1.1 GOALS

The goal of this section is to provide guidance for all electrical work at LAWA. Additional discipline specific guidance related to electrical work can be found throughout the Design & Construction Handbook (DCH) including, but not limited to sustainability, plumbing, fire life safety, telecom/IT, and commissioning guideline sections. It is imperative that the designer review and coordinate the requirements of all sections of the DCH. General design requirements of note include Notes to the Design Team, Codes and Regulatory Agencies, and Design Submittals.

1.2 GENERAL REQUIREMENTS

A. All electrical rooms shall be provided with Access Control & Alarm Monitoring Systems (ACAMS) in addition to manual key access. ACAMS design & installation shall be per LAWA IMTG guide specification 28-13-00 "ACCESS CONTROL AND ALARM MONITORING SYSTEM (ACAMS)"; additionally, coordinate with LAWA IMTG.

B. Main Electrical Room fire protection systems shall be provided per Section 1.4B1, "Fire Protection Systems - Building Main Electrical Room" of the Airport Plumbing Design Standards.

1.3 POWER DISTRIBUTION SYSTEM

A. System Type

1. The main service at each building shall be 5,000amp, 277/480V – 3 phase, 4 wire. The switchboard shall be a double-ended arrangement with a normally open tie-breaker and metering compartments complying with LADWP requirements. Each end is fed from a separate LADWP transformer/circuit for redundancy and reliability. The main circuit breakers and the tie-breaker shall all be rated at 5000A. The system shall provide 100% redundancy and the total electrical load for the building shall be less than 5000A. If the connected load for a building exceeds 5000A, then provide a load-shedding scheme to allow one service to serve the entire electrical load through the closed tie-breaker. The load shedding scheme may be a manual type utilizing kirk-key interlocks on the breakers.

B. Main Electrical Room

1. The Main Electrical Room shall be adjacent (common wall) to the LADWP Utility Vault. Do not route unprotected service conductors through the building. Provide 5000A busway for the service entrance from the DWP vault to the main switchgear. Route busways separate directions into DWP vault and maintain distance between the two busways for safety and reliability. Piping unrelated to the function of the main electrical room is not permitted. The use of protection methods against condensation, leaks or breaks in piping is not permitted to justify unrelated piping in main electrical rooms. The Main Electrical Room shall be dedicated solely to electrical equipment except that required HVAC and Fire Protection serving the specific room is allowed.

C. Utilization Voltage

1. The building distribution system shall be a radial type. Where possible the utilization equipment shall be served at 277/480V including lighting, mechanical equipment and any other equipment specified by LAWA. Provide 120/208V transformers and distribution gear for other devices and equipment.

D. Short Circuit/Arc Flash

1. Provide an Overcurrent Protection Device Coordination Study and Arc Flash Study that includes all existing and new equipment. The Study can be provided by the Contractor. All electrical panels shall have a fault rating equal to at least 130% of the available fault current. All equipment must be fully rated. Series ratings are not allowed.

E. Segregation of Power

1. Power to tenants varies in each building. Some buildings have separate DWP meters for tenants and for LAWA and some do not separate the service. Verify the requirements with LAWA. Concessions, however, shall be separated from other power. The Concessions branch provides power to all concessionaires. The Concessions branch will have dedicated distribution all the way from the Main Service Switchboard. Where the separation of branches does not exist each major renovation will require establishment of branches for the renovated area. Minor renovations require that only distribution within the project area will require separation.

F. Equipment Rooms

1. All electrical distribution equipment shall be located in dedicated electrical rooms. Rooms shall be dedicated solely to electrical equipment except that required HVAC and Fire Protection serving the specific room is allowed. Equipment rooms shall not be located beneath areas where water service is provided (e.g. open courtyards, toilets). Piping unrelated to the function of equipment rooms is not permitted. The use of protection methods against condensation, leaks or breaks in piping is not permitted to justify unrelated piping in equipment rooms. Each room, regardless of size, shall have exposed grounding bars installed along walls for ease of equipment grounding. Provide additional space in all rooms to allow the addition of one future section for all switchboards. Provide the additional space so the future section can be added to either side of the switchboards. Designate all conduit entry points and routing paths within the equipment rooms to verify that future loads can be served from the panels in the rooms. Switchgear, switchboards, panelboards and motor control centers shall have adequate vertical wireways to serve spares circuit breakers or spaces for future circuit breakers. Spaces shall be designed to allow maintenance equipment access, to facilitate equipment replacement without significant demolition & reconstruction. Provide accessible route or space for portable crane to replace or maintain electrical equipment. All free standing electrical equipment require space to provide one additional section (both sides); outline on the plans as “future space: do not block”.

