shall be equipped with insulated copper load extension buses terminating in solderless type terminals in the rear cable compartment of each structure. Bus extensions shall be silver-plated where outgoing terminals are attached.

E. The circuit breaker door design shall be such that the following functions may be performed without the need to open the circuit breaker door: lever circuit breaker between positions, operate manual charging system, close and open circuit breaker, examine and adjust trip unit, and read circuit breaker rating nameplate.

F. The secondary disconnecting devices shall consist of floating terminals mounted on the stationary unit and engaging mating contacts at the front of the breaker. The secondary disconnecting devices shall be gold-plated and engagement shall be maintained in the "connected" and "test" positions.

G. The removable power circuit breaker element shall be equipped with disconnecting contacts and interlocks for drawout application. It shall have four positions, "connected", "test", "disconnected" and "removed". The breaker drawout element shall contain a worm gear levering "in" and "out" mechanism with removable lever crank. Levering shall be accomplished via the use of conventional tools. Mechanical interlocking shall be provided so that the breaker is in the tripped position before levering "in" or "out" of the cell. The breaker shall include an optional provision for key locking open to prevent manual or electric closing. Padlocking shall provide for securing the breaker in the connected, test, or disconnected position by preventing levering.

H. An insulating flash shield shall be mounted above each circuit breaker to prevent flashover

from the arc chutes to ground.

1. The switchgear shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

I. Provide a rear compartment barrier between the cable compartment and the main bus to protect against inadvertent contact with main or vertical bus bars.

J. Provide in the cell when the circuit breaker is withdrawn, a safety shutter which automatically covers the line and load stabs and protects against incidental contact.

1. Provide a metal barrier full height and depth between adjacent vertical structures in the cable compartment.

K. Provide a glass polyester full height and depth barrier between adjacent vertical structures in the bus compartment with appropriate slots for main bus.

2.4 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on ANSI standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

B. Provide a full capacity neutral bus.

C. A copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchgear. The ground bus short-time withstand rating shall meet that of the largest circuit breaker within the assembly.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with Belleville-type washers.

E. Provide bus extensions on ends for future sections.

2.5 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchgear shall be furnished as required. Control components mounted within the assembly shall be suitably marked for identification corresponding to the appropriate designations on manufacturer’s wiring diagrams.

B. Provide a front accessible, isolated vertical wireway for routing of factory and field wiring. Factory provisions shall be made for securing field wiring without the need for adhesive wire anchors.

C. Front access to all circuit breaker secondary connection points shall be provided for ease of troubleshooting and connection to external field connections without the need of removing the circuit breaker for access.

D. All control wire shall be type SIS. Control wiring shall be 16 ga for control circuits and 14 ga

for shunt trip and current transformer circuits. Wire bundles shall be secured with nylon ties and anchored to the assembly with the use of pre-punched wire lances or nylon non-adhesive anchors. All current transformer secondary leads shall first be connected to conveniently accessible shorting terminal blocks before connecting to any other device. Shorting screws with provisions for storage shall be provided. All groups of control wires leaving the switchgear shall be provided with terminal blocks with suitable numbering strips and provisions for #10 AWG field connections. Each control wire shall be marked to the origin zone/wire name/destination zone over the entire length of the wire using a UV cured ink process. Plug-in terminal blocks shall be provided for all shipping split wires. Terminal connections to remote devices or sources shall be front accessible via doors above each circuit breaker. Terminal blocks shall be of the latched pull-apart type.

E. NEMA 2-hole mechanical- type lugs shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size.

F. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided.

G. Provide 25% spare terminals.

2.6 CIRCUIT BREAKERS

A. All protective devices shall be low voltage power circuit breakers. All breakers shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating.

B. All power circuit breakers shall be constructed and tested in accordance with ANSI C37.13, C37.16, C37.17, C37.50, UL 1066 and NEMA SG-3 standard. The breaker shall carry a UL label.

C. Breakers shall be provided in drawout configuration. The 800, 1600, 2000 and 3200 ampere frame power circuit breakers shall be provided in the same physical frame size, while 4000, 5000 and 6000 ampere frame power circuit breakers shall be provided in a second physical frame size. Both physical frame sizes shall have a common height and depth.

D. Power circuit breakers shall utilize a two-step stored-energy mechanism to charge the closing springs. The closing of the breaker contacts shall automatically charge the opening springs to ensure quick-break operation.

E. Breakers shall be electrically operated (EO).

F. Electrically operated breakers shall be complete with 120 Vac motor operators. The charging time of the motor shall not exceed 6 seconds. Control power for all switchgear control circuits shall be provided by a factory-sized control power transformer wired on the line side of the main breaker(s).

G. To facilitate lifting, the power circuit breaker shall have integral handles on the side of the breaker.

H. The power circuit breaker shall have a closing time of not more than 3 cycles.

1. The primary contacts shall have an easily accessible wear indicator to indicate contact erosion.

I. The power circuit breaker shall have three windows in the front cover to clearly indicate any electrical accessories that are mounted in the breaker. The accessory shall have a label that will indicate its function and voltage. The accessories shall be plug and lock type and UL listed for easy field installation. They shall be modular in design and shall be common to all frame sizes and ratings.

