SECTION 25 20 00 – TERMINAL BUILDING AUTOMATION SYSTEM (BAS)

PART 1 – GENERAL

1.1 Intent

A. The intent of this Section is to define the requirements for a terminal Building Automation System (BAS). BAS is the total integrated system of fully operational and functional elements, including, but not limited to, equipment, software, programming, and associated materials.

B. LAWA has designated the BAS for its Central Utilities Plant (Johnson Controls Metasis BACnet BAS with Wonderware Graphical User Interface) as the Facility Management Control System (FMCS) for LAX.

C. LAWA has designated an FMCS Systems Administrator (FMCS SA) to coordinate BACnet tie-in with all Terminal BAS Contractors and to perform all final termination and programming.

1.2 Summary

A. All work of this Section shall be coordinated and provided by a single BAS Contractor who shall be the primary manufacturer, installer, commissioner and ongoing service provider for the work.

B. The work of this Section shall be scheduled, coordinated and interfaced with the associated work of other trades.

C. If the BAS Contractor believes there are conflicts or missing information in the project documents, s/he shall promptly request, in writing, clarification and instruction from LAWA. In all cases, where conflicts in bid documents exist, the more extensive and costly alternative shall prevail with LAWA retaining the right to request a deduct change order to provide the lower cost alternative. Regardless, a fully functional BAS system shall be provided.

D. The BAS Contractor is responsible for integration of the BAS and FMCS systems. The BAS Contractor shall provide Point of Connection (POC) of the BAS and the FMCS. The BAS Contractor shall provide minimum of 80 hours of labor for the BAS/FMCS integration.

E. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BAS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to LAWA.

1.3 Quality Requirements

A. General Requirements

1. The BAS Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and long term maintenance and service of total integrated building automation systems, of a recognized national manufacturer of building automation systems for no less than 15 years.
2. The BAS Contractor shall have experience providing BAS services for a large campus environment comparable to LAX and for clients / organizations with similar complexity and diversity of facilities.
3. The BAS Contractor shall have a branch facility within a 50-mile radius of the LAX site.

4. As evidence and assurance of the BAS Contractor's ability to support LAWA's system with service and parts, the contractor must have been in the BAS business for at least the last fifteen (15) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years within a 100 mile radius of the LAX site.
5. The BAS architecture shall consist of the products of a manufacturer regularly engaged in the production of building automation systems, and shall be the manufacturer's latest standard of design at the time of bid.

B. Safety Requirements

1. Provide a safety program in compliance with Sections 00 73 19, 01 35 23, and 01 66 00 of the Design and Construction Handbook.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BAS Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the BAS Contractor. At minimum, the Project Manager shall:
   a) Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
   b) Manage the financial aspects of the BAS Contract.
   c) Coordinate as necessary with other trades.
   d) Be responsible for the work and actions of the BAS workforce on site.

D. Requirements of Regulatory Agencies

All work shall meet the requirements of local codes, ordinances, except where more strict requirements are specified. Codes and Standards which govern BAS work are as follows:

1. National Electric Code (NEC) and applicable local Electric Code.
2. Underwriters Laboratories (UL) listing and labels.
3. UL 916 Energy Management
4. NFPA 70 - National Electrical Code.
5. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
6. Factory Mutual (FM).
7. American National Standards Institute (ANSI).
8. National Electric Manufacturer's Association (NEMA).
9. American Society of Mechanical Engineers (ASME).
10. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
11. Air Movement and Control Association (AMCA).
12. Institute of Electrical and Electronic Engineers (IEEE).
13. American Standard Code for Information Interchange (ASCII).
14. Electronics Industries Association (EIA).
15. Occupational Safety and Health Administration (OSHA).
16. American Society for Testing and Materials (ASTM).

17. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
18. Americans Disability Act (ADA)
19. ASHRAE Standard 135 (BACnet)
20. LAWA Design & Construction Handbook

1.4 Definitions

Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.

Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level.

Control Sequence: A BAS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required attaining the defined operational control objectives.

Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.

BAS Network: The total digital on-line real-time interconnected configuration of BAS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.

Node: A digitally programmable entity existing on the BAS network.

BAS Integration: The complete functional and operational interconnection and interfacing of all BAS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BAS as required by this Section.

Provide: The term "Provide" and its derivatives when used in this Section shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.

Furnish: The term "Furnish" and its derivatives when used in this Section shall mean supply at the BAS Contractor's cost to the designated third party trade contractor for installation. BAS Contractor shall connect furnished items to the BAS, calibrate, test, commission, warrant and document.

Wiring: The term "Wiring" and its derivatives when used in this Section shall mean provide the BAS wiring and terminations.

Install: The term "Install" and its derivatives when used in this Section shall mean receive at the jobsite and mount.

Protocol: The term "protocol" and its derivatives when used in this Section shall mean a defined set of rules and standards governing the on-line exchange of data between BAS network nodes.

Software: The term "software" and its derivatives when used in this Section shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BAS industry for real-time, on-line, integrated BAS configurations.

The use of words in the singular in this Section shall not be considered as limiting when other indications in this Section denote that more than one such item is being referenced.

Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in this Section are for general information only and are to assist in the reading and interpretation of this Section.

The following abbreviations and acronyms may be used in describing the work of this Section:

ADC	-	Analog to Digital Converter
AHU	-	Air Handling Unit
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
ASHRAE		American Society of Heating, Refrigeration and Air Conditioning Engineers
AWG	-	American Wire Gauge
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
CUP	-	Central Utility Plant
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	Digital Input
DO	-	Digital Output
EEPROM	-	Electronically Erasable Programmable Read Only Memory
MPOE		Main Point of Entry
EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
FMCS	-	Facility Management Control System (located at CUP)
FMCS SA		Facility Management Controls System Administrator
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/output
IT	-	Information Technology
LAWA FMCS SA	-	LAWA FMCS System Administrator
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NAE	-	Network Automation Engine (supervisory level device)
NC	-	Normally Closed
NO	-	Normally Open
OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Device
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter

TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Device
UC	-	Unitary Controller
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

1.5 BAS Description

A. The BAS shall be a complete BACnet system designed for connection to dedicated BAS IT network at LAX. This functionality shall extend into the equipment rooms. BAS Contractor shall be responsible for coordination with LAWA's engineering staff and LAWA FMCS SA to ensure that the BAS will perform in the LAX environment without disruption to any of the other activities taking place on that LAN.

B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BAS manufacturer for use as a building operations terminal.

C. Where necessary and as dictated elsewhere in these Specifications, servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft SQL Server.

D. The work of the single BAS Contractor shall be as defined individually and collectively in all Sections of this Specification together with the associated Point Schedules and Drawings and the associated interfacing work as referenced in the related documents.

E. The BAS work shall include, but not be limited to, the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, performance bonding, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these documents which are required for the complete, fully functional and commissioned BAS.

F. Provide a complete, neat and workmanlike installation. System shall be installed by original equipment manufacturer (OEM) of the BAS products, by direct employees of the OEM, who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided.

G. Manage and coordinate the BAS work in a timely manner in accordance with LAWA-approved schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

H. The BAS as provided shall incorporate, at minimum, the following integrated features, functions and services:

1. Operator information, alarm management and control functions;
2. Enterprise-level information and control access back to the FMCS;
3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions;
4. Diagnostic monitoring and reporting of BAS functions;
5. Offsite monitoring and management access;

6. Energy management; and
7. Standard applications for terminal HVAC systems.

1.6 Work by Others

A. General Contractor is responsible for the demarcation of work and responsibilities between the BAS Contractor and other related trades and for ensuring delivery of fully functional and integrated BAS.

1.7 Submittals

A. Provide submittals in accordance with Sections 01 33 00 and 01 78 00 of the Design and Construction Handbook.

B. In addition, provide the following:

1) FMCS Integration Coordination Plan (detailing the timing in the project schedule above that the LAWA FMCS SA will be able to integrate the BAS into the FMCS and the employee of the BAS that will be made available to coordinate this critical integration).
2) BAS network architecture diagrams including all nodes and interconnections.
3) Systems schematics, sequences and flow diagrams.
4) Points schedule for each point in the BAS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
5) Samples of Graphic Display screen types and associated menus.
6) Detailed bill of materials list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
7) Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
8) Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
9) Details of all BAS interfaces and connections to the work of other trades.
10) Product data sheets or marked catalog pages including part number, photo and description for all products including software.
11) Sample thermostat (temperature sensor).

1.8 Record Documentation

A. Provide Operation and Maintenance Manuals in accordance with Section 01 78 00 of the Design and Construction Handbook.

B. In addition, provide the following:

1) Archive copy of all site-specific databases and sequences.
2) BAS network diagrams, including integration to the FMCS.
3) Interfaces to all third-party products and work by other trades.

C. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

D. After completion of all tests and adjustments the BAS Contractor shall provide a copy of all as-built information and product data to be installed on a LAWA-designated computer workstation or server.

1.9 Warranties

A. Provide Warranties in accordance with Section 01 78 00 of the Design and Construction Handbook.

B. In addition, provide the following:

1. Provide a five-year labor and material warranty on the BAS.
2. If within sixty (60) months from the date of acceptance of product, upon written notice from LAWA, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BAS Contractor at the cost of the BAS Contractor.
3. Maintain an adequate supply of materials within 50 miles of LAX such that replacement of key parts and labor support, including programming.
4. Warranty work shall be done during hours designated by LAWA.

PART 2 – GENERAL

2. <u>Part 2 – Products</u>

2.1 General Description

A. The BAS shall use BACnet open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BAS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications.

B. The BAS shall consist of the following:

1. Field Controller(s)
2. Terminal Controllers
3. Input/Output Module(s)
4. Portable Operator's Terminal(s)
5. Network processing, data storage and communications equipment
6. Other components required for a complete and working BAS

C. The BAS shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment as approved in writing by LAWA.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
2. The BAS shall maintain all settings and overrides through a system reboot.

E. Acceptable Manufacturers:

1. Johnson Controls
2. Siemens
3. Honeywell

2.2 BAS Architecture

A. Primary BAS Network

1. The primary BAS network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
2. The BAS shall network multiple User Interface clients, automation engines, system controllers and application-specific controllers. Provide application and data server(s) as required for systems operation.
3. The primary BAS network will be compatible with other enterprise-wide networks. Where indicated, the primary BAS network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

B. Secondary BAS Network

1. Secondary BAS networks shall provide either "Peer-to-Peer," or Primary-Secondary communications, and shall operate at a minimum communication speed of 9600 baud.
2. DDC Controllers shall reside on the either primary or on the secondary BAS network. All controllers shall be tied into the system so that they can be accessed via the LAN network.
3. Secondary BAS network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
4. The main equipment controllers shall reside only on the primary BAS network.

C. Integration

1. Hardwired
   a) Analog and digital signal values shall be passed from one system to another via hardwired connections.
   b) There will be one separate physical point on each system for each point to be integrated between the systems.
2. BACnet Protocol Integration - BACnet
   a) The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
   b) The ability to command, share point object data, changes of state (COS) data and schedules between the host and BACnet systems shall be provided.

2.3 User Interface

A. Dedicated User Interface.

1. Where indicated on plans the BAS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BAS to facilitate greater fault tolerance and reliability.
2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BAS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards:
   a) Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions

b) Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
c) Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries

3. PC Hardware – One (1) desktop and two (2) latest laptop personal computers by major computer manufacturer (Hewlett Packard, Dell Corporation and Toshiba) shall be configured as follows:
   a) Memory – 4 GB Minimum,
   b) CPU– 2.8 GHz Clock Speed minimum
   c) Hard Drive – 500GB free hard drive space minimum
   d) Hard drive backup system – CD/RW, DVD/RW or network backup software provided by IT department
   e) CD ROM Drive
   f) Modem: Auto-dial telephone, 56,000 baud.
   g) Ports – (1) Serial, (2) USB ports
   h) Keyboard – Desktop PC 101 Keyboard and 3 Button Mouse
   i) Monitor configuration
      I. Each Display – 22” Flat Panel Monitor
      II. 32 bit or higher color resolution
      III. Display card with multiple monitor support
   j) LAN communications – Ethernet communications board
   k) Built-in wireless 802.11 b/g/n LAN
   l) Mouse: two-button optical type wireless.

4. Operating System Software
   a) Windows 7 (32 bit)
   b) Provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
   c) Provide software registration cards to LAWA for all included software
   d) The software shall run on the Microsoft Internet Explorer (7.0 or higher) browser supporting the following functions:
      I. Configuration
      II. Commissioning
      III. Data Archiving
      IV. Monitoring
      V. Commanding
      VI. System Diagnostics

5. Peripheral Hardware
   a) Reports printer:
      I. Printer Make – Hewlett Packard DeskJet or equal
      II. Print Speed – Black 32 ppm, Color 20 ppm
      III. Print Resolution – Black 600 dpi, Color 300 dpi
      IV. Buffer – 64 K Input Print Buffer
      V. Color Printing – Include Color Kit

B. Distributed Web Based User Interface

All features and functions of the dedicated User Interface previously defined in this Section shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the primary BAS network and conforming to the following Minimum hardware requirements and compliance with LAWA IMTG Standards, Policies and Procedures:

a) 4GB RAM
b) 2.8 GHz Clock Speed Pentium 4 Microprocessor
c) 100 GB Hard Drive.
d) 1024x768 minimum resolution display with 64K colors and 32 bit color

C. Site Management User Interface Application Components

1. Operator Interface
   a) All Inputs, Outputs, Set points, and all other parameters as defined within Part 3 of this Section, or shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.
   b) The User Interface software shall provide help menus and instructions for each operation and/or application.
   c) The system shall support customization of the UI configuration and a home page display for each operator.
   d) The system shall support user preferences in the following screen presentations:
      I. Alarm
      II. Trend
      III. Display
      IV. Applications
   e) All controller software operating parameters shall be displayed for the operator to view/modify from the User Interface. These include: set points, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
   f) The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
      I. User access for selective information retrieval and control command execution
      II. Monitoring and reporting
      III. Alarm, non-normal, and return to normal condition annunciation
      IV. Selective operator override and other control actions
      V. Information archiving, manipulation, formatting, display and reporting
      VI. BAS internal performance supervision and diagnostics
      VII. On-line access to user Help menus
      VIII. On-line access to current BAS as-built records and documentation
      IX. Means for the controlled re-programming, re-configuration of BAS operation and for the manipulation of BAS database information in compliance with the prevailing codes, approvals and regulations for individual BAS applications
   g) The system shall support a list of application programs configured by the users that are called up by the following means:
      I. The Tools Menu
      II. Hyperlinks within the graphics displays
      III. Key sequences
   h) The operation of the control system shall be independent of the User Interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.
2. Alarms

a) Alarms shall be routed directly from controllers to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the User Interface shall, at the minimum, provide the following functions:
   I. Log date and time of alarm occurrence.
   II. Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
   III. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
   IV. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
   V. Provide select alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

b) The BAS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.

c) The BAS shall allow a minimum of 4 categories of alarm sounds customizable through user defined wav.files.

d) The BAS shall annunciate application alarms at minimum, as required by Part 3 of this Section.

3. Reports and Summaries

a) Reports and Summaries shall be generated and directed to the User Interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
   I. All points in the BAS
   II. All points in each BAS application
   III. All points in a specific controller
   IV. All points in a user-defined group of points
   V. All points currently in alarm
   VI. All points locked out
   VII. All user defined and adjustable variables, schedules, interlocks and the like.

b) Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.

c) Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.

d) Provide a focused set of reports that includes essential information required for effective management of energy resources within the facility. Energy reports shall be configurable from a LAWA-selected and approved predefined, preconfigured templates. Requirements include, but shall not be limited to:
   I. Energy Overview
   II. Load Profile
   III. Simple Energy Cost
   IV. Consumption
   V. Equipment Runtime
   VI. Electrical Energy
   VII. Energy Production
   VIII. Reports shall be selectable by date, time, area and device. Each report shall include a color visual summary of essential energy information.

4. Schedules
    a) A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
        I. Weekly schedules
        II. Exception Schedules
        III. Monthly calendars
    b) Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
    c) It shall be possible to define one or more exception schedules for each schedule including references to calendars.
    d) Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
    e) Schedules and Calendars shall comply with ASHRAE SP135/ BACnet Standard.
    f) Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.
    g) The Controllers shall have capability to configure and implement optimal start and stop programming based on existing indoor and outdoor environmental conditions as well as equipment operating history

5. Password
    a) Multiple-level password access protection shall be provided to allow the user/manager to User Interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
    b) Each user shall have the following: a user name (accept 24 characters minimum), a password (accept 12 characters minimum), and access levels.
    c) The system shall allow each user to change his or her password at will.
    d) When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
    e) A minimum of six levels of access shall be supported individually or in any combination as follows:
        I. Level 1 = View Data
        II. Level 2 = Command
        III. Level 3 = Operator Overrides
        IV. Level 4 = Database Modification
        V. Level 5 = Database Configuration
        VI. Level 6 = All privileges, including Password Add/Modify
    f) A minimum of 100 unique passwords shall be supported.
    g) Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
    h) Operators shall be further limited to only access, command, and modify those buildings, systems, and subsystems for which they have responsibility.
    i) The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.

6. Screen Manager

a) The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.

7. Dynamic Color Graphics
   a) The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
   b) The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
   c) The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
   d) Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a User Interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
      I. All graphics shall be fully scalable
      II. The graphics shall support a maintained aspect ratio.
      III. Multiple fonts shall be supported.
      IV. Unique background shall be assignable on a per graphic basis.
      V. The color of all animations and values on displays shall indicate the status of the object attribute.
      VI. Graphics that represent buildings or systems shall allow natural links and transitions between related detailed tabular views of data that complement the graphic.
   e) Operation from graphics – It shall be possible to change values (set points) and states in system controlled equipment directly from the graphic.
   f) Floor Plan graphics – The User Interface shall provide graphic applications that summarize conditions on a floor. Floor plan graphics shall indicate thermal comfort using dynamic colors to represent zone temperature deviations from zone set point(s). Floor plan graphics shall display overall metrics for each zone in the floor.

8. Historical trending and data collection
   a) Each Controller shall store trend and point history data for all analog and digital inputs and outputs, as follows:
      I. Any point, physical or calculated, may be designated for trending. Two methods of collection shall be allowed:
         i. Defined time interval
         ii. Upon a change of value
      II. Each Controller shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
   b) Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis.
   c) The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in SQL database format.

9. Trend data viewing and analysis
   a) Provide a trend viewing utility that shall have access to all database points.

b) It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
c) The trend viewing utility shall have the capability to define trend study displays to include multiple trends
d) Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
e) Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. The Display shall support the user's ability to change colors, sample sizes, and types of markers.

10. Database Management
    a) Where a separate SQL database is utilized for information storage the System shall provide a Database Manager that separates the database monitoring and managing functions by supporting two separate windows.
    b) Database secure access shall be accomplished using standard SQL authentication including the ability to access data for use outside of the Building Automation application.
    c) The database managing function shall include summarized information on trend, alarm, event, and audit for the following database management actions:
        I. Backup
        II. Purge
        III. Restore
    d) The Database management function shall support four tabs:
        I. Statistics – shall display Database Server information and Trend, Alarm (Event), and Audit information on the BAS Databases.
        II. Maintenance – shall provide an easy method of purging records from the BAS Server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting the database, and allowing for the retention of a selected number of day's data.
        III. Backup – Shall provide the means to create a database backup file and select a storage location.
        IV. Restore – shall provide a restricted means of restoring a database by requiring the user to log into an Expert Mode in order to view the Restore screen.
    e) The database monitoring functions shall be accessed through Microsoft Windows and shall continuously read database information once the user has logged in.
    f) The System shall provide user notification via taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.
    g) The Monitoring Settings window shall have the following sections:
        I. General – Shall allow the user to set and review scan intervals and start times.
        II. Email – Shall allow the user to create and review e-mail and phone text messages to be delivered when a Warning or Alarm is generated.
        III. Warning – shall allow the user to define the Warning limit parameters, set the Reminder Frequency, and link the e-mail message
        IV. Alarm – shall allow the user to define the Alarm limit parameters, set the Reminder Frequency, and link the e-mail message.
        V. Database login – Shall protect the system from unauthorized database manipulation by creating a Read Access and a Write Access for each of the Trend, Alarm (Event) and Audit databases as well as an Expert Mode required to restore a database.
    h) The System shall provide user notification via Taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.