G. Emergency & Standby Power

1. Only equipment related to fire/life-safety shall be connected to the emergency power distribution system. Review telecom/IT design guidelines for emergency & standby power requirements; any variances to be approved by LAWA. Other tenant related loads that are not fire/life-safety shall be supplied by a tenant provided standby power source. Any tenant provided systems shall utilize batteries as a source. Concessions spaces and Passenger Boarding Bridges may utilize battery units for all required emergency power sources including any life-safety/egress lighting. The emergency power system shall be fed from an on-site diesel driven emergency generator set through automatic transfer switch(es). Generators shall be equipped with an active diesel particulate filter compliant with current SCAQMD and CARB emissions standards for a major source facility. Generator emission control devices shall meet

SCAQMD, CARB and EPA emission tier standards at the time of installation. Generators must utilize sub-base fuel oil tanks. Underground or separate above ground tanks are not allowed.

H. Single line

1. Draw "top/down" with levels/room no.'s/grid lines, identify (split-bus/smart) panels required for title 24 compliance, separate normal/emergency power sheets, additionally include feeder/branch lengths & voltage drop & kaic/afc available at distribution equipment & transformers.

2. Additionally, include simplified single line diagrams for normal & emergency/standby power:

   a. Illustrating distribution board names & the associated BUILDING-SYSTEM/ELECTRICAL LOAD TYPE they support (e.g. "3S4BL1 - LIGHTING").
   b. Include a connected Load Summary categorized by BUILDING-SYSTEMS/ELECTRICAL LOAD TYPES (e.g. "LIGHTING – 40KW).

1.4 EQUIPMENT

A. General

1. Manufacturers: For standardization purposes all panelboards, switchboards, switchgear, and transformers shall be limited to General Electric, Square D and Eaton.

2. Seismic Criteria: All equipment, major components and anchorage must be certified to meet all seismic requirements of the Code.

3. Certification: All equipment must have LARR numbers where applicable.

4. LAWA requires a unique system of identification for all conduits, feeders, wiring, enclosures, devices, panels and equipment. Refer to Guide Specifications for complete details.

5. No electrical equipment shall be installed in Custodial Rooms, Restrooms, Nursing Rooms, and Pet Relief Rooms.

B. Main Switchgear

1. Main switchgear (gear fed directly from DWP transformers) shall be metal-enclosed switchgear utilizing insulated case draw-out type circuit breakers for long-term maintenance and reliability. Provide breakers with metering capability compatible with the electrical submetering system. Provide sufficient switchgear sections to allow enough conduit entry space to accommodate all feeders including feeders for future sections. Main Service switchgear shall be rated NOT less than 100 kaic.

C. Distribution Switchboards/Panelboards

1. Panels rated greater than 800A shall be switchboards. Panels 800A or less shall be distribution panelboards. All boards shall utilize full-length copper bussing with full-size neutrals. Circuit breakers may be group mounted molded case circuit breakers. Fused switch assemblies are not allowed. Circuit breakers in switchboards shall be electronic trip type breakers. Provide 20% spare fully bussed space in all boards. All boards shall be fully rated for 130% of the available short circuit fault current. All devices must be fully rated. Series-rating of breakers is not allowed. Provide sufficient

sections to allow enough conduit entry space to accommodate all feeders including feeders for future sections.

D. Raceways and Enclosures:

1. Definitions:

a. Outdoor Locations: Locations directly exposed to weather, including under building overhangs.
b. Wet Locations: Unprotected locations exposed to weather or subject to saturation with water or in direct contact with concrete, masonry or earth.
c. Damp Locations:
(1) Locations protected from weather, not subject to saturation with water. Covered locations with open sides that are subject to wind-driven rain shall be considered damp.
(2) Areas below the soffit/header line and within 10’ of a wet location shall be considered damp locations.
d. Dry Locations:
(1) Locations not normally subject to dampness or wetness.
(2) Areas above the soffit/header line or greater than 10’ from a wet location shall be considered dry locations.

2. Raceways:

a. Outdoor Locations: Use Galvanized Rigid Steel.
b. Wet and Damp Locations: Use Galvanized Rigid Steel.
c. Dry Locations: Zinc Plated EMT or Galvanized Rigid Steel is allowed in all locations.
d. Where Subject to Physical Damage: Use Galvanized Rigid Steel
e. Tug Routes, bag tug areas and other drive aisles:
(1) Above the tallest vehicle, tug, cart, trailer, etc., use Zinc Plated EMT, unless area is defined as Damp or Wet.
(2) Below the tallest vehicle, tug, cart, trailer, etc., use Galvanized Rigid Steel.
f. Type MC Cable, Romex, or aluminum conduits are not allowed.
g. Flexible Conduits: Use flexible steel conduits for termination to equipment.