J. The breaker control interface shall have color-coded visual indicators to indicate contact open or closed positions, as well as mechanism charged and discharged positions. Manual control pushbuttons on the breaker face shall be provided for opening and closing the breaker. The power circuit breaker shall have a "Positive On" feature. The breaker flag will read "Closed" if the contacts are welded and the breaker is tripped or opened.

1. The current sensors shall have a back cover window that will permit viewing the sensor rating on the back of the breaker. A rating plug will offer indication of the rating on the front of the trip unit.

K. A position indicator shall be located on the faceplate of the breaker. This indicator shall provide color indication of the breaker position in the cell. These positions shall be Connect (Red), Test (Yellow), and Disconnect (Green). The levering door shall be interlocked so that when the breaker is in the closed position, the breaker levering-in door shall not open.

L. Each power circuit breaker shall offer sixty (60) front-mounted dedicated secondary wiring points. Each wiring point shall have finger safe contacts, which will accommodate #10 AWG maximum field connections with ring tongue or spade terminals or bare wire.

2.7 TRIP UNITS

A. Each low voltage power circuit breaker shall be equipped with a solid-state tripping system consisting of three current sensors, microprocessor-based trip device and flux-transfer shunt trip. Current sensors shall provide operation and signal function. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached. Interchangeable current sensors with their associated rating plug shall establish the continuous trip rating of each circuit breaker.

B. The trip unit shall have an information system that utilizes battery backup LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. A reset button shall be provided to turn off the LED indication after an automatic trip. A test pushbutton shall energize a LED to indicate the battery status.

C. The trip unit shall be provided with a display panel, including a representation of the time/current curve that will indicate the protection functions. The unit shall be continuously self-checking and provide a visual indication that the internal circuitry is being monitored and is fully operational.

D. The trip unit shall be provided with a making-current release circuit. The circuit shall be armed for approximately two cycles after breaker closing and shall operate for all peak fault levels above 25 times the ampere value of the rating plug.

E. Trip unit shall have selectable powered and unpowered thermal memory for enhanced circuit protection.

F. Complete system selective coordination shall be provided by the addition of the following individually adjustable time/current curve shaping solid-state elements:

1. All circuit breakers shall have adjustments for long delay pickup and time.
2. All circuit breakers shall have individual adjustments for short delay pickup and time, and include I^2t settings.
3. All circuit breakers shall have an adjustable instantaneous pickup.
4. All circuit breakers shall have individually adjustable ground fault current pickup and time, and include I^2t settings.

G. The trip unit shall have provisions for a single test kit to test each of the trip functions.

H. The trip unit shall provide zone interlocking for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream breaker and allow the breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the present time delay. Factory shall wire for zone interlocking for the power circuit breakers within the switchgear.

I. The trip unit shall include a power/relay module which shall supply control to the readout display. Following an automatic trip operation of the circuit breaker, the trip unit shall maintain the cause of trip history and the mode of trip LED indication as long as its internal power supply is available.

J. The trip unit shall include a voltage transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the voltage transformer module shall be connected internally to the line side of the circuit breaker through a dielectric test disconnect plug.

K. Provide a trip unit with Arc Reduction Module built into the trip unit, which includes multiple instantaneous trip set points, a normal/maintenance mode switch and indicating light to remind maintenance personnel when the switch is in the maintenance mode B all integral to the breaker trip unit. The ARMS reduction feature shall also have provisions for remote setting of the breaker into a maintenance mode.

L. For emergency Circuit breakers, provide individually adjustable ground fault alarm only.

M. The trip unit shall be equipped to permit communication via a network twisted pair for remote monitoring and control.

N. The trip unit shall include a power/relay module which shall supply control to the readout display. Following an automatic trip operation of the circuit breaker, the trip unit shall maintain the cause of trip history and the mode of trip LED indication as long as its internal

power supply is available. An internal relay shall be programmable to provide contacts for remote ground alarm indication.

O. The trip unit shall include a voltage transformer module, suitable for operation up to 600V, 50/60 Hz. The primary of the voltage transformer module shall be connected internally to the line side of the circuit breaker through a dielectric test disconnect plug.

P. The display for the trip units shall be a 24-character LED display.

Q. Metering display accuracy of the complete system, including current sensors, auxiliary CTs, and the trip unit, shall be +/- 1% of full scale for current values. Metering display accuracy of the complete system shall be +/- 2% of full scale for power and energy values.

R. The unit shall be capable of monitoring the following data:

1. Instantaneous value of phase, neutral and ground current
2. Instantaneous value of line-to-line voltage
3. Minimum and maximum current values
4. Watts, VARs, VA, watthours, VARhours and VA hours

S. The energy-monitoring parameter values (peak demand, present demand, and energy consumption) shall be indicated in the trip unit's alphanumeric display panel.