11. Demand Limiting and Load Rolling
    a) The BAS shall:

i. Provide a Demand Limiting and Load Rolling program for the purpose of limiting peak energy usage and reducing overall energy consumption.
ii. Support both Sliding Window and Fixed Window methods of predicting demand.
iii. Support three levels of sensitivity in the Sliding Window demand calculations for fine tuning the system.
    1. Low Setting – Sheds loads later and over the shortest amount of time. Maximizes the time the equipment is on.
    2. Medium Setting – Sheds loads earlier over a longer amount of time than the Low Setting. Increases the time the equipment is on and decreases the probability of exceeding the Tariff Target over the Low Setting.
    3. High Setting – Sheds loads earlier over a longer amount of time than the Medium Setting to minimize the probability of exceeding the Tariff Target.
iv. Have both a Shed Mode and a Monitor Only Mode of operation.
    1. When the Shed Mode is engaged, the BAS shall actively control the Demand.
    2. When the Monitor Mode is engaged, the BAS will simulate the shedding action but will not take any action.
v. Support a Maximum Shed Time for each load as determined by the user. The BAS shall restore the load before the Maximum Shed time has expired.
vi. Support a Minimum Shed Time for each load as determined by the user. The BAS shall not restore the load sooner than the Minimum Shed Time has expired.
vii. Support a Minimum Release Time for each load as determined by the user. The BAS shall not shed the load until it has been off for the Minimum Release time.
viii. Support three user defined options if the meter goes unreliable.
    1. Shedding – The currently shed loads will be released as their Maximum shed times expire.
    2. Maintain the Current Shed Rate – The BAS will use the Demand Limiting shed rate that was present when the meter went unreliable.
    3. Use Unreliable Meter Shed Rate – the BAS will control to a user defined Unreliable Shed Rate target.

b) The Demand Limiting program shall:
    i. Monitor the energy consumption rate and compare it to a user defined Tariff Target. The system shall maintain consumption below the target by selectively shedding loads based upon a user defined strategy.
    ii. Be capable of supporting a minimum of 10 separate Load Priorities. Each load shall be user assigned to a Load Priority.
    iii. Be capable of supporting a minimum of 12 separate Tariff Targets defining the maximum allowed average power during the current interval.

c) The Load Rolling program shall:
    i. Sum the loads currently shed and compare it to a user defined Load Rolling Target. The BAS shall maintain consumption below the target by selectively shedding loads based upon a user defined Load Priority.
    ii. Be capable of supporting a minimum of 10 separate Load Priorities. Each load shall be user assigned to a Load Priority.
    iii. Be capable of supporting a minimum of 12 separate Tariff Targets defining the amount of power by which the demand must be reduced.

d) Provide the user with a Load Tab that displays all of the Demand Limiting and Load Rolling parameters for any selected load.

e) Provide the user with a Load Summary that displays all of the loads associated with the Demand Limiting and Load Rolling programs. Status Icons for each load shall indicate:
    i. Load is Offline

ii. Load is Disabled
iii. Load is Shed
iv. Load is Locked
v. Load is in Comfort Override

f) The Load Summary shall include a Load Summary Runtime view listing the following load conditions:
i. Load Priority
ii. Shed Strategy
iii. Load Rating
iv. Present Value
v. Ineligibility Status
vi. Active Timer
vii. Time Remaining
viii. Last Shed Time

12. Other Utilities Software

a) The BAS shall be capable of supporting any other LAWA-approved utilities software, including, but not limited to Energy Star and Maximo.

2.4 DDC System Controllers

A. Unitary Controller (UC)

1. General

a. The facility BAS shall include BTL-listed, microprocessor-based, direct digital control UCs.
b. UCs shall provide control of HVAC and other integrated controllable functions. Each controller shall have its own control programs and shall continue to operate in the event of a failure or communication loss to its associated DDCP.
c. UCs shall be provided for variable air volume (VAV) boxes and fan coil units as required to satisfy the sequences of operation.
d. VAV box UCs shall be provided with 120/24 Volt transformers (or as required/coordinated with mechanical specifications for operation) to the VAV box manufacturers for factory mounting.
e. UCs shall be programmable from either the FMCS workstations or by the Portable Terminal Unit connected locally. The necessary hardware and software required for communication with the UC, from either the FMCS (Servers) or via a Portable Operator Terminal Unit, shall be provided including licensing requirements.
f. The BACnet Protocol Implementation Statement shall be submitted for each type of the UC.

2. Components

a. Memory: Control programs shall be stored in battery backed-up RAM and EPROM. Each system controller shall have a minimum of 64 MB of user RAM memory and 64 MB of EPROM.
b. Communication Ports: UCs shall provide a communication port to the field bus. In addition, a port shall be provided for connection of a portable service tool to support local commissioning and parameter changes with or without the DDCP online. It shall be possible from a service port on any UC to view, enable /disable, and modify values of any point or program on any controller on the local field bus, any DDCP or any UC on a different field bus.
c. I/O: Each UC shall support the addition of the following types of inputs and outputs:

I. Digital inputs for status and alarm contacts;
II. Counter inputs for summing pulses from meters;
III. Thermistor inputs for measuring temperatures in space, ducts, and thermo wells;
IV. Analog inputs for pressure, humidity, flow, and position measurements;
V. Digital outputs for on and off equipment control; and
VI. Analog outputs for valve and damper position control, and capacity control of primary equipment.

d. Expandability: Input and output capacity shall be expandable through the use of plug-in modules. A minimum of two modules shall be added to the base UC before additional power is required.
e. Networking: Each UC shall be able to exchange information on a peer-to-peer basis with other Stand-alone Digital Control Units during each field bus scan. Each UC shall be capable of storing and referencing global variables (on the LAN) with or without any FMCS workstations online. Each UC shall be able to have its program viewed and/or enabled/disabled either locally through a BAS Portable Operator's Terminal or through a FMCS workstation.
f. Indicator Lamps: UCs shall have an optional, LED indication of CPU status, and field bus status.
g. Real-Time Clock. A UC shall have a real-time clock in either hardware or software. The accuracy shall be within 10 seconds per day. The real-time clock shall provide the following information: time of day, day, month, year, and day of week. Each UC shall receive a signal, every hour, over the network from the DDCP that synchronizes all UC real-time clocks.
h. Automatic Restart after Power Failure: Upon restoration of power, the UC shall automatically and without human intervention, update all monitored functions; resume operation based on current, synchronized time and status; and implement special startup strategies as required.
i. Battery Back-Up: Each UC shall have at least three (3) years of battery backup to maintain all volatile memory. System shall be interfaced with the building UPS System.
j. Alarm Management.
   I. For each system point, alarms can be created based on high and low limits or conditional expressions. All alarms shall be tested each scan of the UC and can result in the display of one or more alarm messages or reports.
   II. Up to eight (8) alarms can be configured for each point in the controller, enabling the escalation of the alarm priority (urgency) based upon which alarm(s) is/are triggered.
   III. Alarms shall be generated based on their priority. A minimum of 255 priority levels shall be provided.
   IV. If communication with the DDCP is temporarily interrupted, the alarm shall be buffered in the UC. When communications return, the alarm shall be transmitted to the DDCP if the point is still in the alarm condition.

B. System Software

1. General

a. All necessary software to form a complete operating system as described in this specification shall be provided.
b. The software programs specified in this section shall be provided as an integral part of the DDC controller and shall not be dependent upon any higher level computer for execution.

2. Control Software Description:

a. Pre-Tested Control Algorithms: The DDC controllers shall have the ability to perform the following pre-tested control algorithms:
   I. Two Position Control
   II. Proportional Control
   III. Proportional plus Integral Control
   IV. Proportional, Integral, plus Derivative Control
   V. Automatic Control Loop Tuning

b. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
c. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
d. Power fail Motor Restart: Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation. (i.e. - Restart of equipment following the return to normal condition after equipment shutdown by the Fire Alarm System).
e. Sequential Start: Provide sequential start for all equipment. After a power failure, and after restoration of normal power, equipment shall start per a predetermined sequence as programmed via the BAS.

3. Energy Management Applications: DDC controllers shall have the ability to perform any or all of the following energy management routines:

   a. Time-of-Day Scheduling
   b. Calendar Based Scheduling
   c. Holiday Scheduling
   d. Temporary Schedule Overrides
   e. Optimal Start/Optimal Stop
   f. Night Setback Control
   g. Enthalpy Switch Over (Economizer)
   h. Peak Demand Limiting
   i. Energy Usage & Demand
   j. Fan Speed/CFM Control
   k. Heating/Cooling Interlock
   l. Supply Air Reset
   m. Chilled Water Reset
   n. Condenser Water Reset
   o. Hot Water Reset
   p. Chiller Sequencing

4. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow operator customization. Programs shall be applied to building equipment as described in the Execution portion of this specification.

5. Custom Process Programming Capability: DDC controllers shall be able to execute custom, job-specific processes defined by the operator, to automatically perform calculations and special control routines.

   a. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:
      I. Any system-measured point data or status
      II. Any calculated data
      III. Any results from other processes
      IV. User-Defined Constants
      V. Arithmetic functions (+,-,*, /, square root, exponential, etc.)
      VI. Boolean logic operators (and, or, exclusive or, etc.)

VII. On-delay/Off-delay/One-shot timers

b. Process Triggers: Custom processes may be triggered based on any combination of the following:
   I. Time interval
   II. Time of day
   III. Date
   IV. Other processes
   V. Time programming
   VI. Events (e.g., point alarms)
   VII. Restart of equipment following the return to normal condition after equipment shutdown by the Fire Alarm System (FAS)

6. Dynamic Data Access: A single process shall be able to incorporate measured or calculated data from any and all other DDC controllers on the local area network. In addition, a single process shall be able to issue commands to points in any and all other DDC panels on the local area network.

7. Advisory/Message Generation: Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device, buffer the information in a follow-up file, or cause the execution of a dial-up connection to a remote device such as a printer.

8. Custom Process Documentation: The custom control programming feature shall be self-documenting. All interrelationships defined by this feature shall be documented via graphical flowcharts and English language descriptors.

9. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each DDC controller shall perform distributed independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall the DDC's ability to report alarms be affected by either operator activity at a PC Workstation or local I/O device, or communications with other panels on the network. Each analog input shall have associated alarm and pre-alarm (warning) levels that are software adjustable. Provide a minimum of one high alarm, one high warning alarm, one low alarm and one low warning alarm level per analog input.

   a. Point Change Report Description: All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
   b. Prioritization: The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Each DDC shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point as well as be able to define under which conditions point changes need to be acknowledged by an operator, and/or sent to follow-up files for retrieval and analysis at a later date.
   c. Report Routing: Alarm reports, messages, and files will be directed to a user-defined list of operator devices or PC disk files used for archiving alarm information. Alarms shall also be automatically directed to a default device in the event a primary device is found to be off-line.
   d. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a minimum 65-character alarm message to more fully describe the alarm condition or direct operator response. Each standalone DDC shall be capable of storing a library of at least 250 Alarm Messages which are assignable to any number of points in the panel.
   e. Auto-Dial Alarm Management: In Dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by

time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

f. Transaction Logging: Operator commands and system events shall be automatically logged to disk in Personal Computer industry standard database format. Operator commands initiated from Direct-connected workstations, dial-up workstations, and local DDC panel Network Terminal devices shall all be logged to this transaction file. This data shall be available at the Operator Interface Workstation (OIW). Facility shall be provided to allow the user to search the transaction file using standard database query techniques, including searching by dates, operator name, data point name, etc. In addition, this transaction file shall be accessible with standard third party database and spreadsheet packages.

10. Historical Data and Trend Analysis: A variety of historical data collection utilities shall be provided to automatically sample, store, and display system data in all of the following ways:

a. Continuous Point Histories: Standalone DDC's shall store Point History Files for all analog and binary inputs and outputs. The Point History routine shall continuously and automatically sample the value of all analog inputs at half hour intervals. Samples for all points shall be stored for the past 24 hours to allow the user to immediately analyze equipment performance and all problem-related events for the past day. Point History Files for binary input or output points and analog output points shall include a continuous record of the last ten status changes or commands for each point.

b. Control Loop Performance Trends: Standalone DDC's shall also provide high resolution sampling capability in one-second increments for verification of control loop performance.

c. Extended Sample Period Trends: Measured and calculated analog and binary data shall also be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 2 hours shall be provided. Each standalone DDC shall have a dedicated buffer for trend data, and shall be capable of storing a minimum of 5000 data samples.

d. Data Storage and Archiving: Trend data shall be stored at the Standalone DDC's, and uploaded to hard disk storage when archival is desired. Uploads shall occur based upon either user-defined interval, manual command, or when the trend buffers become full. All trend data shall be available in disk file format compatible with Third Party personal computer applications.

11. Runtime Tantalization: Standalone DDC panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the Execution portion of this specification.

a. The Tantalization routine shall have a sampling resolution of one minute or less.

b. The user shall have the ability to define a warning limit for Runtime Tantalization. Unique, user-specified messages shall be generated when the limit is reached.

12. Analog/Pulse Tantalization: Standalone DDC's shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.

a. Tantalization shall provide calculation and storage of accumulations of up to 99,999.9 units (e.g. KWH, gallons, KBTU, tons. etc.).

b. The Tantalization routine shall have a sampling resolution of one minute or less.

c. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

13. Event Totalization: Standalone DDC panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event Totalization shall be performed on a daily, weekly, or monthly basis.

a. The Event Tantalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

b. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

C. VAV TERMINAL UNIT CONTROLLER (VAV - UC)

1. General: Ship VAV UC Controllers to terminal box manufacturer's factory for controller mounting prior to shipping to site. Coordinate with Box manufacturer.

2. The VAV UC shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units.

3. The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.

4. The VAV UC shall be a configurable digital controller with an integral differential pressure transducer. It shall be compatible with 3 wire (incremental) and proportional damper actuators.

5. The VAV UC shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.

6. Each VAV UC shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

7. The VAV UC shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.

8. Each VAV UC shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

9. The VAV UC shall provide the ability to download and upload UC configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.

10. UC control set point changes initiated over the network shall be written to UC non-volatile memory to prevent loss of set point changes and to provide consistent operation in the event of communication failure.

11. The VAV UC firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

12. The VAV UC shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.

13. The VAV UC shall interface with balancer tools that allow automatic recalculation of box flow pickup gain ("K" factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow set points.

14. The VAV UC shall be capable of direct electronic connection to a balancing hood. Connection shall be through a port located on the room sensor, or directly at the controller. As an alternative, software balancing tools shall be provided that will run in a hand-held Palm Pilot type PC (such as the 3COM Palm Pilot or IBM Workpad). The balancing tools shall allow adjustment of airflow set points and

parameters, and provide permanent upload of the values entered to the UC. The Palm Pilot shall connect to the terminal unit through the room sensor port.

15. The VAV UC performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop's sample interval, which may be used to continuously monitor and document system performance. The UC shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.

    a. Absolute temperature loop error.
    b. Signed temperature loop error.
    c. Absolute airflow loop error.
    d. Signed airflow loop error.
    e. Average damper actuator duty cycle.

16. The VAV UC shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:

    a. Unreliable space temperature sensor.
    b. Unreliable differential pressure sensor.
    c. Starved box.
    d. Insufficient cooling.
    e. Insufficient heating.

17. The VAV UC shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow based on the percent of outdoor air in the primary air stream.

18. The VAV UC shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

19. The VAV UC shall be compatible with the U.S. EPA Energy Star Buildings recommendations for fan energy reduction via demand-based static pressure reset down to 2/3 of duct static pressure set point, "VSD 2/3 Reset."

20. Inputs:

    a. Analog inputs shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:

        i. 0-10 VDC Sensors
        ii. 4-20 mA Sensors
        iii. 1000ohm RTDs
        iv. NTC Thermistors

    b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
    c. For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.

21. Outputs

    a. Analog outputs shall provide the following control outputs:

i. 0-10 VDC
ii. 4-20 mA

b. Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
c. For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

2.5 Field Devices

A. Input/Output Module **(IOM)**

1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the UC.
2. The IOM shall communicate with the UC over the Bus.
3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
   a) The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
   b) The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
   c) A BACnet Protocol Implementation Conformance Statement shall be provided for the UCorFC .
   d) The Conformance Statement shall be submitted 10 days prior to bidding.
4. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
5. The IOM shall have a minimum of 4 points to a maximum of 17 points.
6. The IOM shall support the following types of inputs and outputs:
   a) Universal Inputs - shall be configured to monitor any of the following:
      I. Analog Input, Voltage Mode
      II. Analog Input, Current Mode
      III. Analog Input, Resistive Mode
      IV. Binary Input, Dry Contact Maintained Mode
      V. Binary Input, Pulse Counter Mode
   b) Binary Inputs - shall be configured to monitor either of the following:
      I. Dry Contact Maintained Mode
      II. Pulse Counter Mode
   c) Analog Outputs - shall be configured to output either of the following
      I. Analog Output, Voltage Mode
      II. Analog Output, current Mode
   d) Binary Outputs - shall output the following:
      I. 24 VAC Triac
   e) Configurable Outputs - shall be capable of the following:
      I. Analog Output, Voltage Mode
      II. Binary Output Mode
7. The IOM shall include troubleshooting LED indicators to identify the following conditions:
   a) Power On
   b) Power Off
   c) Download or Startup in progress, not ready for normal operation
   d) No Faults
   e) Device Fault
   f) Normal Data Transmission
   g) No Data Transmission
   h) No Communication

B. Terminal Controller (TC)

1. The TC shall be capable of controlling two- or four-pipe fan coils, cabinet unit heaters or other similar equipment, pressure dependent Variable Air Volume System or other similar zoning type systems employing reheat including local hydraulic reheat valves, two pipe fan coil, cabinet unit heater or other similar equipment with single-speed fan control.
2. The TC shall communicate over the Field Controller Bus using BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
3. The TC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
   a) The TC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
   b) A BACnet Protocol Implementation Conformance Statement shall be provided for the TC.
   c) The Conformance Statement shall be submitted 10 days prior to bidding.
4. The TC shall support remote read/write and parameter adjustment from the web based User Interface through a Network Automation Engine.
5. The TC shall include an intuitive User Interface providing plain text messages.
   a) Two line, 8 character backlit display
6. The TC shall provide the flexibility to support any one of the following inputs:
   a) Integral Indoor Air Temperature Sensor
   b) Duct Mount Air Temperature Sensor
   c) Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator
   d) Two configurable binary inputs
7. Provide the flexibility to support any one of the following:
   a) Three Speed Fan Control
   b) Two On/Off
   c) Two Floating
   d) Two Proportional (0 to 10V)
8. The TC shall provide a minimum of six (6) levels of keypad lockout.
9. The TC shall provide the flexibility to adjust the following parameters:
   a) Adjustable Temporary Occupancy from 0 to 24 hours
   b) Adjustable heating/cooling deadband from 2º F to 5º F
   c) Adjustable heating/cooling cycles per hour from 4 to 8
10. Where required by application and indicated on plans or room schedules provide the TEC with an integral Passive Infra-Red (PIR) occupancy sensor.
11. The TC shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.
12. The VMA shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.
13. The VMA shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
    a) The VMA shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
    b) A BACnet Protocol Implementation Conformance Statement shall be provided for the VMA.
    c) The Conformance Statement shall be submitted. The VMA shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.

14. The VMA shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.
15. The VMA shall be a configurable digital controller with integral differential pressure transducer.. All components shall be connected and mounted as a single assembly that can be removed as one piece.
16. The VMA shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
17. The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.
18. Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.
19. The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
20. Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.
21. The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
22. Control set point changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of set point changes and to provide consistent operation in the event of communication failure.
23. The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
24. The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.
25. The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain (“K” factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow set points.
26. Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop’s sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.
    a) Absolute temperature loop error
    b) Signed temperature loop error
    c) Absolute airflow loop error
    d) Signed airflow loop error
    e) Average damper actuator duty cycle
27. The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:
    a) Unreliable space temperature sensor
    b) Unreliable differential pressure sensor
    c) Starved box
    d) Actuator stall
    e) Insufficient cooling

f) Insufficient heating

19. The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.
20. The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow Based on the percent of outdoor air in the primary air stream.
21. The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.
22. Inputs:
    a) Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:
        I. 0-10 VDC Sensors
        II. 1000ohm RTDs
        III. NTC Thermistors
    b) Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."
    c) For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
    d) Provide side loop application for humidity control.
23. Outputs
    a) Analog outputs shall provide the following control outputs:
        1. 0-10 VDC
        2. 4-20 mA.
    b) Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.
    c) For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.
24. Application Configuration
    a) The VMA shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.
25. Sensor Support
    a) The VMA shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
    b) The VMA shall support an LCD display room sensor.
    c) The VMA shall also support standard room sensors as defined by analog input requirements.
    d) The VMA shall support humidity sensors defined by the AI side loop.

C. Installation, testing, and calibration of all devices shall be provided to meet the system requirements.

2.6 Input Devices

A. General Requirements:

1. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.

2. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
3. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	$\pm$ .5°F.
Room Temp	$\pm$ .5°F.
Duct Temperature	$\pm$ .5°F.
All Others	$\pm$ .75°F.

B. Room Temperature Sensors
1. Room sensors shall be constructed for either surface or wall box mounting.
2. Room sensors shall have the following options when specified:
   a) Set point reset slide switch providing a $\pm$3 degree (adjustable) range.
   b) Individual heating/cooling set point slide switches.
   c) A momentary override request push button for activation of after-hours operation.
   d) Analog thermometer.

C. Room Temperature Sensors with Integral Display
1. Room sensors shall be constructed for either surface or wall box mounting.
2. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
   a) Display room and outside air temperatures.
   b) Display and adjust room comfort set point.
   c) Display and adjust fan operation status.
   d) Timed override request push button with LED status for activation of after-hours operation.
   e) Display controller mode.
   f) Password selectable adjustment of set point and override modes.

D. Thermo Wells
1. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
2. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
3. Thermo wells and sensors shall be mounted in a threadolet or 1/2” NFT saddle and allow easy access to the sensor for repair or replacement.
4. Thermo wells shall be constructed of 316 stainless steel.