3. Enclosures at LAX:

a. Due to highly the corrosive exterior environment at LAX, for all outdoor electrical enclosures, including switchboards / panelboards, use NEMA Type 4 or NEMA Type 3R stainless steel gasketed enclosures. Top entry conduits to switchgear, switchboards, distribution panelboards and outdoor enclosures shall not be allowed. See Specification Section 26 05 02 for additional information.

4. All conductors shall be routed in raceways (e.g. plenum rated cables not acceptable).

1.5 METERING

A. Utility (DWP) metering varies in each building. Confirm the metering arrangement with LAWA.

B. Provide Submeters for:

1. Concessions as per CDG lease agreement;

2. Electrical loads as per LAWA Sub-metering Policy;

3. Any major electrical loads not covered by CDG lease agreement or LAWA Sub-metering Policy.

C. Provide methods, materials, & services required for meter(s) compatible integration with power monitoring control system, network lighting control system, building automation system & CUP FMCS.

1. Consolidate meters as much as possible in multi-meter enclosures within electrical rooms.

1.6 LIGHTING

A. General

1. Lighting fixtures and design shall provide the lighting levels, visual comfort, color rendering and aesthetics to complement the area where it is installed. Lighting of public areas is especially important to LAWA and all lighting design in public areas shall be approved by LAWA prior to submitting documents for plan check. All lighting shall be installed in areas accessible by ladder or lift for ease of maintenance.

B. Lamp Sources

1. All lighting design shall be as energy efficient as possible and shall comply with the latest Title 24 requirements. Dimmable LED's shall be required in lieu of fluorescent luminaires utilizing the appropriate color temperatures; provide consistent color temperature (tight binning), high CRI (85+), and rated life>50,000 hours. Where necessary provide pulse-start metal halide HID sources.

C. Lighting Controls

1. Provide a complete programmable system allowing for daylight harvesting, DMX-512 fixture control, and interfacing with Building Automation Control system in accordance with Title 24 guidelines. Provide distributed or centralized relay network control utilizing Cat 5 network cabling, routers, bridges, control devices and fixtures for a fully addressable control system. The lighting control system shall be programmable for individual fixtures or zones and shall annunciate at the building engineer's office and at LAX, the Central Utility Plant. All lighting controls shall be from same manufacturer.

2. Lighting controls shall be located in LAWA Electrical rooms or closets that are accessible to LAWA Personnel without causing interruption to tenants. Lighting controls shall not be located in ceilings, on office space walls or in tenant spaces not accessible to LAWA.

D. Lighting Levels

1. Interior - The following lighting levels are recommended for building public areas. Other areas should conform with Title 24, IES standards and industry standards.

a. Arrival (Exterior) = 5-10FC.
b. Artwork and Displays = 40-50FC.
c. Back of House Areas.
(1) General illumination for working areas = 25-35FC.
(2) Corridors and stairways = 5-10FC.
d. Baggage Handling = 35-45FC.
e. Concessions and Food Courts.

(1) General illumination = 15-20FC.
(2) Work surfaces = 35-45FC.

f. Concourse = 10-15FC.
g. Departure (Exterior) = 5-10FC.
h. Information Desks = 30-40FC.
i. Restrooms = 10-15FC.
j. Retail.
(1) General illumination = 20-25FC.
(2) Accenting = 40-50FC.
k. TSA / Security.
(1) General illumination = Per current TSA guideline.
l. Ticketing.
(1) General illumination = 15-20FC.
(2) Work Surfaces = 35-45FC.

2. Exterior - Apron Lighting Levels:

a. Minimum horizontal illuminance at ground level: 2.0 foot-candles at 200 feet.
b. Maximum horizontal illuminance at ground level: 0.5 foot-candles at 300 feet.
c. Minimum vertical illuminance at a height of 3 feet above ground level: 5.0 foot-candles at a distance of 200 feet.
d. Maximum vertical illuminance at a height of 50 feet: 0.25 foot-candles at 250 feet.
e. Fixture Type: LED type. Mount fixture on lowering device with ballasts installed within fixture. For non-lowering devices provide remote ballast at base of pole. Round, tapered steel poles. For two-piece poles; minimum 3 gauge for lower section and 7 gauge for upper section.