T. The trip unit shall display the following power quality values: crest factor, power factor, percent total harmonic distortion, and harmonic values of all phases through the 31st harmonic.

U. An adjustable high load alarm shall be provided, adjustable from 50 to 100% of the long delay pickup setting.

V. The trip unit shall contain an integral test pushbutton. A keypad shall be provided to enable the user to select the values of test currents within a range of available settings. The protection functions shall not be affected during test operations. The breaker may be tested in the TRIP or NO TRIP test mode.

W. Programming may be done via a keypad at the faceplate of the unit or via the communication network.

X. System coordination shall be provided by the following microprocessor-based programmable time current curve shaping adjustments. The short-time pickup adjustment shall be dependent on the long delay setting.

1. Programmable long-time setting
2. Programmable long-time delay with selectable I^2t or I^4t curve shaping
3. Programmable short-time setting
4. Programmable short-time delay with selectable flat or I^2t curve shaping, and zone selective interlocking
5. Programmable instantaneous setting

6. Programmable ground fault setting trip or ground fault setting alarm
7. Programmable ground fault delay with selectable flat or I^2t curve shaping and zone selective interlocking

Y. The trip unit shall offer a three-event trip log that will store the trip data, and shall time and date stamp the event.

Z. The trip unit shall have the following advanced features integral to the trip unit:

1. Adjustable undervoltage release
2. Adjustable overvoltage release
3. Reverse load and fault current
4. Reverse sequence voltage alarm
5. Underfrequency
6. Overfrequency
7. Voltage phase unbalance and phase loss during current detection

2.8 MISCELLANEOUS DEVICES

A. Key interlocks shall be provided. These interlocks shall keep the circuit breakers trip-free when actuated.

B. Fused control power transformers shall be provided as required for proper operation of the equipment. A manual disconnect shall be provided ahead of the primary fuses. Control power transformers shall have adequate capacity to supply power to all the control circuits within the lineup.

2.9 LAWA METERING

A. Provide a separate LAWA metering compartment with front hinged door, where required.

B. Provide current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

C. Provide potential transformers including primary and secondary fuses with disconnecting means for metering.

D. Microprocessor-Based Digital Metering Unit (DMU) shall include branch circuit metering utilizing Eaton IQ-260 meters and main circuit metering utilizing IQ-2270 meters. All meters shall utilize RS-485 daisy-chained factory-supplied connection and a PowerXpert 600 Gateway per lineup for customer/contractor supplied network cable between lineups.

2.10 ENCLOSURES

A. This switchgear shall be installed indoor in NEMA 1 Enclosure. Outdoor installations will have to be justified, NEMA 4 or NEMA 3R Stainless steel gasketed and approved by LAWA

2.11 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits. Refer to Electrical Identification for additional information.

B. Furnish master nameplate giving switchgear designation, voltage ampere rating, short-circuit rating, and manufacturer's name.

C. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's drawings.

D. Refer to Identification for Electrical Systems for information pertaining to nameplates on equipment.

2.12 FINISH

A. All exterior and interior steel surfaces of the switchgear shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchgear shall be ANSI 61.

2.13 ACCESSORIES

A. Provide a floor running portable circuit breaker transfer truck with manual lifting mechanism, one for each concourse main electrical room.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The switchgear shall be completely assembled, wired, adjusted and tested at the factory. After assembly, the complete switchgear shall be tested to ensure the accuracy of the wiring and the functioning of all equipment. The main bus system shall be given a dielectric test of 2200 volts for one minute between live parts and ground and between opposite polarities.

B. The wiring and control circuits shall be given a dielectric test of 1500 volts for one minute, or 1800 volts for one second, between live parts and ground, in accordance with ANSI C37.20.1.

C. A certified test report of all standard production tests shall be shipped with each assembly.

D. Factory test as outlined above shall be witnessed by LAWA's representative.

1. The manufacturer shall notify LAWA two (2) weeks prior to the date the tests are to be performed
2. The manufacturer shall include the cost of transportation and lodging for up to three (3) LAWA's representatives. The cost of meals and incidental expenses shall be LAWA's responsibility

3.2 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of 5 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.3 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification before final payment.

3.4 TRAINING

A. The Contractor shall provide a training session for up to ten (10) LAWA's representatives for 2 normal workdays at a job site location determined by LAWA.

B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

3.5 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's recommendations.

B. The Contractor shall ensure that the switchgear installation shall provide at a minimum physical floor space for one additional switchgear section at each line-up end. A double ended switchgear will require two section floor spaces, one at each end. The Contractor shall properly mark these spaces for future expansion.

C. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

D. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include but not limited to:

1. Checking to ensure that the pad location is level to within 0.125 inches per three foot of distance in any direction
2. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations

E. Assembling all shipping sections, removing all shipping braces and connecting all shipping split mechanical and electrical connections.

F. Securing assemblies to foundation or floor channels.

G. Measuring and recording Megger readings phase-to-phase, phase-to-ground, and neutral-to-ground (four wire systems only).

H. Inspecting and installing all circuit breakers in their proper compartments.

END OF SECTION 26 23 00