E. Outside Air Sensors
1. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
2. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
3. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

F. Duct Mount Sensors
1. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.

2. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
3. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

G. Averaging Sensors

1. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
2. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment
3. Acceptable Manufacturers: Setra. Johnson Controls, Siemens

H. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
7. Acceptable Manufacturers: Veris Industries, and Mamac.

I. Differential Pressure Transmitters

1. General Air and Water Pressure Transmitter Requirements:
   a) Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
   b) Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
   c) Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Mechanical Contractor and LAWA permanent, easy-to-use connection.
   d) A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Low Differential Water Pressure Applications (0” - 20” W.C.)
   a) The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
   b) The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

I. .01-20” W.C. input differential pressure range.
II. 4-20 mA output.
III. Maintain accuracy up to 20 to 1 ratio turndown.
IV. Reference Accuracy: +0.2% of full span.

c) Acceptable Manufacturers: Setra and Mamac.

3. Medium to High Differential Water Pressure Applications (Over 21” W.C.)
   a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
      I. Differential pressure range 10” W.C. to 300 PSI.
      II. Reference Accuracy: ±1% of full span (includes non-linearity, hysteresis, and repeatability).
   b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
   c. Acceptable Manufacturers: Setra, Mamac Rosemount .
4. Building Differential Air Pressure Applications (-1” to +1” W.C.)
   a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      I. -1.00 to +1.00 W.C. input differential pressure ranges. (Select range appropriate for system application)
      II. 4-20 mA output.
      III. Maintain accuracy up to 20 to 1 ratio turndown.
      IV. Reference Accuracy: +0.2% of full span.
   c. Acceptable Manufacturers: Johnson Controls, Siemens and Setra.
5. Low Differential Air Pressure Applications (0” to 5” W.C.)
   a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
   b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
      I. (0.00 - 1.00” to 5.00”) W.C. input differential pressure ranges. (Select range appropriate for system application.)
      II. 4-20 mA output.
      III. Maintain accuracy up to 20 to 1 ratio turndown.
      IV. Reference Accuracy: +0.2% of full span.
   c. Acceptable Manufacturers: Johnson Controls , Siemens and Setra.

6. Indoor Air Quality (CO2) Sensors- Wall and Duct Mounted

   a. Provide indoor air quality sensors to monitor Carbon Dioxide (CO2). The sensors shall be of microprocessor-based photo-acoustic type with heated stannic dioxide semiconductor.
   b. The CO2 sensors shall have no more than 1% drift during the first year of operation and minimal drift thereafter so that no calibration will be required.
   c. The units shall be wall or duct mounted type as indicated on plans and in the sequence of operation.
   d. Wall mounted sensors shall be provided with white plastic cover, without LED indicators.
   e. Duct mounted sensors shall be provided with LED indicators in a dust proof plastic housing with transparent cover.

f. The sensor shall meet the following requirements:

I. Operating voltage: 24 VAC +/- 20%
II. Frequency: 50/60 Hz
III. Power consumption: max. 6 VA
IV. CO2 measuring range:0 – 2000 ppm
V. Tolerance: +/- 100 ppm
VI. Output: 0 – 10 VAC
VII. Calibration: none required
VIII. Permissible air velocity in duct: <26.2 Ft/s.
IX. The sensors shall be model: Siemens QPA63 Series, Johnson Controls, Honeywell or approved equal

7. Carbon Monoxide (CO) Transmitter

a. Sensor assemblies to be rated general purpose and suitable for N.E.C. installation. (NEMA 1 enclosure).
b. Carbon monoxide analyzer shall be capable of measurement in the range of 0-500 parts per million with 4-20 mA output. (7000 to 9000 square feet per sensor).
c. Operating temperature: -15 deg C to 40 deg C
d. Stability: ±1%
e. Repeatability: less than ±2% full scale
f. Manufacturer: Sensor shall be Brasch gas detector or as approved by the Engineer

8. Medium Differential Air Pressure Applications (5” to 21” W.C.)

a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressures transmitters shall be provided that meet the following performance requirements:
   I. Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
   II. Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
   III. Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
c. Acceptable manufacturers: Johnson Controls, Siemens and Setra.

J. Flow Monitoring

1. Air Flow Monitoring

a. AHU Fan Inlet Air Flow Measuring Stations
   1. At the inlet of each fan and near the exit of the inlet sound trap, airflow sensors which continuously monitor the fan air volumes and system velocity pressure shall be provided. The AHU air flow measuring stations and the transmitters are to be provided and installed by the AHU manufacturer.
   2. Each sensor shall be surface mount type. Unit shall be capable of monitoring and reporting the airflow and temperature at each fan inlet location through two or four sensing circuits. If a static pressure manifold is used, it shall incorporate dual offset

static tops on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as $\pm$ 20° in the approaching air stream.

3. Devices creating fan performance degradation, resulting in additional energy consumption, caused from pressure drop associated with probes or mounting apparatus in the center of the fan inlet are not allowed. The device shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Sensor circuit casings shall be constructed of U.L. 94 flame rated high impact ABS and include a stainless steel thermistor cap that maintains the precise calibrated flow over the heated and ambient measurement points. Each sensor circuit shall consist of two ceramic base, glass encapsulated, thermistors for measuring ambient temperature and velocity. Circuit shall be designed for operation in a wide range of environments, including high humidity and rapid thermal cycling.
4. Acceptable manufacturers are: Johnson Controls, Air Monitor Corp., Tek-Air Systems, Inc., or Dietrich Standard.

b. Single Probe Air Flow Measuring Sensor
1. The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a hot wire anemometer and utilize two temperature sensors and a heater element temperature. The other sensor shall measure the downstream air temperature. The temperature differential shall be directly related to airflow velocity.

c. Duct Air Flow Measuring Stations
1. Furnish and install, at locations shown on plans or as in accordance with schedules, an equalized air measuring probe system piped to a high performance pressure transducer or an electronic type airflow temperature measuring station.
2. Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.
3. Assembly shall be AMCA tested and capable of measuring a range from 70 to 5,000 FPM (22 to 2224 MPM).
1. Equalized air measuring assembly shall measure to ±3% average and consist of 6063T5 extruded aluminum step sensing blade(s) with anodized finish, plenum-rated polyethylene pressure tubing, brass barbed fittings, mounting hardware and a glass-on-silicone capacitance sensor pressure transducer capable of measuring up to six field-selectable pressure ranges up to 1 in. W.C.
2. The transducer shall be accurate to ±1% of full scale and be contained in a National Electrical Manufacturer’s Association (NEMA) 4 (IP-65) enclosure. Transducer shall be factory mounted and piped to high and low pressure ports through fittings made of brass.
3. All sensor tubing shall terminate in solid brass barbed fittings.
4. Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.
5. Air straightener shall be provided for sizes over 17 square feet (1.6 sq meters).
6. Airflow measuring station assemblies shall be fabricated of galvanized steel or aluminum casing of appropriate thickness for slip fits or with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air direction analyzer and parallel cell profile suppressor (3/4” maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air direction analyzer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.
7. Electronic air measuring station shall be capable of monitoring and reporting the airflow and temperature at each measuring location through one or more measuring

probes containing multiple sensor points and a control transmitter that communicates with the BAS.

8. Probe(s) shall be constructed of an airfoil shaped aluminum extrusion containing the sensor circuit(s).
9. Each sensor circuit shall consist of coated thermistors, for temperature and velocity, mounted to a Printed Circuit Board (PCB).
10. Probe multiplexer circuit(s) shall include a microprocessor that collects data from each PCB and digitally communicates the average airflow and temperature of each probe to a microprocessor based control transmitter.
11. Multiplexer board shall be encased to prevent moisture damage.
12. Shielded CAT5e communications cable shall be Underwriters Laboratories Inc.® (UL) plenum-rated with RJ45 terminal connectors. Dust boot covers and gold-plated contacts shall link probes to electronic controller.
13. Control transmitter shall be capable of processing independent sensing points and shall operate on a fused 24 VAC supply.
14. Control transmitter shall feature a 16 x 2 character alphanumeric LCD screen, digital offset/gain adjustment, continuous performing sensor/transmitter diagnostics, and a visual alarm to detect malfunctions.
15. All electronic components of the assembly shall be Restriction of Hazardous Substances (RoHS) Directive compliant.
16. Installation Considerations

    i. The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .065” W.C. at 1000 feet per minute, or .23” W.C. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 2% as determined by U.S. – GSA certification tests, and shall contain a minimum of one total pressure sensor per 36 square inches of unit measuring area.

    ii. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.

    iii. Where control dampers are shown as part of the airflow measuring station, parallel blade precision controlled volume dampers integral to the station and complete with actuator, and linkage shall be provided.

    iv. Stations shall be installed in strict accordance with the manufacturer’s published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.

17. All air measuring devices shall be tested according to AMCA Standard 610
18. Acceptable manufacturers: Johnson Controls, Air Monitor Corp., Tek-Air, and Dietrich Standard.

d. Static Pressure Traverse Probe
   I. Duct static probes shall be provided where required to monitor duct static pressure. Acceptable manufacturers: Cleveland Controls

2. Water Flow Monitoring
   a. Water flow meters shall be electromagnetic type with integral microprocessor-based electronics. The meter shall have an accuracy of 0.25%.
   b. Acceptable manufacturers: Onicon

K. Power Monitoring Devices

1. Current Measurement (Amps)

a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.

b. Current Transformer – A split core current transformer shall be provided to monitor motor amps.

   I. Operating frequency – 50 - 400 Hz.
   II. Insulation – 0.6 Kv class 10Kv BIL.
   III. UL recognized.
   IV. Five amps secondary.
   V. Select current ration as appropriate for application.
   VI. Acceptable manufacturers: Veris Industries

c. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:

   I. 6X input over amp rating for AC inrushes of up to 120 amps.
   II. Manufactured to UL 1244.
   III. Accuracy: +.5%, Ripple +1%.
   IV. Minimum load resistance 30kOhm.
   V. Input 0-20 Amps.
   VI. Output 4-20 mA.
   VII. Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
   VIII. Acceptable manufacturers: Veris Industries

L. Refrigerant Leak Detectors

1. The refrigerant leak detector shall be a standalone device and shall provide a SPDT output to directly energize the refrigeration room exhaust ventilation fans. The detector shall include a sensor or sensors connected to a control panel. Two relay contacts at the control panel shall provide trouble and alarm indication to the Facility Management System. The alarm relay contact shall also directly energize the exhaust fans.

2. The refrigerant leak detector shall sense the type of refrigerant used in the specified chillers. Multiple sensors shall be required to detect different refrigerants and/or provide proper sensing coverage for the area of the refrigeration room.

3. Acceptable manufacturers, MSA Instruments

M. Status and Safety Switches

1. General Requirements

   a) Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BAS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

   a) The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
   b) Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
   c) Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
   d) Acceptable manufacturers: Veris Industries

3. Air Filter Status Switches
   a) Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
   b) A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
   c) Provide appropriate scale range and differential adjustment for intended service.
   d) Acceptable manufacturers: Cleveland Controls

4. Air Flow Switches
   a) Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
   b) Acceptable manufacturers: Cleveland Controls

5. Air Pressure Safety Switches
   a) Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
   b) Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
   c) Acceptable manufacturers, Cleveland Controls

6. Water Flow Switches
   a) Water flow switches shall be equal to the Johnson Controls P74.

7. Low Temperature Limit Switches
   a) The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
   b) The sensing element shall be a minimum of 22 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
   c) For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
   d) The low temperature limit switch shall be Johnson Controls A70, Honeywell, and Siemens.

8. BTU Monitoring Devices

   a) BTU Meter: (Chilled water and Hot Water Applications): Provide an ONICON System-10 BTU Meter. The BTU meter shall provide the following information via both an integral LCD and via serial network communications (protocol conforming to BACnet): Energy Total, Energy Rate, Flow Total, Flow Rate, Supply Temperature and Return Temperature. Each BTU meter shall be factory programmed for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required). Provide the following with each BTU meter application:

   b) Temperature sensors: Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST* traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within $\pm 0.15^{0}$F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).
   c) Ultrasonic Flow Meter: The flow meter shall be a clamp-on, dual channel or dual path transit-time precluding the requirement of penetrating into the pipe. The

dual channel operating mode shall be capable of acting as two independent meters with the ability to perform math functions between the two channels (add or subtract). The dual path operating mode will eliminate the effects of flow profile distortion, cross flow or swirl errors caused by upstream interference or pumping irregularities. The flow meter shall be completely microprocessor based utilizing the transit-time flow measurement technique. The flow meter shall employ the phase detection multiple pulse transmit principle in conjunction with multiple frequency axial beam transducer technology to insure operation on liquids with solids and/or bubbles. In addition, the flow meter shall incorporate an alternate Doppler method measurement mode for highly aerated or heavy solid bearing liquids.

d) The flow meter shall provide automatic transducer spacing utilizing a Universal Mounting Frame or mounting track. The meter shall also provide automatic Reynolds Number and liquid sonic velocity variation compensation and live zero flow as well as the ability to zero flow automatically at programmed intervals. The flow meter shall have the ability to indicate flow rate, flow velocity, total flow, signal strength, liquid sonic velocity, Reynolds Number and liquid aeration level for both channels and paths. The flow meter shall also have the ability to be programmed to compensate for specific upstream profile disturbances. The flow meter shall be equipped with an integral front panel keypad and multifunction 240 x 128 pixel LCD display with the ability of displaying both channels and paths simultaneously. In addition, the flow meter shall provide self and application diagnostics to isolate any fault conditions to either equipment failure or abnormal process conditions. The flow meter shall have full HELP menu routines corresponding to all levels of programming and operation.

e) The flow meter electronics shall be housed in a NEMA 4X enclosure and powered by 115 VAC, 60 Hz. One (1) isolated 4 to 20 ma DC and one (1) 0 to 5,000 Hz. pulse output proportional to flow shall be provided for each channel or the average of both paths. In addition, the unit shall provide one (1) 0 to 10 volt output and four (4) SPDT alarm relays assignable to flow velocity, liquid sonic velocity, signal strength or liquid aeration. An internal 250 KB data logger shall be provided to allow storage of all measured and calculated variables and alarms. A bi-directional RS-232 connection shall be provided to allow remote programming and interrogation.

f) The flow meter shall have an accuracy of ±1% of flow over a ±40 fps flow range. Repeatability shall be 0.1% of flow with a flow sensitivity of 0.001 fps at any flow rate including no flow conditions.

g) Flow meters that employ amplitude detection/correlation routines or use a single frequency transducer design will not be acceptable. Shear mode flow meters or meters utilizing wetted transducers or electrodes, or flow-measuring techniques other than previously described will not be acceptable.

h) By use of either transit-time or Doppler modes of operation, the flow meter shall be capable of measuring all liquids in full sonically conductive pipes. Flow meters that simply offer standalone transit-time or Doppler measurement modes are not acceptable.

i) The furnished flow meter shall be Controlotron, Model 1010DN, Panametrics or as approved by the Engineer.

2.7 Output Devices

A. Actuators

1. General Requirements

a) Damper and valve actuators shall be electronic and/or pneumatic, as specified.

2. Electronic Damper Actuators

a) Electronic damper actuators shall be direct shaft mount.

b) Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, or a gear release to allow manual positioning.

c) Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 22 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper assembly shall be wired back to the BAS Controller.

d) Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds.

e) Acceptable manufacturers: Belimo, Mamac.

3. Electronic Valve Actuators

a) Electronic valve actuators shall be manufactured by the valve manufacturer.

b) Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

c) Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on the valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

d) Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

e) Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

f) Acceptable manufacturers: Belimo

B. Control Relays

1. Control Pilot Relays

a) Control pilot relays shall be of a modular plug-in design with retaining springs or clips.

b) Mounting Bases shall be snap-mount.

c) DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.

d) Contacts shall be rated for 10 amps at 120VAC.

e) Relays shall have an integral indicator light and check button.

f) Acceptable manufacturers: Johnson Controls, Honeywell, ASCO or Lectro

2. Lighting Control Relays

a) Lighting control relays shall be latching with integral status contacts.
b) Contacts shall be rated for 20 amps at 277 VAC.
c) The coil shall be a split low-voltage coil that moves the line voltage contact armature to the ON or OFF latched position.
d) Lighting control relays shall be controlled by:
   I. Pulsed Tri-state Output – Preferred method.
   II. Pulsed Paired Binary Outputs.
   III. A Binary Input to the BAS shall monitor integral status contacts on the lighting control relay. Relay status contacts shall be of the “dry-contact” type.
e) The relay shall be designed so that power outages do not result in a change-of-state, and so that multiple same state commands will simply maintain the commanded state. Example: Multiple OFF command pulses shall simply keep the contacts in the OFF position.

C. Control Valves (PICV)

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the BAS contractor, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Section.

2. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer’s recommendations for the given application. In general, valves (2 or 3-way) serving **variable** flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.

3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.

4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.

5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.

6. Acceptable manufacturers: Belimo

D. Electronic/Pneumatic Transducers

Pneumatic transducers shall provide:

a) Output: 3-Div 22 PSIG.
b) Input: 4-20 mA or 0-10 VDC.
c) Manual output adjustment.
d) Pressure gauge.
e) External replaceable supply air filter.
f) Acceptable manufacturers: Mamac

E. Local Control Panels

1. All control panels shall be constructed by a UL certified panel manufacturer, incorporating the BAS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with sub-panel, hinged door, and lock.
2. In general, the control panels shall consist of the DDC controllers and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function.
3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed 300-volt service and provide adequate clearance for field wiring.
5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
6. A 120 volt convenience outlet, fused on/off power switch, and required transformers shall be provided in each enclosure.

F. Power Supplies

1. Required AC or DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VAC or VDC as required.
4. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
5. A power disconnect switch shall be provided next to the power supply.

G. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided by Mechanical Contractor for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

PART 3 – EXECUTION

3.1. BAS Specific Requirements

A. Programming

1. All programming shall be by a LAWA approved contractor listed below.
   a) Johnson Controls:
      Main Office 562.594.3200
   b) Siemens Industry:

Main Office 714.761.2200

c) Honeywell
Main Office 714.562.3048

2. The technician shall be experienced in programming the system and have certificates demonstrating that they have completed the required training courses

B. Provision of Supervisory Controllers

1. When installing new control devices and points ensure that the Controller serving the area has sufficient capacity. If Controller utilization is over 80% provide and install a new any required point expansion modules.

C. Tenant Sub Metering

1. Each service in a tenant space shall be metered and BACnet connection of pulsed output from the meter shall be tied into the BAS for tenant billing purposes. Metered services shall include:
   a) Heating Hot Water – Onicon electromagnetic BTU Meter with BACnet connection
   b) Chilled Water – Onicon electromagnetic BTU Meter with BACnet connection
   c) Gas – Meter shall be provided by the Section 22000 plumbing contractor with a BACnet connection or pulsed output.
   d) Electricity – Meter shall be provided by the Electrical Contractor with a BACnet connection.

D. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

E. Actuation / Control Type

1. Primary Equipment
   a) Controls shall be provided by equipment manufacturer as specified herein.
   b) Each damper and valve actuation shall be electric.
2. Air Handling Equipment
   a) Each air handers shall be controlled with dedicated HVAC-DDC Controller
   b) The AHU BAS controls shall be factory installed.
   c) All damper and valve actuation shall be electric.
3. Terminal Equipment:
   a) Each terminal Units (VAV, UV, etc.) shall be controlled with dedicated electric damper and valve actuation.
   b) All Terminal Units shall be controlled with HVAC-DDC Controller)
   c) Terminal unit BAS controls shall be factory installed.

F. The BAS system shall monitor common alarm, common trouble and common supervisory condition from the Fire Life Control System.

3.2. Installation Practices

A. BAS Wiring

1. All low voltage conduit, wiring, accessories and wiring connections required for the installation of the Building Automation System, as herein specified, shall be provided by the BAS Contractor. All wiring shall comply with the requirements of applicable portions of Design and Construction Handbook Electrical Section and all local and national electric codes, unless specified otherwise in this section.
2. All BAS wiring materials and installation methods shall comply with BAS manufacturer recommendations.
3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BAS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BAS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
4. Class 2 Wiring
   a) All Class 2 (24VAC or less) wiring shall be installed in conduits. The VAV shall be supplied with 24VAC power.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
7. Notify LAWA FMCS SA within 72 hours of when BAS is acknowledging that the BAS data is available to be integrated into the FMCS. BAS BACnet system shall be fully capable of auto-discovery by the FMCS BACnet system.

B. BAS Line Voltage Power Source

1. 120-volt AC circuits used for the Building Automation System shall be taken from panel boards and circuit breakers provided by Electrical Contractor.
2. Circuits used for the BAS shall be dedicated to the BAS and shall not be used for any other purposes.
3. DDC terminal unit controllers may use AC power from motor power circuits.

C. BAS Conduits

1. All wiring shall be installed in conduit or raceway. . Minimum control wiring conduit size 3/4”.
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by LAWA in writing.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 6 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

D. Penetrations

BAS Contractor shall:

1. Provide fire stopping for all conduits and raceways penetrations through fire-rated walls and/floors
2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E. BAS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location. Cable types specified in Item A shall be color coded for easy identification and troubleshooting. BAS Contractor shall submit color coding legend to LAWA for approval prior to installation.
2. The conduits shall be painted in 50 feet intervals with Navy Blue paint. The junction box covers shall be painted with Navy Blue paint.