3. Exterior – Parking Lot Levels:

a. Minimum horizontal illuminance at ground level: 1.5 foot candles.
b. Recommended Fixture Type: Cree OSQ Series; Autobahn ATB2 Series.
c. Driver, voltage, & optic types, as well as other fixture options are selected based on design considerations (e.g., pole height, pole distance, # of fixture per pole).

4. Building Exteriors and Parking - Provide fuses and fuse holders for outdoor lighting ballasts and light pole fixtures. For exterior wallpacks use induction type lamps.

1.7 RENOVATION / REMODEL WORK

A. Generally, all equipment and devices within the limits of the renovation must be completely removed. All wiring must be removed back to the last active device even if it resides outside the limits of the remodel/demolition. For branch wiring this is to the last receptacle, switch or other device remaining in service. Additionally, all branch circuit breakers within boards rated 208/120V 225A & below shall be removed when abandoned & replaced with breaker filler plate. If the wiring is a feeder serving only the removed equipment then the feeder must be removed all the way back to the serving electrical panel regardless of the serving panel location. All conduits within the limits of the remodel must be removed. Conduits can be cut off at the limits of the renovation and the conduit outside the limits of remodel can be abandoned in place and identified as ”abandoned”.

B. If new conduit runs are placed on existing conduit racks then the existing racks within the remodel area must be modified to meet current Codes and Standards. If conduit runs that pass through the remodel area are to remain then those racks within the remodel area must be

modified to meet current Codes and Standards. Reuse of an existing conduit requires that the entire conduit run be modified to meet current Codes and Standards including those portions outside the remodel area.

C. Power Shutdown: Refer to the LAWA Power Shutdown Requirements.

D. New buildings & renovations shall obtain worst case scenario DWP fault current for use in design calculations.

E. Electrical distribution shall be designed based on GEOGRAPHY & FUNCTION:

1. Concourse & ticketing buildings may each have a North, South, East, West dedicated electrical distribution equipment (e.g. North/South "core", East/West concourse).

2. Functions unique to the airport, large in magnitude of load, or common to many areas may have a dedicated electrical infrastructure (e.g. concessions, I.T., aircraft systems, BHS, etc.)

1.8 EMERGENCY & STANDBY POWER PERFORMANCE

A. Planning Narrative

1. Clarify impact to airport systems as a result of loss of normal power to project scope of work (SOW).

2. Provide written description of code-required-emergency & standby backup power requirements.

a. Clarify how strategies employed meet requirements.

3. Compare & contrast airport system(s) performance under normal power vs. short & long-term loss of normal power noting any system performance unavailable during loss of normal power. It is acceptable to provide a matrix of Airport Systems & backup source type(s) & associated run time(s).

B. Sequence of Operations

1. Provide sequence with all parameters & set points (e.g. trigger values/conditions, priorities, set points relating to automatic methods of operation, & load shedding).

C. Airport Systems

1. Systems include, but are not limited to, the following: Code required Fire, Life & Safety Systems; Public Safety & Security; Basic Functionality & Operations; Circulation & Conveyance; Passenger Processing; Baggage Handling & Processing; Information & Communication (See Division 27 & 28); Amenities; Airside/Aircraft Interface; Landside Interface; Support Spaces; Mechanical/exhaust systems; & Plumbing systems.

1.9 POWER QUALITY

A. Surge Suppression Devices (SPD) shall be applied to the following equipment & systems:

1. Distribution equipment directly fed by DWP (for all incoming utility feeds).

2. Distribution equipment for all IT, ticket counters & gates, BHS, Aircraft systems (400Hz, PBB, & PC Air), CTX, elevators & escalators.

B. BHS feeder breakers shall be electronic trip breakers with separately adjustable Long time, Short time, Instantaneous and Ground fault tripping (LSIG) & coordinated to clear fault at point at closest point to failure.

C. Voltage Sag Immunity

1. The following equipment & systems shall comply with the recommended voltage-sag immunity levels to "FULL OPERATION" as described in Section 5.3 of the most recent version of *IEEE Std. P1668™ Recommended Practice for Voltage Sag and Short Interruption Ride-Through Testing for End-Use Electrical Equipment Rated Less than 1000 V.*

    a. Elevators, escalators, moving walkways,
        (1) Additionally coordinate with DIV 14 – CONVEYING EQUIPMENT
    b. Baggage Handling Systems (BHS),
    c. Information Technology (I.T.) equipment & systems
    d. Any other equipment used in those operations which are critical for the normal and efficient processing of passengers and baggage into and out of LAX, and with regard to ensuring good passenger experience.