F. BAS Panel Installation

1. The BAS controls components such as communication modules, hubs, servers, controllers, network connections, etc. shall be mounted in cabinets. Cabinets shall have hinged doors. Cabinets in the indoor dry location shall confirm to NEMA 1 standards. Cabinets in the damp locations (pump rooms) shall be a steel construction with baked enamel coating and shall confirm to NEMA 3R standards. Cabinets in the outdoor location shall be of a stainless steel construction and shall confirm to NEMA 3R standards.
2. The BAS contractor shall be responsible for coordinating panel locations with other trades and Electrical and Mechanical Contractors and LAWA.
3. The BAS panel shall be equipped with the minimum 500 VA UPS.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels wherever possible.

H. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BAS in accessible local control panels unless otherwise approved in writing by LAWA.
3. The Mechanical Contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors
   a) Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately. If access to the North wall is limited, the sensor may be installed in the AHU outside intake air duct when approved in writing by LAWA.
   b) Sensors shall be installed with a rain proof, perforated cover.
6. Water Differential Pressure Sensors
   a) Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
   b) Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
   c) The transmitters shall be installed in an accessible location unless otherwise approved in writing by LAWA.
7. Medium to High Differential Water Pressure Applications (Over 21” W.C.):

a) Air bleed units, bypass valves and compression fittings shall be provided.

8. Building Differential Air Pressure Applications (-1” to +1” W.C.):
   a) Transmitter’s exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
   b) The interior tip shall be inconspicuous and located as shown on the drawings.
9. Air Flow Measuring Stations:
   a) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
   b) Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
10. Duct Temperature Sensors:
    a) Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
    b) The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
    c) For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
    d) The sensor shall be mounted to suitable supports using factory approved element holders.
11. Space Sensors, Room Thermostats:
    a) Shall be mounted per ADA requirements.
    b) Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
12. Low Temperature Limit Switches:
    a) Install on the discharge side of the first water or steam coil in the air stream.
    b) Mount element horizontally across duct in a serpentine pattern for large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
13. Air Differential Pressure Status Switches:
    a) Install with static pressure tips, tubing, fittings, and air filter.
14. Water Differential Pressure Status Switches:
    b) Install with shut off valves for isolation.

I. HVAC Output Devices

1. All output devices shall be installed per the manufacturer’s recommendation. The Mechanical Contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.

3.3 Training

A. Provide training in accordance with Sections 01 79 00 of the Design and Construction Handbook.

B. In addition, the BAS contractor shall provide the following training services:

1. Operator Training (provide 40 hours): Operator training shall include the detailed review of the control installation drawings, points list, and equipment list. The instructor shall then walk through the building identifying the location of the control devices installed. For each type of systems, the instructor shall demonstrate how the system accomplishes the sequence of operation.

   a. From the workstation, the operator shall demonstrate the software features of the system. As a minimum, the operator demonstrate and explain logging on, setting passwords, setting up a schedule, trend, point history, alarm, and archiving the database.
   b. One day (8 hours) of the 40 hours will be devoted to on-site orientation by a field engineer who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the control system software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

2. Factory training for a minimum of six (6) LAWA representatives for 40 hours (minimum) in a factory training lab. This training shall be performed by a factory-certified professional trainer and, at a minimum, shall consist of:

   a. Two days (16 hours) basic system operation.
   b. One day (16 hours) system reporting and alarm management.
   c. One day (16 hours) scheduling and point trending

3. The LAWA shall be issued Continuing Education Credits (C.E.U.s) for the factory training.
4. Third Party Interface Training: BAS contractor shall provide a minimum of 24 hours detail training for systems such as lighting control, VFD, emergency generator, electrical switchgear and any other system or equipment that will interface with the BAS.

3.4 Commissioning and Testing.

A. Provide commissioning in accordance with Sections 01 19 00 of the Design and Construction Handbook.

1. General

   a. Commissioning the Building Automation System is a mandatory documented performance requirement of the selected BAS Contractor for all control systems detailed in this Specification and sequence of operations. Commissioning shall include verification of proper installation practices by the BAS Contractor and subcontractors under the BAS Contractor, point verification and calibration, system/sequence of operation verification with respect to specified operation, and network/workstation verification. Documentation shall be presented upon completion of each commissioning step and final completion to ensure proper operation of the Building Automation System.
   b. BAS commissioning and testing documentation is to be provided separately to LAWA.

2. Testing Requirements

   a. Intent: Demonstrate to satisfaction of authorized representative that BAS is performing in accordance with requirements of this Section.
   b. Logs of Tests: Complete logs of tests retained by Contractor for inspection and review of authorized representative at any time after testing started. Upon final completion of system tests log records submitted.

c. Witness of Tests: At time directed by authorized representative complete functional, operational test shall be performed by contractor. Test witnessed by personnel directed by authorized representative. Tests continue until functions of points, of alarms and command functions are proven to satisfaction of authorized representative.

d. Performance of Field Tests: Complete tests required at different and distinct times for various phases of construction as designated by authorized representative.

3. Testing Procedure

a. Upon completion of the installation, the BAS Contractor shall start-up the system and performs all necessary testing and run diagnostic tests to ensure proper operation. The BAS Contractor shall be responsible for generating all software and entering all database information necessary to perform existing control sequences.

4. Testing Documentation

a. Prior to acceptance testing, BAS Contractor shall create, on an individual system basis, trend logs of input and output points, or have an automatic Point History feature for documentation purposes.

5. Field Points Testing

a. This step shall verify that all of the installed points receive or transmit the correct information prior to loading/activating the system software.

b. ON/OFF commands from the workstation shall be performed in order to verify each binary output point.

c. All binary input points are to be tested by observing a change of state upon command at PC workstation or locally in the field.

d. All analog output points shall be tested using a command from the PC workstation to modulate the output device from minimum calibrated signal to maximum calibrated output.

e. All analog input points are to be tested by comparing the reading obtained through the workstations to the value of an independent testing meter

f. All two-way communication interfaces (Modbus, Bacnet, etc.) tested and monitored values and commanded verified at the BAS workstation and in the field.

6. Verify that activation of site related alarms specifically identifies and notifies LAWA remote monitoring sites and selected personnel.

7. VAV box performance verification and documentation: (Perform testing if required).

a. As part of the commissioning of the terminal unit control (UC) and air distribution system, the Contractor shall initiate an automated test where the dampers in one half of a group of boxes are stepped towards full open while the other half are stepped towards full closed. At each step, after a settling time, box airflow and damper positions will be sampled. Following the cycle, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation, or Maximum flow not achieved. The report shall be submitted as documentation of the installation.

b. The controls contractor shall issue a report based on a sampling of the UC calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance. The sampling shall take place after completion of Test and Balance, when design cooling and heating media have been available and occupied conditions approximated for five consecutive days.

c. Verify that new graphics are complete and contain dynamic (real-time) information that can be viewed at both workstation locations.

8. Non-compliant Items

a. The Contractor shall remove and replace, at its expense, all items that are not in compliance with the requirements of this section or other portions of LAWA's Design and Construction Handbook.

3.5 Sequences of operation and control diagrams

A. Control points and sequences

1. All equipment shall be user-definable as to which piece of equipment is the lead unit, the lag unit or the spare (standby) unit. The unit arrangements called out for initial start-up conditions only.
2. All set points shall be user-definable; set points called out are for initial start-up conditions only.
3. See plans for control details and Sequences of Operation.

3.6 Point Lists

The BAS Contractor shall provide the system's point list. The sample is show below:

Sample Point List

Systems **AHU 1,2,3,4**

Point	**Description**	**Type**	**Units**	**Trend**	**Alarm**	**Totalize**
DA-P	Discharge Static Pressure	AI	in WC	X		
DA-T	Discharge Air Temperature	AI	Deg F	X		
PH-T	Preheat Temperature	AI	Deg F	X		
SF-S	Supply Fan Status	BI	Off On	X	X	X
PH-O	Preheat Output	AO	%	X		
RH-O	Reheat Output	AO	%	X		
CLG-O	Cooling Output	AO	%	X		
SF-O	Supply Fan Output	AO	%	X		
SF-C	Supply Fan Command	BO	Off On	X		
PH-LCKO	Preheat Lockout Command	BO	Off On	X		
CLG-LCKO	Cooling Lockout Command	BO	Off On	X		
RH-LCKO	Reheat Lockout Command	BO	Off On	X		
DAT-SP	Discharge Temperature Set point	AO	Deg F	X		
PHT-SP	Preheat Temperature Set point	AO	Deg F	X		
DAP-SP	Discharge Static Pressure Set point	AO	in WC	X		

End of Section

SECTION 26 05 02 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section supplements all sections of this Division and shall apply to all phases of work hereinafter specified, or required to provide a complete installation of electrical systems for the Project. The intent of the Specifications is to provide a complete electrical system that includes all documents that are a part of the Contract.

1. Work Included: Furnish all labor, material, services and skilled supervision necessary for the construction, erection, installation, connections, testing, and adjustment of all circuits and electrical equipment specified herein.

B. Equipment or Fixtures: Equipment and fixtures shall be connected to provide circuit continuity in accordance with the Specifications, whether or not each piece of conductor, conduit, or protective device is shown between such items of equipment or fixtures, and the point of circuit origin.

C. Work Installed but Furnished under Other Sections: The Electrical Work includes the installation or connection of certain materials and equipment furnished under other sections. Verify installation details. Foundations for apparatus and equipment will be furnished under other sections unless otherwise noted or detailed.

NOTE: Provide conduit for all controls and other devices both line and low voltage. Install all control housings and back bone boxes required for installing conduit and wire to the controls.

1.2 GENERAL REQUIREMENTS

A. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.

B. Codes and Regulations:

1. Design, manufacture, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
    a. Institute of Electrical and Electronic Designers - IEEE
    b. National Electrical Manufacturers' Association - NEMA
    c. California Fire Code - CFC
    d. California Building Code - CBC
    e. Underwriters' Laboratories, Inc. - UL

f. National Fire Protection Association - NFPA
g. American Society for Testing and Materials - ASTM
h. American National Standards Institute - ANSI
i. American Standard Association - ASA
j. National Electrical Code - NEC, as modified by the city of Los Angeles
k. Insulated Power Cable Designers Association - IPCEA
l. California Code of Regulations, Title 24
m. International Electrical Testing Association - NETA

C. The term "Code", when used within the specifications.

D. Seismic Design of Electrical Equipment:

1. All electrical prefabricated equipment is to be designed and constructed in such a manner that all portions, elements, sub assemblies and/or parts of said equipment and the equipment as a whole, including their attachments, will resist a horizontal load equal to the operating weights of those parts multiplied times the following factors:

Type of equipment	Horizontal cp	Vertical cp
Rigid and rigidly supported piping or equipment such as boilers, chillers, pumps, motors, transformers, unit substations and control panels.	0.50	0.33
Flexible and flexibly supported equipment such as air-handling units, piping and other equipment so supported that the fundamental period of vibration of the equipment and its supporting system is greater than 0.05 seconds. Communication equipment and emergency stand-by equipment	1.00	0.6

2. Load is to be applied at the center of gravity of the part and to be in any direction horizontally.
3. Design stresses shall be in accordance with the specifications for design of the American Institute of Steel Construction. Anchorage, support and/or attachment of said prefabricated equipment to the structure should be in accordance with the details found in the plans and specifications.
4. Seismic restraints shall be designed for a 1.5 importance factor, and stamped structural calculations, signed by a California Registered Structural Engineer, will be provided as support.
5. It is the entire responsibility of the Contractor to verify the design of equipment so that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
6. If the state of California requires that certain electrical equipment and components have a special seismic certification, the contractor and vendor shall provide such certification.

E. Requirements of Regulatory Agencies:

1. Codes, Permits and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where provisions differ in regard to code application, size, quality, quantity or type of equipment, Contractor shall include in the bid, costs for the most costly provision either denoted in the specifications or on the drawings. This provision shall apply as an amendment to the California Public Contracts Code.

   a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Work shall be obtained by the Contractor at his expense, unless otherwise specified.
   b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

F. Shop Drawings and Submittals: Submittals on all material prior to installation.

1. Shop drawings shall be submitted on, but not limited to, the following:
2. Equipment Wiring Connections
3. Medium Voltage Cables
4. Low Voltage Electrical Power Conductors and Cables
5. Grounding and Bonding for Electrical Systems
6. Hangers and Supports for Electrical Systems
7. Raceway and Boxes for Electrical Systems
8. Underground Ducts and Raceways for Electrical Systems
9. Vibration and Seismic Controls for Electrical Systems
10. Identification for Electrical Systems
11. Short Circuit and Overcurrent Protective Device Coordination Study
12. Web Based Power Monitoring Communications System
13. Lighting Control Devices
14. Network Lighting Control Systems
15. Medium Voltage Transformers
16. Metal Clad Switchgear (VacClad) B Medium Voltage
17. 34.5 kV Metering Switchgear
18. Low Voltage Transformers
19. Switchboards
20. Panelboards
21. Motor Control Centers
22. Enclosed Bus Assemblies
23. Electrical Cabinets and Enclosures
24. Wiring Devices
25. Fuses
26. Enclosed Switches
27. Enclosed Circuit Breakers
28. Enclosed Transfer Switches
29. Enclosed Controllers
30. Variable Frequency Motor Controllers
31. Engine Generators

32. Resistive Load Banks
33. Emergency Generators and Distribution Switchgear
34. Battery Equipment (Inverter)
35. Static Uninterruptible Power Supply
36. Emergency Circuit Conductors and Cable.
37. Metal Clad Drawout Switchgear B Low Voltage
38. Transient Voltage Suppression for Low Voltage Electrical Power Circuits
39. Interior Lighting
40. Exterior lighting
41. Fire Detection and Alarm
42. 3@ scale drawings of outdoor 34.5 kV switchgear yard, indoor 34.5 kV electrical vaults, all low voltage electrical rooms comply with all applicable LADWP, CEC and LA City requirements for equipment layout and installation. Also include associated grounding system grid drawings and details.
43. 1/8@ drawings for underground duct bank installation for normal and emergency feeders from main electrical rooms to sub electrical rooms with necessary conduit bank cross section details and equipment terminations.

G. Cutting and Patching:

1. Obtain written permission from LAWA before core drilling or cutting any structural members. Exact method and location of conduit penetrations and/or openings in concrete walls, floors, or ceilings shall be as approved by LAWA.
2. Use care in piercing waterproofing. After the part piercing the waterproofing has been set in place, seal openings and make absolutely watertight.
3. Seal all openings to meet the fire rating of the particular wall floor or ceiling.

H. Miscellaneous:

1. LED control lights shall be used in all switchgear, switchboards, motor control centers and similar equipment.
2. Outdoor equipment enclosures shall be NEMA Type 4, Type 3R Stainless Steel, or better.

1.3 JOB CONDITIONS

A. Existing Conditions:

1. The contractor shall visit the site and verify existing conditions.
2. Electrical circuits affecting work shall be de energized while working on or near them.
3. Arrange the work so that electrical power is available to all electrical equipment within existing facility at all times. Schedule all interruptions at the convenience of LAWA, including exact time and duration, in accordance with LAWA's power shut down procedures. Provide temporary power during all periods of interruption, which are deemed excessive by LAWA.

B. Protection:

1. Protection of apparatus, materials and equipment. Take such precautions as necessary to properly protect all apparatus, fixtures, appliances, material, equipment and installations from damage of any kind. LAWA may reject any particular piece or pieces of material, apparatus or equipment scratched, dented or otherwise damaged.
2. Seal equipment or components exposed to the weather and make watertight and insect proof. Protect equipment outlets and conduit openings with temporary plugs or caps at all times that work is not in progress.
3. Provide weather protection, with heaters, for equipment stored outdoors.

1.4 POWER SHUTDOWN PROCEDURES

A. The contractor's construction schedule shall indicate dates of proposed electrical power shutdowns required to perform the installation. The contractor shall notify LAWA a minimum of thirty (30) days prior to each shutdown. All shutdown coordination meetings shall be arranged by the contractor for each shutdown.

B. Power shutdowns shall occur between the hours of 12:00 am and 4:00 am.

C. Only one switchboard shall be shutdown at any one time. Shutdowns shall be scheduled a minimum of three (3) days apart.

D. No interruptions to airport operations shall be allowed during periods deemed by LAWA as Holiday Construction Restriction Periods. These periods are typically from the Friday before the week of the Thanksgiving Holiday to the following Monday after the Thanksgiving Holiday (~9 calendar days), and the Friday before the week of the Christmas Holiday to the Monday following New Years Day (~16 calendar days). Contractor shall verify the Holiday Construction Restriction Periods with LAWA prior to preparing the construction schedule.

> **NOTE:** Refer to the LAWA Utility Shutdown Procedures for additional information.

1.5 TESTING AND ADJUSTMENT

A. Upon completion of all Electrical Work, the contractor shall provide all testing as follows:

1. Operational Test: Test all circuit breakers, receptacles and all other electrical equipment. Replace all faulty devices and equipment discovered during testing with new devices and equipment at no additional cost, and that part of the system (or devices or equipment) shall then be retested.
2. Secondary Grounding Resistance: Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point.
3. Ground Fault System Test: Measure system neutral insulation resistances to ensure no shunt ground paths exist.
4. All grounding resistance and ground fault test procedures shall be performed by

an independent testing firm.

1.6 MAINTENANCE, SERVICING AND INSTRUCTION MANUALS, AND WIRING DIAGRAMS

A. Prior to substantial completion, the contractor shall submit 4 copies of operating and maintenance and servicing instructions, as well as an equal number of copies of complete wiring diagrams all neatly bound in hard cover 3 ring binders with table of contents and tabs for the following items or equipment:

1. Lighting Control Devices System
2. Medium Voltage Transformers
3. Medium Voltage Vacuum Circuit Breakers
4. Medium Voltage Metering Switchgear
5. Low Voltage Transformers
6. Switchboards
7. Panelboards
8. Motor Control Centers
9. Enclosed Bus Assemblies
10. Wiring Devices
11. Fuses
12. Enclosed Switches
13. Enclosed Circuit Breakers
14. Enclosed Transfer Switches
15. Enclosed Controllers
16. Variable Frequency Motor Controllers
17. Engine Generators
18. Resistive Load Banks
19. Emergency Generators and Distribution Switchgear
20. Battery Equipment (Inverter)
21. Static Uninterruptible Power Supply
22. Transient Voltage Suppression for Low Voltage Electrical Power Circuits
23. Interior Lighting
24. Exterior Lighting
25. Fire Detection and Alarm
26. Web Based Power Monitoring System

B. All wiring diagrams shall specifically cover the installed system indicating zones, wiring, and components added to the system.

C. Include Product and calculations data with maintenance and Operations manuals. Include all testing reports with Maintenance and Operation manuals.

1.7 FINAL INSPECTION AND ACCEPTANCE

A. After all requirements of the specifications and/or the drawings have been fully completed, representatives of LAWA will inspect the Work. The Contractor shall provide competent personnel to demonstrate the operation of any item of system, to the full satisfaction of each representative. The Contractor shall provide 8 hours of minimum scheduled operation and maintenance training to staff to be trained on each system indicated above. See specific sections for additional training/operation hours required.

B. Provide manuals for attendees.

C. Final acceptance of the work will be made by LAWA after receipt of approval and recommendation of acceptance from each representative.

D. The Contractor shall furnish Record Drawings before final payment of retention.

1.8 WARRANTIES

A. Guarantee all materials, equipments, apparatus and workmanship to be free of defective material and faulty workmanship for period of one year unless extended guarantee periods are specified in individual sections.

B. Special Warranties:

1. All 34.5kV Electrical Equipment, Switchgear and Accessories for 3 years (parts and labor).

C. During the period between Substantial Completion and Partial Acceptance (Final Acceptance of a defined area of the work), the Contractor shall provide the necessary services to Operate and Maintain the equipment in proper working order including, but not limited to:

1. Operation and Maintenance Response:

a. Provide twenty (24) hour emergency service during this period consisting of:

(1) Critical Issue: A prompt response (within 15 minutes) to emergency request by telephone or otherwise from LAWA or designated representative. Onsite within 30 minutes of notification to triage and assess the situation.

(2) Non Critical Issues: A prompt response (within 15 minutes) to request by telephone or otherwise from LAWA or designated representative. Onsite within one (1) hour after receiving notice from LAWA representative or having knowledge of a need to service the system. If event occurs after business hours, weekends or holidays, response shall be within one (1) hour of commencement of next business day.

(3) Scheduled Operational Needs: 24 hour notice of scheduled operational need. Failure to respond to scheduled operational need render need as a Critical Issue.

b. For Critical issues, on site response shall be within 30 minutes of notification. Repair or service of respective components and/or system shall be commenced immediately upon arrival on site. This requirement shall include after business hours, weekends, and holidays. Critical issues are defined as complete system failure, failure of controls, entrapments, and/or potential injury to persons, or other item that LAWA deems a critical operational need.

c. For Noncritical issues, on site response shall be within one (1) hour of notification. If event occurs after business hours, weekends, or holidays, response shall be within one (1) hour of commencement of next business day. Repair or service of respective components and/or system shall be commenced within (4) hours of the arrival on site.

2. Maintenance:

   a. Inspection of completed installation and periodic testing to maintain equipment in completely operable, like new condition.
   b. Perform any necessary regulatory testing to ensure system(s) are compliant with applicable code, all to the satisfaction of the Authority Having Jurisdiction.
   c. Periodic lubrication of parts, filter changes and equipment components as per OEM's recommendation. Documentation to be provided for each piece of equipment when services are provided.
   d. Spare Parts: The Contractor shall maintain adequate supply of spare parts during this period. Any spare parts utilized during this period that are part of the contractually obligated inventory of spare parts for Final Acceptance shall be replenished prior to Final Acceptance.

3. Operation:

   a. All necessary work to operate/maintain the equipment in proper working order.
   b. Perform daily maintenance and system health checks as applicable, and any necessary system backups, failover/failback testing.
   c. Routinely monitoring equipment and systems for anomalies and respond or report to system maintenance team to respond and resolve.
   d. Perform configuration changes as needed to support project, airport, tenant operations, etc.
   e. Maintain logs of configuration changes.

4. Perform work without removing equipment from service during peak traffic periods (unless emergency and/or unless specifically authorized by LAWA) and those peak periods have been determined by LAWA as 7:00 a.m. to 12:00 a.m. (midnight) daily.
5. Unlimited regular time callbacks are included with the applicable response time. Regular time will be Monday through Friday, 8:00am to 4:30pm, exclusive of holidays. Overtime\Premium time call backs originating from an operational error related to the performance requirements of the equipment shall be borne by the Contractor.

END OF SECTION 26 05 02

SECTION 26 05 02 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section supplements all sections of this Division and shall apply to all phases of work hereinafter specified, or required to provide a complete installation of electrical systems for the Project. The intent of the Specifications is to provide a complete electrical system that includes all documents that are a part of the Contract.

1. Work Included: Furnish all labor, material, services and skilled supervision necessary for the construction, erection, installation, connections, testing, and adjustment of all circuits and electrical equipment specified herein.

B. Equipment or Fixtures: Equipment and fixtures shall be connected to provide circuit continuity in accordance with the Specifications, whether or not each piece of conductor, conduit, or protective device is shown between such items of equipment or fixtures, and the point of circuit origin.

C. Work Installed but Furnished under Other Sections: The Electrical Work includes the installation or connection of certain materials and equipment furnished under other sections. Verify installation details. Foundations for apparatus and equipment will be furnished under other sections unless otherwise noted or detailed.

> **NOTE:** Provide conduit for all controls and other devices both line and low voltage. Install all control housings and back bone boxes required for installing conduit and wire to the controls.

1.2 GENERAL REQUIREMENTS

A. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.

B. Codes and Regulations:

1. Design, manufacture, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
   a. Institute of Electrical and Electronic Designers - IEEE
   b. National Electrical Manufacturers' Association - NEMA
   c. California Fire Code - CFC
   d. California Building Code - CBC
   e. Underwriters' Laboratories, Inc. - UL

f. National Fire Protection Association - NFPA
g. American Society for Testing and Materials - ASTM
h. American National Standards Institute - ANSI
i. American Standard Association - ASA
j. National Electrical Code - NEC, as modified by the city of Los Angeles
k. Insulated Power Cable Designers Association - IPCEA
l. California Code of Regulations, Title 24
m. International Electrical Testing Association - NETA

C. The term "Code", when used within the specifications.

D. Seismic Design of Electrical Equipment:

1. All electrical prefabricated equipment is to be designed and constructed in such a manner that all portions, elements, sub assemblies and/or parts of said equipment and the equipment as a whole, including their attachments, will resist a horizontal load equal to the operating weights of those parts multiplied times the following factors:

Type of equipment	Horizontal cp	Vertical cp
Rigid and rigidly supported piping or equipment such as boilers, chillers, pumps, motors, transformers, unit substations and control panels.	0.50	0.33
Flexible and flexibly supported equipment such as air-handling units, piping and other equipment so supported that the fundamental period of vibration of the equipment and its supporting system is greater than 0.05 seconds. Communication equipment and emergency stand-by equipment	1.00	0.6

2. Load is to be applied at the center of gravity of the part and to be in any direction horizontally.
3. Design stresses shall be in accordance with the specifications for design of the American Institute of Steel Construction. Anchorage, support and/or attachment of said prefabricated equipment to the structure should be in accordance with the details found in the plans and specifications.
4. Seismic restraints shall be designed for a 1.5 importance factor, and stamped structural calculations, signed by a California Registered Structural Engineer, will be provided as support.
5. It is the entire responsibility of the Contractor to verify the design of equipment so that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
6. If the state of California requires that certain electrical equipment and components have a special seismic certification, the contractor and vendor shall provide such certification.

E. Requirements of Regulatory Agencies:

1. Codes, Permits and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where provisions differ in regard to code application, size, quality, quantity or type of equipment, Contractor shall include in the bid, costs for the most costly provision either denoted in the specifications or on the drawings. This provision shall apply as an amendment to the California Public Contracts Code.

   a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Work shall be obtained by the Contractor at his expense, unless otherwise specified.
   b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

F. Shop Drawings and Submittals: Submittals on all material prior to installation.

1. Shop drawings shall be submitted on, but not limited to, the following:
2. Equipment Wiring Connections
3. Medium Voltage Cables
4. Low Voltage Electrical Power Conductors and Cables
5. Grounding and Bonding for Electrical Systems
6. Hangers and Supports for Electrical Systems
7. Raceway and Boxes for Electrical Systems
8. Underground Ducts and Raceways for Electrical Systems
9. Vibration and Seismic Controls for Electrical Systems
10. Identification for Electrical Systems
11. Short Circuit and Overcurrent Protective Device Coordination Study
12. Web Based Power Monitoring Communications System
13. Lighting Control Devices
14. Network Lighting Control Systems
15. Medium Voltage Transformers
16. Metal Clad Switchgear (VacClad) B Medium Voltage
17. 34.5 kV Metering Switchgear
18. Low Voltage Transformers
19. Switchboards
20. Panelboards
21. Motor Control Centers
22. Enclosed Bus Assemblies
23. Electrical Cabinets and Enclosures
24. Wiring Devices
25. Fuses
26. Enclosed Switches
27. Enclosed Circuit Breakers
28. Enclosed Transfer Switches
29. Enclosed Controllers
30. Variable Frequency Motor Controllers
31. Engine Generators

32. Resistive Load Banks
33. Emergency Generators and Distribution Switchgear
34. Battery Equipment (Inverter)
35. Static Uninterruptible Power Supply
36. Emergency Circuit Conductors and Cable.
37. Metal Clad Drawout Switchgear B Low Voltage
38. Transient Voltage Suppression for Low Voltage Electrical Power Circuits
39. Interior Lighting
40. Exterior lighting
41. Fire Detection and Alarm
42. 3@ scale drawings of outdoor 34.5 kV switchgear yard, indoor 34.5 kV electrical vaults, all low voltage electrical rooms comply with all applicable LADWP, CEC and LA City requirements for equipment layout and installation. Also include associated grounding system grid drawings and details.
43. 1/8@ drawings for underground duct bank installation for normal and emergency feeders from main electrical rooms to sub electrical rooms with necessary conduit bank cross section details and equipment terminations.

G. Cutting and Patching:

1. Obtain written permission from LAWA before core drilling or cutting any structural members. Exact method and location of conduit penetrations and/or openings in concrete walls, floors, or ceilings shall be as approved by LAWA.
2. Use care in piercing waterproofing. After the part piercing the waterproofing has been set in place, seal openings and make absolutely watertight.
3. Seal all openings to meet the fire rating of the particular wall floor or ceiling.

H. Miscellaneous:

1. LED control lights shall be used in all switchgear, switchboards, motor control centers and similar equipment.
2. Outdoor equipment enclosures shall be NEMA Type 4, Type 3R Stainless Steel, or better.
~~2.~~3. All floor mounted equipment shall be installed on a concrete housekeeping pad. Refer to Hangers and Supports for Electrical Equipment (26 05 30) Part 3.5 for requirements. (Added August 2013).

1.3 JOB CONDITIONS

A. Existing Conditions:

1. The contractor shall visit the site and verify existing conditions.
2. Electrical circuits affecting work shall be de energized while working on or near them.
3. Arrange the work so that electrical power is available to all electrical equipment within existing facility at all times. Schedule all interruptions at the convenience of LAWA, including exact time and duration, in accordance with LAWA's power shut down procedures. Provide temporary power during all periods of interruption, which are deemed excessive by LAWA.

B. Protection:

1. Protection of apparatus, materials and equipment. Take such precautions as necessary to properly protect all apparatus, fixtures, appliances, material, equipment and installations from damage of any kind. LAWA may reject any particular piece or pieces of material, apparatus or equipment scratched, dented or otherwise damaged.
2. Seal equipment or components exposed to the weather and make watertight and insect proof. Protect equipment outlets and conduit openings with temporary plugs or caps at all times that work is not in progress.
3. Provide weather protection, with heaters, for equipment stored outdoors.

1.4 POWER SHUTDOWN PROCEDURES

A. The contractor's construction schedule shall indicate dates of proposed electrical power shutdowns required to perform the installation. The contractor shall notify LAWA a minimum of thirty (30) days prior to each shutdown. All shutdown coordination meetings shall be arranged by the contractor for each shutdown.

B. Power shutdowns shall occur between the hours of 12:00 am and 4:00 am.

C. Only one switchboard shall be shutdown at any one time. Shutdowns shall be scheduled a minimum of three (3) days apart.

D. No interruptions to airport operations shall be allowed during periods deemed by LAWA as Holiday Construction Restriction Periods. These periods are typically from the Friday before the week of the Thanksgiving Holiday to the following Monday after the Thanksgiving Holiday (~9 calendar days), and the Friday before the week of the Christmas Holiday to the Monday following New Years Day (~16 calendar days). Contractor shall verify the Holiday Construction Restriction Periods with LAWA prior to preparing the construction schedule.

NOTE: Refer to the LAWA Utility Shutdown Procedures for additional information.

1.5 TESTING AND ADJUSTMENT

A. Upon completion of all Electrical Work, the contractor shall provide all testing as follows:

1. Operational Test: Test all circuit breakers, receptacles and all other electrical equipment. Replace all faulty devices and equipment discovered during testing with new devices and equipment at no additional cost, and that part of the system (or devices or equipment) shall then be retested.
2. Secondary Grounding Resistance: Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point.
3. Ground Fault System Test: Measure system neutral insulation resistances to

ensure no shunt ground paths exist.

4. All grounding resistance and ground fault test procedures shall be performed by an independent testing firm.

1.6 MAINTENANCE, SERVICING AND INSTRUCTION MANUALS, AND WIRING DIAGRAMS

A. Prior to substantial completion, the contractor shall submit 4 copies of operating and maintenance and servicing instructions, as well as an equal number of copies of complete wiring diagrams all neatly bound in hard cover 3 ring binders with table of contents and tabs for the following items or equipment:

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14. Enclosed Transfer Switches
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16. Variable Frequency Motor Controllers
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22. Transient Voltage Suppression for Low Voltage Electrical Power Circuits
23. Interior Lighting
24. Exterior Lighting
25. Fire Detection and Alarm
26. Web Based Power Monitoring System

B. All wiring diagrams shall specifically cover the installed system indicating zones, wiring, and components added to the system.

C. Include Product and calculations data with maintenance and Operations manuals. Include all testing reports with Maintenance and Operation manuals.

1.7 FINAL INSPECTION AND ACCEPTANCE

A. After all requirements of the specifications and/or the drawings have been fully completed, representatives of LAWA will inspect the Work. The Contractor shall provide competent personnel to demonstrate the operation of any item of system, to the full satisfaction of each representative. The Contractor shall provide 8 hours of minimum scheduled operation and maintenance training to staff to be trained on each system indicated above. See specific sections for additional training/operation hours required.

B. Provide manuals for attendees.

C. Final acceptance of the work will be made by LAWA after receipt of approval and recommendation of acceptance from each representative.

D. The Contractor shall furnish Record Drawings before final payment of retention.

1.8 WARRANTIES

A. Guarantee all materials, equipments, apparatus and workmanship to be free of defective material and faulty workmanship for period of one year unless extended guarantee periods are specified in individual sections.

B. Special Warranties:

1. All 34.5kV Electrical Equipment, Switchgear and Accessories for 3 years (parts and labor).

C. During the period between Substantial Completion and Partial Acceptance (Final Acceptance of a defined area of the work), the Contractor shall provide the necessary services to Operate and Maintain the equipment in proper working order including, but not limited to:

1. Operation and Maintenance Response:

a. Provide twenty (24) hour emergency service during this period consisting of:

(1) Critical Issue: A prompt response (within 15 minutes) to emergency request by telephone or otherwise from LAWA or designated representative. Onsite within 30 minutes of notification to triage and assess the situation.

(2) Non Critical Issues: A prompt response (within 15 minutes) to request by telephone or otherwise from LAWA or designated representative. Onsite within one (1) hour after receiving notice from LAWA representative or having knowledge of a need to service the system. If event occurs after business hours, weekends or holidays, response shall be within one (1) hour of commencement of next business day.

(3) Scheduled Operational Needs: 24 hour notice of scheduled operational need. Failure to respond to scheduled operational need render need as a Critical Issue.

b. For Critical issues, on site response shall be within 30 minutes of notification. Repair or service of respective components and/or system shall be commenced immediately upon arrival on site. This requirement shall include after business hours, weekends, and holidays. Critical issues are defined as complete system failure, failure of controls, entrapments, and/or potential injury to persons, or other item that LAWA deems a critical operational need.

c. For Noncritical issues, on site response shall be within one (1) hour of notification. If event occurs after business hours, weekends, or holidays, response shall be within one (1) hour of commencement of next business day. Repair or service of respective components and/or system shall be commenced within (4) hours of the arrival on site.

2. Maintenance:

   a. Inspection of completed installation and periodic testing to maintain equipment in completely operable, like new condition.
   b. Perform any necessary regulatory testing to ensure system(s) are compliant with applicable code, all to the satisfaction of the Authority Having Jurisdiction.
   c. Periodic lubrication of parts, filter changes and equipment components as per OEM’s recommendation. Documentation to be provided for each piece of equipment when services are provided.
   d. Spare Parts: The Contractor shall maintain adequate supply of spare parts during this period. Any spare parts utilized during this period that are part of the contractually obligated inventory of spare parts for Final Acceptance shall be replenished prior to Final Acceptance.

3. Operation:

   a. All necessary work to operate/maintain the equipment in proper working order.
   b. Perform daily maintenance and system health checks as applicable, and any necessary system backups, failover/failback testing.
   c. Routinely monitoring equipment and systems for anomalies and respond or report to system maintenance team to respond and resolve.
   d. Perform configuration changes as needed to support project, airport, tenant operations, etc.
   e. Maintain logs of configuration changes.

4. Perform work without removing equipment from service during peak traffic periods (unless emergency and/or unless specifically authorized by LAWA) and those peak periods have been determined by LAWA as 7:00 a.m. to 12:00 a.m. (midnight) daily.
5. Unlimited regular time callbacks are included with the applicable response time. Regular time will be Monday through Friday, 8:00am to 4:30pm, exclusive of holidays. Overtime\Premium time call backs originating from an operational error related to the performance requirements of the equipment shall be borne by the Contractor.

END OF SECTION 26 05 02

SECTION 26 05 03-EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes electrical connections to equipment.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Product Data: Submit wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

B. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer’s wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

B. Determine connection locations and requirements.

C. Sequence rough-in of electrical connections to coordinate with installation of equipment.

D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

A. Manufacturers:

1. **Hubbell.**
2. **Leviton.**
3. **Pass & Seymour.**

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.

NOTE: Specify cord type SJO for normal use and type SO for heavy duty use.

D. Cord Construction: Type SO or SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.

B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.

C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

A. Make electrical connections.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. nstall receptacle outlet to accommodate connection with attachment plug.

E. Install cord and cap for field-supplied attachment plug.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.4 ADJUSTING

A. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION 26 05 03

SECTION 26 05 13 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Medium voltage cable.
2. Cable terminations.
3. Fireproofing tape.
4. Underground cable markers.
5. Bedding and cover materials.

1.2 REFERENCES

A. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. Institute of Electrical and Electronics Engineers.

1. IEEE 48 – Standard Test Procedures and Requirements for Alternating Current Cable Terminations 2.5 kV thru 765 kV
2. IEEE C2 – National Electrical Safety Code.

C. National Electrical Manufacturers Association

1. NEMA WC 70 – Non-shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
2. NEMA WC 71 – Non-shielded Power Cables Rated 2001-5000 Volts for the Distribution of Electric Energy
3. NEMA WC 74 – 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

1.3 SUBMITTALS

A. Product Data: Submit for cable, terminations, and accessories.

B. Test Reports: Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual sizes and locations of cables.

B. Operation and Maintenance Data: Submit instructions for testing and cleaning cable and accessories.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience, and with service facilities within 100 miles of Project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cable ends from entrance of moisture.

PART 2 - PRODUCTS

2.1 MEDIUM VOLTAGE CABLE

A. Manufacturers:

1. **The Okonite Company**
2. **General Cable**
3. **Southwire**

B. Voltage: 5kV, 8kV, 15kV, 35kV.

C. Insulation Level: 133 percent of operating voltage.

D. Cable Continuous Operating Temperature Rating: MV-105.

E. Configuration: Single conductor.

F. Conductor: Copper, compact stranded

G. Conductor Shield: Metal tape insulation shielding

H. Insulation: Ethylene Propylene Rubber EPR

I. Cable Jacket: Sunlight-resistant PVC or Chlorosulfonated polyethylene, CPE.

2.2 CABLE TERMINATIONS

A. Manufacturers:

1. 3M Electrical Products Division.

2. Raychem.
3. Thomas & Betts.

B. Location: Indoor or Outdoor

C. Conductor Quantity: Single core

D. Type: Dual extrusion thick wall heat shrink

2.3 FIREPROOFING TAPE

A. Manufacturers:

1. 3M Electrical Products Division
2. Plymouth Rubber Co.

B. Product Description: Flexible, conformable fabric, coated on one side with flame retardant, flexible polymeric or chlorinated elastomer. Non-corrosive to and compatible with cable sheaths jackets. It does not support combustion.

C. Width: Approximately 3 inches

D. Thickness: Not less than 0.03 inch

E. Weight: Not less than 2.5 pounds per square yard

2.4 UNDERGROUND CABLE MARKERS

A. Trace Wire: Magnetic detectable conductor, red colored plastic covering, imprinted with "Medium Voltage Cable" in large letters.

2.5 CABLE IDENTIFICATION

A. Colored Conductor Tape for Phases: Yellow colored, self-adhesive vinyl tape not less than 3 mils thick by 1 inch wide. 1 stripe for the A phase conductor, 2 stripes for the B phase conductor, 3 stripes for the C phase conductor. Tape shall be located at all terminations, splices and pull boxes.

B. B. Metal Tags: Brass with 1/4 inch embossed legend, punched for use with self-locking nylon tie fastener. Tags shall be located at all terminations, splices and pull boxes. Legend shall include the feeder circuit breaker identifier and phase.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

B. Verify conduit, duct, trench, and manholes are ready to receive cable.

C. Verify routing and termination locations of cable prior to rough-in.

3.2 PREPARATION

A. Use swab to clean conduits and ducts before pulling cables.

3.3 EXISTING WORK

A. Remove abandoned medium-voltage cable.

B. Maintain access to existing medium-voltage cable and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing medium-voltage cable installations using materials and methods as specified.

D. Clean and repair existing medium-voltage cable to remain or to be reinstalled.

3.4 INSTALLATION

A. Avoid abrasion and other damage to cables during installation.

B. Use suitable manufacturer approved lubricants and pulling equipment.

C. Sustain cable pulling tensions and bending radii below manufacturer's recommended limits.

D. Ground cable shield at each termination and splice.

E. Install cables in manholes along wall providing longest route.

F. Arrange cable in manholes to avoid interference with duct entrances.

3.5 FIREPROOFING

A. Apply fireproofing tape to cables when installed in manholes, cable rooms, pull boxes, or other enclosures.

B. Smooth out irregularities, at splices or other locations, with insulation putty before applying fireproofing tape.

C. Apply fireproofing tape tightly around cables spirally in half-lapped wrapping or in butt jointed wrapping with second wrapping covering joints first.

D. Extend fireproofing 1 inch into conduit or duct.

E. Install tape with coated side toward cable.

F. Install random wrappings of plastic tape around fireproofing tape to prevent unraveling.

G. Install fireproofing to withstand a 200 Ampere arc for 30 seconds.

3.6 FIELD QUALITY CONTROL

A. Inspect exposed cable sections for physical damage.

B. Inspect cable for proper connections.

C. Inspect shield grounding, cable supports, and terminations for proper installation.

D. Tests as per applicable NETA standards.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Protect installed cables from entrance of moisture.

END OF SECTION 26 05 13

SECTION 26 05 16 – EMERGENCY CIRCUIT CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices and terminations for emergency or critical circuits rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. CONDUCTORS AND CABLES

1. Manufacturers:

   a. Draka USA
   b. AEI Cables.
   c. Pyrotenax.