2. The manufacturer shall be responsible for & provide documentation of testing & verification of acceptability in accordance with the procedures as outlined in the most recent version of standard IEEE 1668.

    a. Testing & verification of acceptability shall be completed prior to the first scheduled shipment of new products to LAWA.
        (1) Manufacturer must clearly document the test method and test equipment used for creating voltage sags per Annex C of IEEE 1668-2017.

    EXCEPTION No. 1: Testing shall not be required if manufacturer has conducted the required testing before and can provide a test report to prove compliance; subject to LAWA approval.
    EXCEPTION No. 2: Other industry-recognized standards may be submitted in lieu of IEEE 1668-2017. LAWA shall review & approve standard as a satisfactory alternative. It shall be sole financial, technical & legal responsibility of requesting party to produce all information required for LAWA review.
    EXCEPTION No. 3: Project may instead demonstrate (with tests and or documentation similar that described above) the intent of IEEE 1668-2017 compliance by providing external equipment or alternative operation that will ensure that equipment ride-through during voltages sags and short interruptions. LAWA shall approve if this is a satisfactory alternative.

3. Small scale "battery-less" power conditioning technologies shall be required in complying with most recent version of IEEE 1668. Acceptable "battery-less" solutions include, but are not limited to, the following:

    a. Dynamic Sag Correctors (e.g. Rockwell Mini DySC)
    b. Constant Voltage Transformes (e.g. Sola Manufacturing)
    c. Relay & contactor ride-through technologies
    d. DC Buffer Modules to store energy on DC circuits

    EXCEPTION No. 1: It is acceptable to provide battery-based UPS systems where already called for in LAWA DCH DIVISIONS 27, 28 & Emergency Egress Fire-Life-Safety (FLS) systems.

1.10 TITLE 24 ENERGY EFFICIENCY STANDARDS FOR NONRESIDENTIAL BUILDINGS

A. Title 24 SOLAR ZONES shall be physically identified & protected in the field (e.g. “SOLAR ZONE: DO NOT BLOCK”).

B. All Power distribution shall be designed per Title 24 table 130.5-B “Services rated more than 1000 kVA”.

1. Additionally, provide for disaggregation of loads that are unique to LAWA (e.g. Baggage Handling & Aircraft Systems).

2. Provide equipment to allow monitoring & control of aforementioned disaggregated loads. Monitoring/control methods & materials shall interface & be compatible with LAWA BAS/PMCS/FMCS systems.

C. Electrical drawings to include electrical load calculations.

1. See “TITLE 24 ELECTRICAL LOAD CALCULATIONS”

2. Estimates are acceptable at various stages of design when the load or quantity has not been indicated on drawings or specs (e.g. lighting). Document shall be updated to reflect installed load when quantity & load have been determined (e.g. such as from a submittal).

1.11 ELECTRICAL VEHICLE SUPPLY EQUIPMENT (EVSE)

A. System Type

1. All new facilities equipped with parking shall provide EVSE per California Green Building Code. Additionally, provisions for future expandability shall be provided such that 10% of parking may be equipped with EVSE.

2. EVSE shall be UL listed, rated for outdoor use. All EVSE to be hardwired; cord and plug is not acceptable.

3. EVSE shall be installed such that public long term parking and majority of fleet is accommodated by LEVEL 1 charging. Level 2 charging shall be provided in public short term parking. Design for EVSE to share more than one parking space should be considered.

B. EVSE Sources

1. New parking facilities/structures shall provide separate utility revenue meter dedicated to EVSE in order to qualify for Time of Use (TOU) metering and utility rate discounts.

2. New EVSE installations in existing parking structures/lots shall be limited to 200A. Installations shall include a meter safety socket approved by utility for a statistical meter. Panels feeding EVSE shall be dedicated to EV only; No other loads shall be connected.

C. EVSE Labeling

1. All EVSE shall be provided with the following labeling:

a. Printed label with a unique identifying number. Number will identify parking structure and EVSE number.
b. Printed label identifying source panel and circuit number.

2. All panelboards and meter safety sockets feeding EVSE systems shall have the following labeling:

a. Printed label indicating service address, panelboard name, service type (voltage, phase, wire), and service size (Amps).
b. Printed label reading “Dedicated to EV charging only; other loads must not be connected”.

3. EV Parking stalls shall be provided with signage/markings indicating stall is dedicated for EV charging.

END OF SECTION