B. CONDUCTORS SPLICES

1. 3M Company-Interam E-5 Series Mat with Metal Pull Boxes.
2. O-Z/Gedny; EGS Electrical Products Division.
3. Factory-fabricated connectors and splices of size, ampacity rating, material, type and class for application required.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Fire Pump and Emergency Smoke Control System Conductors: 600V RHH Power Cable

1. Cables must be Ul Classified Circuit Protective System with a 2-Hour fire rating when installed in the conduit.
2. Conduit supports shall be spaced no further than every 5' on center.
3. The cable shall utilize silicone ceramification technology in order to Maintain circuit integrity.
4. Cables shall be tested to Ul Standard 2196 - Fire Resistive Cables.
5. Cables shall comply to Ul Subject #44 for Rubber Insulated Type RHH.
6. Cables shall meet the requirements of Article 700 of the NEC-Emergency Systems.
7. Cables shall comply to the International Building Code and "protect against exposure to temperatures in excess of 10000 F (5380 C) for a period of not less than 15 minutes.

3.2 INSTALLATION

A. Run smoke control system evacuation cable/conduit in accordance with applicable sections of these specifications. Install fire pump conduits.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and side wall pressure valves.

C. Use pulling means, including fish tape, cable rope and basket-weave wire/cable grips, that will not damage cable of raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to the applicable UL Listing for each product type being installed.

F. Seal around cables penetrating fire-rated elements.

G. Identify and color-code conductors and cables.

H. Comply with UL electrical circuit protective system FHIT #25.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field-quality control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance and requirements.
2. Perform electrical and visual and mechanical inspection. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with the construction documents.
3. Test results that do not comply with the construction documents and corrective action taken to achieve contract compliance.

END OF SECTION 26 05 16

SECTION 26 05 19-LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

> **NOTE:** This section pertains to **600v class** power conductors and cabling.

1.1 SUMMARY

A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.

1.2 REFERENCES

A. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.
2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

C. Underwriters Laboratories, Inc.:

1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:

1. Solid conductor for feeders and branch circuits 12 AWG.
2. Stranded conductors for control circuits.
3. Conductor not smaller than 12 AWG for power and lighting circuits.
4. Conductor not smaller than 14 AWG for control circuits.
5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

B. Wiring Methods: Provide the following wiring methods:

1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.

3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway.
4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
5. Exterior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
6. Underground Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
7. Other Locations: Use only building wire, Type THHN/THWN insulation, in raceway.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and circuits.

1.5 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:

   1. **General Cable Co.**
   2. **Southwire Co.**
   3. **Rome Cable Co**.

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation Temperature Rating: 75 degrees C.

F. Insulation Material: Thermoplastic.

2.2 ARMORED CABLE

A. Manufacturers:

   1. **General Cable.**
   2. **Southwire Cable.**
   3. **Rome Cable.**

2.3 TERMINATIONS

A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.

B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

3.1 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.2 INSTALLATION

A. Neatly train and lace wiring inside boxes, equipment, and panelboards.

B. Identify and color code wire and cable as described herein. Identify each conductor with its circuit number or other designation indicated.

C. Special Techniques--Building Wire in Raceway:

1. Pull conductors into raceway at same time.
2. Install building wire 4 AWG and larger with pulling equipment.

D. Special Techniques - Cable:

1. Protect exposed cable from damage.
2. Support cables above accessible ceiling, using spring metal clips or metal plastic cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

E. Special Techniques - Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

F. Install solid conductors for branch circuits 10 AWG and smaller. Do not place bare stranded conductors directly under screws.

G. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.

H. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.

I. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.3 WIRE COLOR

A. General: All power and branch circuit conductors shall be provided with color-coded insulation or color-coded self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide. Vinyl tape shall be used in vaults, pull and junction boxes, manholes and handholes. Identify the source and circuit number of each set of conductors with write-on tags.

B. Colors: Color coding shall be as follows:

Phase	208Y/120V	480Y/277V
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	White with Black Stripe
Ground	Green	Green

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 26 05 19

SECTION 26 05 19-LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

NOTE: This section pertains to **600v class** power conductors and cabling.

1.1 SUMMARY

A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.

1.2 REFERENCES

A. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.
2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

C. Underwriters Laboratories, Inc.:

1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:

1. Solid conductor for feeders and branch circuits 12 AWG.
2. Stranded conductors for control circuits.
3. Conductor not smaller than 12 AWG for power and lighting circuits.
4. Conductor not smaller than 14 AWG for control circuits.
5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

B. Wiring Methods: Provide the following wiring methods:

1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.

3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway.
4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
5. Exterior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
6. Underground Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
7. Other Locations: Use only building wire, Type THHN/THWN insulation, in raceway.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and circuits.

1.5 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers:

1. **General Cable Co.**
2. **Southwire Co.**
3. **The Okonite Company.**

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation Voltage Rating: 600 volts.

E. Insulation Temperature Rating: 75 degrees C.

F. Insulation Material: Thermoplastic.

2.2 ARMORED CABLE

A. Manufacturers:

1. **General Cable.**
2. **Southwire Co.**
3. **The Okonite Company.**

2.3 TERMINATIONS

A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.

B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

3.1 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.2 INSTALLATION

A. Neatly train and lace wiring inside boxes, equipment, and panelboards.

B. Identify and color code wire and cable as described herein. Identify each conductor with its circuit number or other designation indicated.

C. Special Techniques--Building Wire in Raceway:

1. Pull conductors into raceway at same time.
2. Install building wire 4 AWG and larger with pulling equipment.

D. Special Techniques - Cable:

1. Protect exposed cable from damage.
2. Support cables above accessible ceiling, using spring metal clips or metal plastic cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.

E. Special Techniques - Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors.
2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

F. Install solid conductors for branch circuits 10 AWG and smaller. Do not place bare stranded conductors directly under screws.

G. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.

H. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.

I. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.3 WIRE COLOR

A. General: All power and branch circuit conductors shall be provided with color-coded insulation or color-coded self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide. Vinyl tape shall be used in vaults, pull and junction boxes, manholes and handholes. Identify the source and circuit number of each set of conductors with write-on tags.

B. Colors: Color coding shall be as follows:

Phase	208Y/120V	480Y/277V
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	White with Black Stripe
Ground	Green	Green

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 26 05 19

SECTION 26 05 27 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rod electrodes.
2. Wire.
3. Grounding well components.
4. Mechanical connectors.
5. Exothermic connections.

1.2 REFERENCES

A. Institute of Electrical and Electronics Designers:

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Metal underground water pipe.
2. Metal building frame.
3. Concrete-encased electrode.
4. Rod electrode.
5. Plate electrode.

1.4 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum.

1.5 SUBMITTALS

A. Product Data: Submit data on grounding electrodes and connections.

B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

C. Manufacturer's Installation Instructions: Submit for active electrodes.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 5 years documented experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.10 COORDINATION

A. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

A. Manufacturers:

1. **Erico, Inc.**
2. **O-Z Gedney Co.**
3. **Thomas & Betts.**

B. Product Description:

1. Material: Copper-clad steel.
2. Diameter: 3/4 inch
3. Length: 10 feet

C. Connector: Connector for exothermic welded connection.

2.2 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: 5 AWG.

C. Grounding Electrode Conductor: Copper conductor bare.

D. Bonding Conductor: Copper conductor bare.

2.3 GROUNDING WELL COMPONENTS

A. Well Pipe: 8 inches NPS (DN200) by 24 inches long fiberglass pipe with belled end.

B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.4 MECHANICAL CONNECTORS

A. Manufacturers:

1. **Erico, Inc.**
2. **ILSCO Corporation**
3. **O-Z Gedney Co.**

B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.5 EXOTHERMIC CONNECTIONS

A. Manufacturers:

1. Copperweld, Inc.
2. ILSCO Corporation
3. O-Z Gedney Co.

B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 INSTALLATION

A. Install rod electrodes as required. Install additional rod electrodes to achieve specified resistance to ground.

B. Install grounding and bonding conductors concealed from view.

C. Install grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.

D. Install 4/0 AWG bare copper wire in foundation footing.

E. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.

F. Bond together metal siding not attached to grounded structure; bond to ground.

G. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

H. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.

I. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

J. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

K. Permanently attach equipment and grounding conductors prior to energizing equipment.

L. The Ufer ground grounding electrode shall consist of a 50-foot length of bare #4/0 copper wire extended its full length below ground level and embedded along the bottom of the concrete foundation footing which is in direct contact with the foundation earth and supported in such a manner that it cannot be less than 3 inches from the bottom or side of the concrete when the foundation concrete is poured.

A loop at the approximate center of this grounding electrode shall be brought out at the top of the foundation and a #4/0 copper ground conductor shall connect the ground electrode to the main ground electrode bus in the equipment room. The conductor shall be connected to the ground electrode by exothermic welding.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Perform ground resistance testing in accordance with IEEE 142.

D. Perform leakage current tests in accordance with NFPA 99.

E. Perform continuity testing in accordance with IEEE 142.

F. When improper grounding is found on receptacles, check receptacles in entire project and correct.

G. Perform retest.

END OF SECTION 26 05 27

SECTION 26 05 30 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: Achieve fire ratings for adjacent construction, but not less than 1 hour fire rating.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code FM, UL, and WH for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T¬Ratings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings, but not less than 1-hour.
2. Floor and roof penetrations: Fire F-Ratings and temperature T-Ratings , but not less than 1-hour.

a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Maintain one copy of each document on site.

G. Comply with CBC Seismic and Gravity Design Criteria.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 5years documented experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:

1. **Allied Tube & Conduit Corp.**
2. **Powerstrut.**
3. **Unistrut.**

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:

1. **Allied Tube & Conduit Corp.**
2. **Unistrut Corp.**
3. **Powerstrut.**

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

A. Furnish materials in accordance with standards.

B. Sleeves for conduits through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.

C. Sleeves for conduits through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18gage thick galvanized steel.

D. Sleeves for conduits through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing:

1. Prefabricated fire rated sleeves including seals, UL listed.

E. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Hilti Corp.
3. 3M fire Protection Products

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel

jacket, joined with collars, penetration sealed with flanged stops.

6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Dark gray

2.6 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing materials to arrest liquid material leakage.

D. Obtain permission from Designer before using powder-actuated anchors.

E. Do not drill or cut structural members.

F. Obtain permission from Designer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide precast inserts systems, expansion anchors, powder actuated anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps with spring steel clips, steel ramset fasteners, and welded fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and

panelboards 1 inch off wall.
4. Support vertical conduit at every floor.

3.4 INSTALLATION – FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured. Dam material to remain.

H. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Pack void with backing material.
   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where cable tray and conduits penetrate fire rated surface, install firestopping product in accordance with manufacturer's instructions.

   a. Non-Rated Surfaces:

3. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows:

   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Install type of firestopping material recommended by manufacturer.

4. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
5. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 12 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 1inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 26 05 30

SECTION 26 05 30 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: Achieve fire ratings for adjacent construction, but not less than 1 hour fire rating.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code FM, UL, and WH for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.7 QUALITY ASSURANCE

A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T¬Ratings, but not less than 1-hour.

1. Wall Penetrations: Fire F-Ratings, but not less than 1-hour.
2. Floor and roof penetrations: Fire F-Ratings and temperature T-Ratings , but not less than 1-hour.

a. Floor Penetrations Within Wall Cavities: T-Rating is not required.

B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.

1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating for assembly in which joint is installed.

D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating for floor assembly.

E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

F. Maintain one copy of each document on site.

G. Comply with CBC Seismic and Gravity Design Criteria.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 5years documented experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. Powerstrut.
3. Unistrut.

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. Unistrut Corp.
3. Powerstrut.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

A. Furnish materials in accordance with standards.

B. Sleeves for conduits through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.

C. Sleeves for conduits through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18gage thick galvanized steel.

D. Sleeves for conduits through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing:

1. Prefabricated fire rated sleeves including seals, UL listed.

E. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.
2. Hilti Corp.
3. 3M fire Protection Products

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.

5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: Dark gray

2.6 FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products or products tested by independent testing laboratory.
2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing materials to arrest liquid material leakage.

D. Obtain permission from Designer before using powder-actuated anchors.

E. Do not drill or cut structural members.

F. Obtain permission from Designer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide precast inserts systems, expansion anchors, powder actuated anchors and preset inserts.
2. Steel Structural Elements: Provide beam clamps with spring steel clips, steel ramset fasteners, and welded fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install

spring lock washers under nuts.

2. Install surface mounted cabinets and panelboards with minimum of four anchors.
3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
4. Support vertical conduit at every floor.

3.4 INSTALLATION – FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.

G. Remove dam material after firestopping material has cured. Dam material to remain.

H. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
   c. Pack void with backing material.
   d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where cable tray and conduits penetrate fire rated surface, install firestopping product in accordance with manufacturer's instructions.

   a. Non-Rated Surfaces:

3. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows:

   a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
   b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve

and building element.

c. Install type of firestopping material recommended by manufacturer.

4. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
5. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Construct concrete~~Provide~~ housekeeping pads ~~of concrete,~~ minimum 4 inches above the finished floor~~thick~~ and not less than 4 inches larger in both directions than the~~extending 12 inches beyond~~ supported equipment. Use 3000 psi, 28-day compressive-strength concrete. Pads shall be reinforced with #4 steel reinforcing rods.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 1inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 26 05 30

SECTION 26 05 33-RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
5. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes at locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Underground More than 5 feet outside Foundation Wall: Provide concrete encased PVC Schedule 40 conduit. Provide cast metal boxes or nonmetallic pullboxes.

> **NOTE:** All permanent underground conduits shall be concrete encased.

C. Underground Within 5 feet from Foundation Wall: Provide rigid steel conduit, plastic coated conduit or thickwall nonmetallic conduit. Provide cast metal or nonmetallic boxes.

D. In or Under Slab on Grade: Provide rigid steel conduit, plastic coated conduit or thickwall nonmetallic conduit. Provide cast or nonmetallic metal boxes.

E. Outdoor Locations, Above Grade: Provide rigid galvanized steel conduit. Electrical metallic tubing may be used in areas 10’ above finished grade. Provide cast metal or nonmetallic outlet, pull, and junction boxes.

> **NOTE:** For conduit at all tug drives, provide rigid galvanized steel with galvanized supports. EMT conduit is **not** allowed at tug drives.

F. In Slab Above Grade: Provide rigid steel conduit, electrical metallic tubing and thickwall nonmetallic conduit. Provide cast sheet metal nonmetallic boxes.

G. Wet and Damp Locations: Provide rigid galvanized steel conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.

H. Exposed Dry Locations: Provide rigid galvanized steel conduit. Electrical metallic tubing may be used 10’ above finished grade. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

I. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

> **NOTE:** EMT conduit is restricted to interior use only. PVC conduit is restricted to underground use and shall be concrete encased.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.5 SUBMITTALS

A. Product Data - Submit for the following:

1. Flexible metal conduit.
2. Liquidtight flexible metal conduit.
3. Nonmetallic conduit.
4. Raceway fittings.
5. Conduit bodies.
6. Surface raceway.
7. Wireway.
8. Pull and junction boxes.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:

1. **Allied Tube & Conduit Corp.**
2. **Wheatland Tube.**
3. **Thomas & Betts.**

B. Rigid Steel Conduit: ANSI C80.1.

C. Intermediate Metal Conduit (IMC): Rigid steel.

D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 PVC COATED METAL CONDUIT

A. Manufacturers:

1. **Ocal-Blue.**
2. **Permacote.**
3. **Plastibond.**

B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.

C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. **AFC Cable.**
2. **Allied Tube & Conduit.**
3. **Thomas & Betts.**

B. Product Description: Interlocked steel construction.

C. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. **AFC Cable.**

2. **Allied Tube & Conduit.**
3. **Thomas & Betts.**

B. Product Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. **Allied Tube Corp.**
2. **Wheatland Tube.**
3. **Thomas & Betts**.

B. Product Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type.

2.6 NONMETALLIC CONDUIT

A. Manufacturers:

1. **PW Eagle.**
2. **Carlon Electrical Products.**
3. **Raco.**

B. Product Description: NEMA TC 2; Schedule 40 or 80 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 SURFACE METAL RACEWAY

A. Manufacturers:

1. **Walker Systems Inc.**
2. **The Wiremold Co.**

B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

C. Finish: Gray or Buff enamel. Stainless steel.

D. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.8 WIREWAY

A. Manufacturers:

1. **Hubbell.**
2. **Walker Systems Inc.**
3. **The Wiremold Co.**

B. Product Description: General purpose, Oiltight and dust-tight, Raintight type wireway.

C. Cover: Hinged or Screw cover.

D. Connector: Slip-in or Flanged.

E. Fittings: Lay-in type with removable top, bottom, and side; captive screws drip shield.

F. Finish: Rust inhibiting primer coating with gray enamel finish.

2.9 OUTLET BOXES

A. Manufacturers:

1. **Raco.**
2. **Appleton.**
3. **Steel City.**

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

D. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.10 PULL AND JUNCTION BOXES

A. Manufacturers:

1. **Raco.**
2. **Appleton.**
3. **Steel City.**

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel. NEMA 4 for exterior.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.

F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

A. Ground and bond raceway and boxes.

B. Fasten raceway and box supports to structure and finishes.

C. Identify raceway and boxes.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

> **NOTE:** All conduit shall be concealed from public view unless approved by LAWA.

3.4 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel.

H. Route exposed raceway parallel and perpendicular to walls.

NOTE: Conduit routed at 45 degree angles is **not** allowed at any time.

I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

J. Route conduit in and under slab from point-to-point.

K. Maintain clearance between raceway and piping for maintenance purposes.

L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

M. Cut conduit square using saw or pipe cutter; de-burr cut ends.

N. Bring conduit to shoulder of fittings; fasten securely.

O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

P. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Q. Install no more than equivalent of four 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 2 inch size.

R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

S. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

V. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

W. Close ends and unused openings in wireway.

NOTE: All conduit shall be routed above any mechanical ductwork **not** below.

3.5 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

K. Install adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires or other piping systems.

M. Support boxes independently of conduit.

N. Install gang box where more than one device is mounted together. Do not use sectional box.

O. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.

C. Locate outlet boxes within 6’ of luminaires.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused openings in boxes.

3.8 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

> **NOTE:** Refer to Identification for Electrical Systems for information pertaining to conduit labeling.

END OF SECTION 26 05 33

SECTION 26 05 33-RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
5. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes at locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Underground More than 5 feet outside Foundation Wall: Provide concrete encased PVC Schedule 40 conduit. Provide cast metal boxes or nonmetallic pull boxes.

NOTE: All permanent underground conduits shall be concrete encased.

C. Underground within 5 feet from Foundation Wall: Provide rigid steel conduit, plastic coated conduit or thickwall nonmetallic conduit. Provide cast metal or nonmetallic boxes.

D. In or Under Slab, on Grade: Provide rigid steel conduit, plastic coated conduit or thickwall nonmetallic conduit. Provide cast metal or nonmetallic boxes.

E. In Slab, Above Grade: Provide rigid steel conduit, electrical metallic tubing or thickwall nonmetallic conduit. Provide cast metal or nonmetallic boxes.

F. Wet Locations, Above Grade: Provide rigid galvanized steel conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes. Provide flush mounting outlet box in finished areas.

G. Damp Locations: Provide rigid galvanized steel conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas. These locations include, but are not limited to, areas underneath buildings open to the outdoor environment.

H. Dry Locations, Exposed and Concealed: Provide electrical metallic tubing conduit. Rigid galvanized steel conduit shall be used in areas subject to physical damage. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas.

I. PVC conduit is restricted to underground use and shall be concrete encased.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.5 SUBMITTALS

A. Product Data - Submit for the following:

1. Flexible metal conduit.
2. Liquidtight flexible metal conduit.
3. Nonmetallic conduit.
4. Raceway fittings.
5. Conduit bodies.
6. Surface raceway.
7. Wireway.
8. Pull and junction boxes.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers:

1. **Allied Tube & Conduit Corp.**
2. **Republic Conduit.**
3. **Wheatland Tube.**

B. Rigid Steel Conduit: ANSI C80.1.

C. Intermediate Metal Conduit (IMC): Rigid steel.

D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

1. Manufacturers:
   a. Cooper Crouse-Hinds.
   b. O-Z/Gedney.
   c. Thomas & Betts.

2.2 PVC COATED METAL CONDUIT

A. Manufacturers:

1. **Ocal-Blue.**
2. **Permacote.**
3. **Plastibond.**

B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.

C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. **AFC Cable.**
2. **Electri-Flex.**
3. **Southwire Co.**

B. Product Description: Interlocked steel construction.

C. Fittings: NEMA FB 1.

1. Manufacturers:
   a. AFC Cable.
   b. Cooper Crouse-Hinds.
   c. Thomas & Betts.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:
1. **AFC Cable.**
2. **Electri-Flex.**
3. **Southwire Co.**

B. Product Description: Interlocked steel construction with PVC jacket.

C. Fittings: NEMA FB 1.

1. Manufacturers:
   a. AFC Cable.
   b. Cooper Crouse-Hinds.
   c. Thomas & Betts.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. **Allied Tube & Conduit.**
2. **Republic Conduit.**
3. **Wheatland Tube.**

B. Product Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression type.

1. Manufacturers:
   a. Cooper Crouse-Hinds.
   b. O-Z/Gedney.
   c. Thomas & Betts.

2.6 NONMETALLIC CONDUIT

A. Manufacturers:

1. **Allied Tube & Conduit.**
2. **Cantex.**
3. **JW Eagle.**

B. Product Description: NEMA TC 2; Schedule 40 or 80 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 SURFACE METAL RACEWAY

A. Manufacturers:

1. **Walker Systems Inc.**
2. **The Wiremold Co.**

B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

C. Finish: Gray or Buff enamel. Stainless steel.

D. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.

2.8 WIREWAY

A. Manufacturers:

1. **Cooper B-Line.**
2. **Hubbell.**
3. **Walker Systems Inc.**

B. Product Description: General purpose, Oiltight and dust-tight, Raintight type wireway.

C. Cover: Hinged or Screw cover.

D. Connector: Slip-in or Flanged.

E. Fittings: Lay-in type with removable top, bottom, and side; captive screws drip shield.

F. Finish: Rust inhibiting primer coating with gray enamel finish.

2.9 OUTLET BOXES

A. Manufacturers:

1. **Appleton.**
2. **Raco.**
3. **Steel City.**

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
2. Concrete Ceiling Boxes: Concrete type.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

D. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.10 PULL AND JUNCTION BOXES

A. Manufacturers:

1. **Appleton.**
2. **Raco.**

3. **Steel City.**

B. Sheet Metal Boxes: NEMA OS 1, galvanized steel. NEMA 4 for exterior.

C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.

D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.

E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.

F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

A. Ground and bond raceway and boxes.

B. Fasten raceway and box supports to structure and finishes.

C. Identify raceway and boxes.

D. Arrange raceway and boxes to maintain headroom and present neat appearance.

> **NOTE:** All conduit shall be concealed from public view unless approved by LAWA.

3.4 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel.

H. Route exposed raceway parallel and perpendicular to walls.

NOTE: Conduit routed at 45 degree angles is **not** allowed at any time.

I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

J. Route conduit in and under slab from point-to-point.

K. Maintain clearance between raceway and piping for maintenance purposes.

L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

M. Cut conduit square using saw or pipe cutter; de-burr cut ends.

N. Bring conduit to shoulder of fittings; fasten securely.

O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

P. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Q. Install no more than equivalent of four 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 2 inch size.

R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

S. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

V. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

W. Close ends and unused openings in wireway.

NOTE: All conduit shall be routed above any mechanical ductwork **not** below.

3.5 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

K. Install adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires or other piping systems.

M. Support boxes independently of conduit.

N. Install gang box where more than one device is mounted together. Do not use sectional box.

O. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.

C. Locate outlet boxes within 6’ of luminaires.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused openings in boxes.

3.8 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

NOTE: Refer to Identification for Electrical Systems for information pertaining to conduit labeling.

END OF SECTION 26 05 33

SECTION 26 05 34-FLOOR BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes floor boxes; floor box service fittings; and access floor boxes.

> **NOTE:** Verify the existing floor assembly construction and its ability to accommodate any additional floor penetrations without compromising structural integrity and any required fire rating.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

1.3 SUBMITTALS

A. Product Data: Submit catalog data for floor boxes service fittings.

B. Samples: Submit two of each service fitting illustrating size, material, configuration, and finish.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of each floor box and poke-through fitting.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 – PRODUCTS

> **NOTE:** Pedestal type and poke thru type boxes are **not** allowed without written LAWA approval.

2.1 FLOOR BOXES

A. Manufacturers:

1. **Wiremold Co.**
2. **Walker, Inc.**
3. **Hubbell.**

B. Floor Boxes: NEMA OS 1.

C. Adjustability: Fully adjustable or semi-adjustable.

D. Material: Cast metal or Formed steel.

2.2 FLUSH-COVER-TYPE COMBINATION FITTING

A. Manufacturers:

1. **Walker, Inc.**
2. **Wiremold Co.**

B. Material: Brass or Aluminum.

> **NOTE:** The specified material for the floor box cover shall be aesthetically compatible with the adjacent floor finish and be approved by LAWA.

2.3 FLUSH-COVER-SERVICE FITTING ACCESSORIES

A. Protective Ring: Brass or Aluminum finish.

B. Split Nozzle: Brass or Aluminum finish.

C. Carpet Ring: Brass or Aluminum finish.

2.4 ACCESS FLOOR BOX

A. Manufacturers:

1. **Wiremold, Inc.**
2. **Tate.**
3. **Thomas & Betts Steel City.**

B. Product Description: Sheet metal box suitable for mounting in access floor system.

PART 3 – EXECUTION

> **NOTE:** In order to avoid severing any existing structural reinforcement, use ground penetrating radar to survey the existing concrete slab before cutting or drilling any new floor penetrations.

3.1 EXAMINATION

A. Verify locations of floor boxes and outlets in offices, and work areas prior to rough-in.

B. Verify openings in access floor are in proper locations.

3.2 EXISTING WORK

A. Disconnect abandoned service fitting devices and remove service fittings. Fill in hole for abandoned floor boxes. Remove abandoned boxes, fill in hole and restore to adjacent finished area.

B. Maintain access to existing floor boxes remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing service fitting installations using materials and methods compatible with existing electrical installations, or as specified.

D. Clean and repair existing service fittings to remain or to be reinstalled.

3.3 INSTALLATION

A. Floor Box Requirements: Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

B. Set floor boxes aligned with adjacent floor finish.

> **NOTE:** When aligning floor boxes note that most of the existing floor within the terminals are not level. Align all new floor boxes totally flush with the adjacent floor finish on all sides.

C. Install boxes and fittings to preserve fire resistance rating of slabs and other elements, using materials and methods.

3.4 ADJUSTING

A. Adjust floor box flush with finish flooring material.

3.5 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

END OF SECTION 26 05 34

SECTION 26 05 44 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Ducts in concrete-encased duct banks.
2. Handholds and hand hole accessories.
3. Manholes and manhole accessories.

1.2 REFERENCES

A. ANSI C2

B. NFPA 70

C. City of Los Angeles Electrical Code (LAEC)

D. ASTM 478

E. UL 651

F. NEMA TC-2, TC-3

G. ASTM 615

H. ASTM C990

I. AASHTO HS20

1.3 SUBMITTALS

A. Product Data: For the following:

1. Manhole and hand hole hardware.
2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
3. Duct-bank materials, including spacers and miscellaneous components.
4. Warning tape. Detectable type.

B. Shop Drawings: Show fabrication and installation details for underground ducts and utility structures and include the following:

1. For manholes:

a. Duct sizes and locations of duct entries.
b. Reinforcement details.
c. Manholes cover design and engraving.
d. Step details.
e. Grounding details.
f. Dimensioned locations of cable rack inserts, pulling-in irons, and sumps.

2. For precast manholes and hand holes, Shop Drawings shall be signed and sealed by a qualified Professional Engineer, and shall show the following:

a. Construction of individual segments.
b. Joint details.
c. Design calculations.

C. Coordination Detailing Activity Drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

D. Product Certificates: For concrete and steel used in underground precast manholes, according to ASTM C 858.

E. Product Test Reports: Indicate compliance of manholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the LAWA's Representative, and marked for intended use.

B. Comply with ANSI C2.

C. Comply with California Electric Code (NFPA 70) and City of Los Angeles Electrical Code (LAEC).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at Project site as recommended by manufacturer to prevent physical damage.

C. Arrange so identification markings are visible.

D. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving occupied facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Comply with LAWA power shut-down procedures.
2. Do not proceed with utility interruptions without LAWA's Representative written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to manholes and handholes, and as approved by the LAWA Representative.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Underground Precast Concrete Utility Structures:

   a. Jensen Precast.
   b. Utility Vault Co.
   c. Brooks

2. Frames and Covers:

   a. Alhambra Foundry

b. **Campbell Foundry Co.**
c. **East Jordan Iron Works, Inc.**

3. Nonmetallic Ducts and Accessories:

a. **Carlon Electrical Products.**
b. **Cantex, Inc.**
c. **Certainteed Corp.; Pipe & Plastics Group.**

2.2 DUCTS

A. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 HAND HOLES

A. Cast-Metal Boxes: Cast aluminum, with outside flanges and recessed, gasketed cover for flush mounting and with nonskid finish and legend on cover. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks.

B. Precast Handholes: Reinforced concrete, monolithically poured walls and bottom, with steel frame and access door assembly as the top of hand hole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks. Cover Legend: All underground pullbox covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:

1. “ELEC-LV” for electrical power circuits 600 volts or less.
2. “ELEC-HV” for electrical power circuits over circuits over 600 volts.
3. “COMM” for communications circuits. A custom 3-digit number shall be added to the cover.
4. Contact the LAWA Engineer for number assignment. The minimum letter height shall be one (1) inch.

2.4 PRECAST MANHOLES

A. Precast Units: Interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Entry way diameter: 36 inches minimum.

C. Design and fabricate structure according to ASTM C 858.

D. Structural Design Loading: ASTM C 857, Class A-16 (AASHTO HS20).

E. Base section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

F. Riser Sections: 4-inch minimum thickness, and lengths to provide required depth.

G. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings. Custom configuration for eccentric manhole locations to align with corridors.

H. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches. Adjust to custom manhole locations.

I. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

J. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

K. Protective Coating: Plant-applied, coal-tar, epoxy-polyamide paint 15-mil minimum thickness applied to exterior and interior surfaces.

L. Source Quality Control: Inspect structures according to ASTM C 1037.

M. Provide custom top section for offset manhole location for alignment with corridor for below building installation.

N. Access Ladder: Provide permanent metal access ladder.

2.5 ACCESSORIES

A. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts.

B. Manhole Frames and Covers: Comply with AASHTO loading specified for manhole; Ferrous frame 36 inch clear ID by 6 inch minimum riser with 4-inch-minimum width flange and 38 -inch-diameter cover.

1. All manhole and underground pullbox covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:

    a. “ELEC-LV” for electrical power circuits 600 volts or less.
    b. “ELEC-HV” for electrical power circuits over circuits over 600 volts.

c. "COMM" for communications circuits.
d. A custom 3-digit number shall be added to the cover. Contact the LAWA Engineer for number assignment. The minimum letter height shall be one (1) inch.

2. Cast iron with cast-in legend as indicated above subsection 1. Milled cover-to-frame bearing surfaces.
3. Manhole Frames and Covers: ASTM A 48; Class 30B gray iron, 36-inch size, machine-finished with flat bearing surfaces.

C. Sump Frame and Grate: ASTM A 48, Class 30B gray cast iron.

D. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch- diameter eye and 1-by-4¬inch bolt.

1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

E. Pulling and Lifting Irons in Floor: 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to reinforced rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

F. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

H. Cable Stanchions: Hot-rolled, hot-dip-galvanized, T-section steel; 2-1/4-inch size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

I. Cable Arms: 3/16-inch- thick, hot-rolled, hot-dip-galvanized, steel sheet pressed to channel shape; 12 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any location on cable stanchions.

J. Cable-Support Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

K. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

L. Warning Tape: Provide underground-line warning tape specified under section "Identification for Electrical Systems."

2.6 CONSTRUCTION MATERIALS

A. Seal manhole section joints with sealing compound recommended by the manhole manufacturer.

B. Damp proofing: Comply with "Bituminous Damp proofing."

C. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

D. Brick for Manhole Chimney: Sewer and manhole brick, ASTM C 32, Grade MS.

E. Concrete: Use 3000-psi- minimum, 28-day compressive strength and 1-inch maximum aggregate size.

F. Provide red dye added to concrete during batching.

PART 3 - EXECUTION

3.1 APPLICATION

A. Underground Ducts for Electrical Cables Higher than 600 V: Type EPC-40-PVC, concrete-encased duct bank.

B. Manholes: Underground precast concrete utility structures.

C. Manholes: Cast-in-place concrete.

3.2 EARTHWORK

A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Soil compaction at all locations shall be as specified by civil and structural specifications.

B. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

C. Restore disturbed pavement.

3.3 CONDUIT AND DUCT INSTALLATION

A. Exercise care in excavating, trenching, and working near existing utilities. Locate any existing buried utilities before excavating.

B. Duct bank trench shall be shored, framed and braced for installing ducts. Frames, forms, and braces shall be either wood or steel. Variations in outside dimensions of the installed duct bank shall not exceed 2 inches on the vertical or the horizontal from the design. Remove forms and bracing after 24 hours and before backfilling.

C. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions. Duct banks shall be laid to a minimum grade slope of 4 inches per 100 feet. This slope may be from one manhole to the next or both ways from a high point between manholes, depending upon the contour of the finished grade.

D. Duct banks shall be installed so that the top of the concrete encasement shall be no less than 36 inches below grade or pavement for primary power. As a general rule, depths shall be a minimum of three feet, but not more than six feet.

E. Curves and Bends: Use manufactured 48 inches minimum elbows for stub-ups at equipment, and enclosures, and at building entrances. Use manufactured long sweep bends with a minimum radius of 4 feet minimum, both horizontally and vertically, at other locations. Manufactured long radius bends may be used in runs of 100 feet or less on approval from the LAWA's representative. Vertical feeder sweep into buildings shall be coated steel. Multiple conduit sweeps shall be concentric and maintain spacing throughout. Medium-voltage conduit sweeps shall be 12' minimum radius sweeps.

F. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

G. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches o.c. for 5-inch ducts and vary proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Where connection to bulkhead of duct bank is made to vaults or existing duct banks, the concrete encasement shall be doweled with on No. 4 reinforcement rod 36 inches long per conduit to the existing encasement.

H. Building Entrances: Make a transition from underground duct to rigid steel conduit 5 feet outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-Encased Ducts: Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall. Expand duct bank at building entry to provide 6" spacing between sealing system sleeves. Coordinate sleeve placement with structural reinforcement bar placement.
2. Provide methane penetration EYS sealing fitting at each conduit penetration into building – both vertical and horizontal. Arrange so that sealant parts remain accessible.

3. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight. Seals shall be Link Seal Assembly with precast ‘CS” model – non-metallic sleeve by Link Seal or equal.

> **NOTE:** All permanent underground ducts are to be concrete encased as described herein.

I. Concrete-Encased, Nonmetallic Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators 6’-0” O.C. to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Duct joints in concrete may be placed side by side horizontally, but shall be staggered at least 6 inches vertically. Joints shall be made in accordance with manufacturer’s recommendations for the particular type of duct and coupling selected. In the absence of specific recommendations, plastic duct connections shall be made by brushing a plastic solvent cement on the inside of a plastic coupling fitting and on the outside of duct’s ends. The duct and fitting shall then be slipped together with a quick one-quarter turn to set the joint.
3. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope. At connection to manholes, dowel concrete encasement with on No. 4 reinforcing bar 36 inches long per duct.
4. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Clearances between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches below finished grade in no traffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

> **NOTE:** Direct-Buried Ducts are for temporary construction only as determined by LAWA.

J. Direct-Buried Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators not more than 4 feet center-to-center along entire length of duct bank including top pipes.
2. Install expansion fittings as required.
3. Trench Bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms for pipes less than 6 inches in nominal diameter.
4. Backfill: Install backfill. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally. Do not place backfill for a period of at least 24 hours after pouring of concrete.
5. Minimum Clearances between Ducts: 3 inches between ducts for like services and 6 inches between power and signal ducts.
6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

K. Warning Tape: Bury metal backed warning tape approximately 12 inches above all concrete-encased duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.

L. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete. Galvanized steel conduits installed below grade shall be painted with two coats of Koppers Bitumastic paint before installing in ground.

M. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

N. Pulling Cord: Install 100-lbf- test nylon cord in all ducts, including spares. Identify opposite terminal points of duct.

3.4 MANHOLE AND HANDHOLE INSTALLATION

A. Elevation: Install manholes with rooftop at least 15 inches below finished grade. Install handholes with depth as required. Cast hand hole cover frame directly into roof of hand hole and set roof surface 1 inch above grade. Place and align precast manholes to provide horizontal tolerance of 2 inches in any direction and vertical alignment with not greater than 1/8 inch maximum tolerance for 6 foot of depth. Completed manhole shall be rigid, true to dimensions and alignment, and shall be watertight.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated. Sumps shall be knocked out at time of installation.

C. Access: Install cast-iron frame and cover.

1. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
2. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

D. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole and hand hole chimneys after brick mortar has cured at least three days. Seal manhole section joints with sealing compound recommended by the manhole manufacturer. Penetration into manholes and/or boxes shall be sealed. Provide conduit duct plugs for unused terminator openings of spare conduits in manhole. Do not water seal top removable cover until cable pulling has been completed.

E. Damp proofing: Apply damp proofing to exterior surfaces of units after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, damp proof joints and connections and touch up abrasions and scars. Damp proof exterior of manhole and hand hole chimneys after brick mortar has cured at least three days.

F. Interior walls and ceiling shall be primed and painted with two coats flat white paint.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

H. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

I. Grounding: Install ground rod through floor in each structure with top protruding 6 inches above floor.

1. Seal floor opening against water penetration with waterproof nonshrink grout. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

J. Precast Concrete Manhole Installation: comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

2. Unless otherwise indicated, support units on a 12” level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth. Provide a minimum 6-inch level base of ¾ inch crushed rock under manhole to ensure uniform distribution of soil pressure on floor.
3. Manholes below building floor shall have all earth work compacted to match compaction required by structural specifications.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Grounding: Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance .

C. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

D. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

C. After the duct line has been completed, a brush with stiff bristles shall be pulled through each duct to make certain that no particles of earth, sand or gravel have been left in the line. (Mandrels not less than 12 inches long, having a diameter approximately 1/4 inch less than inside diameter of the duct, shall be pulled through each duct). Leave a 3/8”-inch minimum polypropylene pull rope in each duct for future use.

END OF SECTION 26 05 44

SECTION 26 05 44 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Ducts in concrete-encased duct banks.
2. Handholds and hand hole accessories.
3. Manholes and manhole accessories.

1.2 REFERENCES

A. ANSI C2

B. NFPA 70

C. City of Los Angeles Electrical Code (LAEC)

D. ASTM 478

E. UL 651

F. NEMA TC-2, TC-3

G. ASTM 615

H. ASTM C990

I. AASHTO HS20

1.3 SUBMITTALS

A. Product Data: For the following:

1. Manhole and hand hole hardware.
2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
3. Duct-bank materials, including spacers and miscellaneous components.
4. Warning tape. Detectable type.

B. Shop Drawings: Show fabrication and installation details for underground ducts and utility structures and include the following:

1. For manholes:

    a. Duct sizes and locations of duct entries.
    b. Reinforcement details.
    c. Manholes cover design and engraving.
    d. Step details.
    e. Grounding details.
    f. Dimensioned locations of cable rack inserts, pulling-in irons, and sumps.

2. For precast manholes and hand holes, Shop Drawings shall be signed and sealed by a qualified Professional Engineer, and shall show the following:

    a. Construction of individual segments.
    b. Joint details.
    c. Design calculations.

C. Coordination Detailing Activity Drawings: Show duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to scale, and show all bends and location of expansion fittings.

D. Product Certificates: For concrete and steel used in underground precast manholes, according to ASTM C 858.

E. Product Test Reports: Indicate compliance of manholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the LAWA's Representative, and marked for intended use.

B. Comply with ANSI C2.

C. Comply with California Electric Code (NFPA 70) and City of Los Angeles Electrical Code (LAEC).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at Project site as recommended by manufacturer to prevent physical damage.

C. Arrange so identification markings are visible.

D. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving occupied facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.

1. Comply with LAWA power shut-down procedures.
2. Do not proceed with utility interruptions without LAWA's Representative written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities and site grading, as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to manholes and handholes, and as approved by the LAWA Representative.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Underground Precast Concrete Utility Structures:

    a. **Jensen Precast.**
    b. **Utility Vault Co.**
    c. **Brooks**

2. Frames and Covers:

    a. **Alhambra Foundry**

b. **Campbell Foundry Co.**
c. **East Jordan Iron Works, Inc.**

3. Nonmetallic Ducts and Accessories:

a. **Carlon Electrical Products.**
b. **Cantex, Inc.**
c. **Certainteed Corp.; Pipe & Plastics Group.**

2.2 DUCTS

A. Rigid Nonmetallic Conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 HAND HOLES

A. Cast-Metal Boxes: Cast aluminum, with outside flanges and recessed, gasketed cover for flush mounting and with nonskid finish and legend on cover. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks.

B. Precast Handholes: Reinforced concrete, monolithically poured walls and bottom, with steel frame and access door assembly as the top of hand hole. Duct entrances and windows shall be located near corners to facilitate racking. Pulling-in irons and other built-in items shall be installed before pouring concrete. Cover shall have nonskid finish and legend. Unit, when buried, shall be designed to support AASHTO H10 loading for sidewalk and landscaped areas and HS20 for roadways, parking lots and loading docks. Cover Legend: All underground pull box covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:

1. “ELEC-LV” for electrical power circuits 600 volts or less.
2. “ELEC-HV” for electrical power circuits over circuits over 600 volts.
3. “COMM” for communications circuits.~~ A custom 3-digit number shall be added to the cover.~~
4. A custom 3-digit number shall be added to the cover. Contact the LAWA Engineer for number assignment. The minimum letter height shall be one (1) inch.

2.4 PRECAST MANHOLES

A. Precast Units: Interlocking mating sections, complete with accessories, hardware, and features as indicated. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Entry way diameter: 36 inches minimum.

C. Design and fabricate structure according to ASTM C 858.

D. Structural Design Loading: ASTM C 857, Class A-16 (AASHTO HS20).

E. Base section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

F. Riser Sections: 4-inch minimum thickness, and lengths to provide required depth.

G. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings. Custom configuration for eccentric manhole locations to align with corridors.

H. Steps: ASTM A 615, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches. Adjust to custom manhole locations.

I. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

J. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

K. Protective Coating: Plant-applied, coal-tar, epoxy-polyamide paint 15-mil minimum thickness applied to exterior and interior surfaces.

L. Source Quality Control: Inspect structures according to ASTM C 1037.

M. Provide custom top section for offset manhole location for alignment with corridor for below building installation.

N. Access Ladder: Provide permanent metal access ladder.

2.5 ACCESSORIES

A. Duct Spacers: Rigid PVC interlocking spacers, selected to provide minimum duct spacings and cover depths indicated while supporting ducts during concreting and backfilling; produced by the same manufacturer as the ducts.

B. Manhole Frames and Covers: Comply with AASHTO loading specified for manhole; Ferrous frame 36 inch clear ID by 6 inch minimum riser with 4-inch-minimum width flange and 38 -inch-diameter cover.

1. All manhole and underground pullbox covers shall have the following cast-in or bead welded and galvanized identification label permanently affixed to the exterior:

a. "ELEC-LV" for electrical power circuits 600 volts or less.
b. "ELEC-HV" for electrical power circuits over circuits over 600 volts.
c. "COMM" for communications circuits.
d. A custom 3-digit number shall be added to the cover. Contact the LAWA Engineer for number assignment. The minimum letter height shall be one (1) inch.

2. Cast iron with cast-in legend as indicated above subsection 1. Milled cover-to-frame bearing surfaces.
3. Manhole Frames and Covers: ASTM A 48; Class 30B gray iron, 36-inch size, machine-finished with flat bearing surfaces.

C. Sump Frame and Grate: ASTM A 48, Class 30B gray cast iron.

D. Pulling Eyes in Walls: Eyebolt with reinforcing-bar fastening insert 2-inch- diameter eye and 1-by-4¬inch bolt.

1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

E. Pulling and Lifting Irons in Floor: 7/8-inch- diameter, hot-dip-galvanized, bent steel rod; stress relieved after forming; and fastened to reinforced rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

F. Bolting Inserts for Cable Stanchions: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

H. Cable Stanchions: Hot-rolled, hot-dip-galvanized, T-section steel; 2-1/4-inch size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

I. Cable Arms: 3/16-inch- thick, hot-rolled, hot-dip-galvanized, steel sheet pressed to channel shape; 12 inches wide by 14 inches long and arranged for secure mounting in horizontal position at any location on cable stanchions.

J. Cable-Support Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

K. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and of adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

L. Warning Tape: Provide underground-line warning tape specified under section "Identification for Electrical Systems."

2.6 CONSTRUCTION MATERIALS

A. Seal manhole section joints with sealing compound recommended by the manhole manufacturer.

B. Damp proofing: Comply with "Bituminous Damp proofing."

C. Mortar: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

D. Brick for Manhole Chimney: Sewer and manhole brick, ASTM C 32, Grade MS.

E. Concrete: Use 3000-psi- minimum, 28-day compressive strength and 1-inch maximum aggregate size.

F. Provide red dye added to concrete during batching.

PART 3 - EXECUTION

3.1 APPLICATION

A. Underground Ducts for Electrical Cables Higher than 600 V: Type EPC-40-PVC, concrete-encased duct bank.

B. Manholes: Underground precast concrete utility structures.

C. Manholes: Cast-in-place concrete.

3.2 EARTHWORK

A. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Soil compaction at all locations shall be as specified by civil and structural specifications.

B. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

C. Restore disturbed pavement.

3.3 CONDUIT AND DUCT INSTALLATION

A. Exercise care in excavating, trenching, and working near existing utilities. Locate any existing buried utilities before excavating.

B. Duct bank trench shall be shored, framed and braced for installing ducts. Frames, forms, and braces shall be either wood or steel. Variations in outside dimensions of the installed duct bank shall not exceed 2 inches on the vertical or the horizontal from the design. Remove forms and bracing after 24 hours and before backfilling.

C. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions. Duct banks shall be laid to a minimum grade slope of 4 inches per 100 feet. This slope may be from one manhole to the next or both ways from a high point between manholes, depending upon the contour of the finished grade.

D. Duct banks shall be installed so that the top of the concrete encasement shall be no less than 36 inches below grade or pavement for primary power. As a general rule, depths shall be a minimum of three feet, but not more than six feet.

E. Curves and Bends: Use manufactured 48 inches minimum elbows for stub-ups at equipment, and enclosures, and at building entrances. Use manufactured long sweep bends with a minimum radius of 4 feet minimum, both horizontally and vertically, at other locations. Manufactured long radius bends may be used in runs of 100 feet or less on approval from the LAWA's representative. Vertical feeder sweep into buildings shall be coated steel. Multiple conduit sweeps shall be concentric and maintain spacing throughout. Medium-voltage conduit sweeps shall be 12' minimum radius sweeps.

F. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

G. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches o.c. for 5-inch ducts and vary proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Where connection to bulkhead of duct bank is made to vaults or existing duct banks, the concrete encasement shall be doweled with on No. 4 reinforcement rod 36 inches long per conduit to the existing encasement.

H. Building Entrances: Make a transition from underground duct to rigid steel conduit 5 feet outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-Encased Ducts: Install reinforcement in duct banks passing through disturbed earth near buildings and other excavations. Coordinate duct bank with structural design to support duct bank at wall without reducing structural or watertight integrity of building wall. Expand duct bank at building entry to provide 6" spacing between sealing system sleeves. Coordinate sleeve placement

with structural reinforcement bar placement.

2. Provide methane penetration EYS sealing fitting at each conduit penetration into building – both vertical and horizontal. Arrange so that sealant parts remain accessible.
3. Waterproofed Wall and Floor Penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight. Seals shall be Link Seal Assembly with precast 'CS" model – non-metallic sleeve by Link Seal or equal.

NOTE: All permanent underground ducts are to be concrete encased as described herein.

I. Concrete-Encased, Nonmetallic Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators 6'-0" O.C. to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Duct joints in concrete may be placed side by side horizontally, but shall be staggered at least 6 inches vertically. Joints shall be made in accordance with manufacturer's recommendations for the particular type of duct and coupling selected. In the absence of specific recommendations, plastic duct connections shall be made by brushing a plastic solvent cement on the inside of a plastic coupling fitting and on the outside of duct's ends. The duct and fitting shall then be slipped together with a quick one-quarter turn to set the joint.
3. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope. At connection to manholes, dowel concrete encasement with on No. 4 reinforcing bar 36 inches long per duct.
4. Reinforcement: Reinforce duct banks where they cross disturbed earth and where indicated.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Clearances between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between

power and signal ducts.

7. Depth: Install top of duct bank at least 24 inches below finished grade in no traffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

> **NOTE:** Direct-Buried Ducts are for <u>temporary</u> construction only as determined by LAWA.

J. Direct-Buried Ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator Installation: Space separators not more than 4 feet center-to-center along entire length of duct bank including top pipes.
2. Install expansion fittings as required.
3. Trench Bottom: Continuous, firm, and uniform support for duct bank. Prepare trench bottoms for pipes less than 6 inches in nominal diameter.
4. Backfill: Install backfill. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally. Do not place backfill for a period of at least 24 hours after pouring of concrete.
5. Minimum Clearances between Ducts: 3 inches between ducts for like services and 6 inches between power and signal ducts.
6. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

K. Warning Tape: Bury metal backed warning tape approximately 12 inches above all concrete-encased duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank.

L. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete. Galvanized steel conduits installed below grade shall be painted with two coats of Koppers Bitumastic paint before installing in ground.

M. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

N. Pulling Cord: Install 100-lbf- test nylon cord in all ducts, including spares. Identify opposite terminal points of duct.

3.4 MANHOLE AND HANDHOLE INSTALLATION

A. Elevation: Install manholes with rooftop at least 15 inches below finished grade. Install handholes with depth as required. Cast hand hole cover frame directly into roof of hand hole and set roof surface 1 inch above grade. Place and align precast manholes to provide horizontal tolerance of 2 inches in any direction and vertical alignment with not greater than 1/8 inch maximum tolerance for 6 foot of depth. Completed manhole shall be rigid, true to dimensions and alignment, and shall be watertight.

B. Drainage: Install drains in bottom of units where indicated. Coordinate with drainage provisions indicated. Sumps shall be knocked out at time of installation.

C. Access: Install cast-iron frame and cover.

1. Install precast collars and rings to support frame and cover and to connect cover with roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
2. Set frames in paved areas and traffic ways flush with finished grade. Set other frames 1 inch above finished grade.

D. Waterproofing: Apply waterproofing to exterior surfaces of units after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole and hand hole chimneys after brick mortar has cured at least three days. Seal manhole section joints with sealing compound recommended by the manhole manufacturer. Penetration into manholes and/or boxes shall be sealed. Provide conduit duct plugs for unused terminator openings of spare conduits in manhole. Do not water seal top removable cover until cable pulling has been completed.

E. Damp proofing: Apply damp proofing to exterior surfaces of units after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, damp proof joints and connections and touch up abrasions and scars. Damp proof exterior of manhole and hand hole chimneys after brick mortar has cured at least three days.

F. Interior walls and ceiling shall be primed and painted with two coats flat white paint.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

H. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

I. Grounding: Install ground rod through floor in each structure with top protruding 6 inches above floor.

1. Seal floor opening against water penetration with waterproof nonshrink grout. Ground exposed metal components and hardware with bare-copper ground conductors. Train conductors neatly around corners. Use cable clamps secured with expansion anchors to attach ground conductors.

J. Precast Concrete Manhole Installation: comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
2. Unless otherwise indicated, support units on a 12” level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth. Provide a minimum 6-inch level base of ¾ inch crushed rock under manhole to ensure uniform distribution of soil pressure on floor.
3. Manholes below building floor shall have all earth work compacted to match compaction required by structural specifications.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Grounding: Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance .

C. Duct Integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

D. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

C. After the duct line has been completed, a brush with stiff bristles shall be pulled through each duct to make certain that no particles of earth, sand or gravel have been left in the line. (Mandrels not less than 12 inches long, having a diameter approximately 1/4 inch less than inside diameter of the duct, shall be pulled through each duct). Leave a 3/8”-inch minimum polypropylene pull rope in each duct for future use.

END OF SECTION 26 05 44

SECTION 26 05 49 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

1.2 REFERENCES

A. ASTM A325, A570, A36, A576

B. CBC

C. IC80

D. MSS SP-69

1.3 DEFINITIONS

A. CBC: California Building Code. (sections 1704 through 1708), IBC: International Building Code.

B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.4 SUBMITTALS

A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.

1. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by ICBO Evaluation Service.

B. Shop Drawings: Provide for anchorage and bracing not defined by details and charts. Indicate materials, and show designs and calculations signed and sealed by a professional Engineer.

1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
2. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacing, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
3. Preapproval and Evaluation Documentation: By ICBO Evaluation Service, or an agency approved by LAWA’s Representative, showing maximum ratings of restraints and the basis for approval (tests or calculations).

C. Coordination Drawings: Plans and sections drawn to scale and coordinating seismic bracing for electrical components with other systems and equipment, including other seismic restraints, in the vicinity.

D. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

F. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

1.5 QUALITY ASSURANCE

A. Comply with seismic restraint requirements in California Building Code/Code of Regulations, unless requirements in this Section are more stringent.

B. Professional Engineer Qualifications: A professional Engineer who is legally qualified to practice in California and who is experienced in providing seismic engineering services, including the design of seismic restraints.

C. Testing Agency Qualifications: An independent testing agency, acceptable to LAWA with minimum of 5 years experience.

1.6 PROJECT CONDITIONS

A. Project Seismic Zone and Zone Factor as Defined in CBC: Zone 4, Zone Factor 0.40.

B. Occupancy Category as Defined in CBC: I=1.5 critical occupancy.

1.7 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and Architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. **Caldyn**
2. **Powerstrut.**
3. **Unistrut Corporation.**

2.2 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.
3. Corrosive Locations: Stainless steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to LAWA's Representative.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A 570, GR 33.
2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.
3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
2. Wire Rope Cable: Comply with ASTM 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.

D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install seismic restraints according to applicable codes and regulations and as approved by the LAWA's Representative, unless more stringent requirements are indicated.

3.2 STRUCTURAL ATTACHMENTS

A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses in accordance with the structural Engineer of record approval.

B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.

C. Attachments to Existing Concrete: Use expansion anchors.

D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.

E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.

F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.

G. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.3 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panel boards, motor-control centers, motor controls, switchboards, switchgear, transformers, unit substations, fused power-circuit devices, transfer switches, busways, battery racks, static uninterruptible power units, power conditioners, capacitor units, communication system components, and electronic signal processing, control, and distribution units as follows:

1. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
2. Concrete Bases for Floor-Mounted Equipment: Use female expansion anchors and install studs and nuts after equipment is positioned.
3. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
4. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
5. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.4 SEISMIC BRACING INSTALLATION

A. Install bracing according to spacing and strengths indicated by approved analysis.

B. Expansion and Contraction: Install to allow for thermal movement of braced components.

C. Cable Braces: Install with maximum cable slack recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in raceways, cables, wire ways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform the following field quality-control testing:

B. Testing: Test pull-out resistance of seismic anchorage devices.

1. Provide necessary test equipment required for reliable testing.
2. Provide evidence of recent calibration of test equipment by a testing agency acceptable to LAWA’s Representative.
3. Schedule test with the LAWA Representative before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
4. Obtain Structural Engineer’s approval before transmitting test loads to the structure. Provide temporary load-spreading members.
5. Test at least four of each type and size of installed anchors and fasteners selected by LAWA’s Representative.
6. Test to 90 percent of rated proof load of device.
7. If a device fails the test, modify all installations of same type and retest until satisfactory results are achieved.
8. Record test results.

END OF SECTION 26 05 49

SECTION 26 05 54 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Underground Warning Tape.
7. Lockout Devices.

1.2 SUBMITTALS

A. Product Data:

1. Submit manufacturer’s catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept identification products on site in original containers. Inspect for damage.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES ON EQUIPMENT

A. Engraved Plastic Nameplates and Signs:
1. Engraving stock, melamine plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes. Engraved legend with white letters on black face for normal power, white letters on red face for emergency power.
   a. Punched or drilled for mechanical fasteners.
   b. Text is at 1/2-inch (13 mm) high lettering

B. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage, phase and wire. The next item shall be either LAWA, Concessions, or Airline panel, depending on loads served. In addition, describe where the panel is fed from.
For example,

PANEL 1LA, 120/208V, 3PH, 4W
LAWA PANEL
FED FROM MS

C. Nameplates shall be secured to equipment front using stainless steel screws or rivets.

D. Custom metal master nameplates shall be furnished and installed by the manufacturer on each distribution section, switchboard section, and motor control center indicating the manufacturer’s name, ampere rating, short-circuit rating (bus bracing) and date. Paper stickers are not acceptable.
For example,

ABC SWITCHBOARD CO.
AMPERE RATING: 5000A
SHORT CIRCUIT RATING: 100KAIC
DATE: 01/01/2011

2.2 PERMANENT MARKINGS

A. All conduits, busways, cable trays and pullboxes shall be identified with permanent stenciled black letters and numbers which indicate the source panel (feeder supply source), circuit numbers and designated panel or load. For example,"PA-1, 3, 5 TO MG." For conduits, the letter height shall be one-third (1/3) the conduit size with ¼ inch minimum height. For pullboxes and busways, the letter height shall be ½ inch minimum height and not larger than ¾ inch in height.

B. The identifications for conduits, busways and cable trays shall be placed at every 50 feet intervals and within 10 feet of wall and floor penetrations, pullboxes, panels, distribution boards, switchboards and electrical equipment.

C. Spare conduits, pullboxes, busways, and abandoned raceways (that are to remain) shall be identified as described above (A,B).

D. The permanent marking identifications on the raceways and pullboxes shall be visible after the installations are made.

2.3 LABELS

A. Labels: Embossed adhesive tape, with 3/16 inch black letters on white background for normal power; white letters on red background for emergency power.

2.4 WIRE MARKERS

A. Description: Cloth tape, split sleeve, or tubing type wire markers.

B. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number.
2. Control Circuits: Control wire number.

2.5 CONDUIT AND RACEWAY MARKERS

A. Description: Permanent, detectable, red colored, continuous printed, polyethylene tape with suitable warning legend describing burial electrical lines. Taps shall be minimum 6 inches wide by 4 mils thick.

B. Color:

1. (Normal Power) : Black lettering on white background;
2. (Emergency Power): White lettering on red background.

C. Legend:

1. Medium Voltage System: 5k, 15kV or 35kV as applicable.
2. 480 Volt System: 480 VOLTS.
3. 208 Volt System: 208 VOLTS.

2.6 UNDERGROUND WARNING TAPE

A. Description: 6 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

2.8 PANELBOARD DIRECTORIES

A. Panelboard directories shall be typewritten or computer generated, arranged in numerical order, and shall list each circuit load and room number in which each load is located. Directories shall be mounted in a 6 by 8 inch metal frame under transparent plastic inside each panelboard door.

B. Changes to existing panelboard directories shall be made with a P-Touch or other label machine.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:

1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
4. Secure nameplate to equipment front using screws, or rivets.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:

   a. Switchgear.

b. Switchboards.
c. Panelboards.
d. Transformers.
e. Disconnect Switches
f. Motor Control Centers.
g. Pushbutton Stations,
h. Terminal Cabinets.
i. Control Panels.
j. Enclosed circuit breakers.
k. Generators.
l. Transfer Switches.
m. Enclosed Controllers.
n. Variable-Frequency Controllers.

7. Install nameplate to maintain NEMA rating of enclosure.

C. Label Installation:

1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install labels for permanent adhesion and seal with clear lacquer.
4. Wire Marker Installation:

a. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
b. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
c. Install labels at data outlets identifying patch panel and port designation.

D. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 26 05 54

SECTION 26 05 54 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Stencils.
6. Underground Warning Tape.
7. Lockout Devices.

1.2 SUBMITTALS

A. Product Data:

1. Submit manufacturer’s catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept identification products on site in original containers. Inspect for damage.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES ON EQUIPMENT

A. Engraved Plastic Nameplates and Signs:

1. Engraving stock, melamine plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes. Engraved legend with white letters on black face for normal power, white letters on red face for emergency power.
   a. Punched or drilled for mechanical fasteners.
   b. Text is at 1/2-inch (13 mm) high lettering

B. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage, phase and wire. The next item shall be either LAWA, Concessions, or Airline panel, depending on loads served. In addition, describe where the panel is fed from.
For example,

PANEL 1LA, 120/208V, 3PH, 4W
LAWA PANEL
FED FROM MS

C. Nameplates shall be secured to equipment front using stainless steel screws or rivets.

D. Custom metal master nameplates shall be furnished and installed by the manufacturer on each distribution section, switchboard section, and motor control center indicating the manufacturer’s name, ampere rating, short-circuit rating (bus bracing) and date. Paper stickers are not acceptable.
For example,

ABC SWITCHBOARD CO.
AMPERE RATING: 5000A
SHORT CIRCUIT RATING: 100KAIC
DATE: 01/01/2011

2.2 PERMANENT MARKINGS

A. All conduits, busways, cable trays and pull boxes shall be identified with permanent stenciled black letters and numbers which indicate the source panel (feeder supply source), circuit numbers and designated panel or load. For example,"PA-1, 3, 5 TO MG." For conduits, the letter height shall be one-third (1/3) the conduit size with ¼ inch minimum height. For pull boxes and busways, the letter height shall be ½ inch minimum height and not larger than ¾ inch in height.

B. The identifications for conduits, busways and cable trays shall be placed at every 50 feet intervals and within 10 feet of wall and floor penetrations, pull boxes, panels, distribution boards, switchboards and electrical equipment.

C. Spare conduits, pull boxes, busways, and abandoned raceways (that are to remain) shall be identified as described above (A,B).

D. The permanent marking identifications on the raceways and pull boxes shall be visible after the installations are made.

E. All receptacle and switch faceplates shall be labeled with the source panel and circuit number. The label shall be black Arial font on white or clear tape, produced by a P-Touch or other label machine.

F. All boxes and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked in red with the words, "EMERGENCY SYSTEM", so they will be readily identified as a component of an emergency circuit or system.

2.3 LABELS

A. Labels: Embossed adhesive tape, with 3/16 inch black letters on white background for normal power; white letters on red background for emergency power.

2.4 WIRE MARKERS

A. Description: Cloth tape, split sleeve, or tubing type wire markers.

B. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number.
2. Control Circuits: Control wire number.

2.5 CONDUIT AND RACEWAY MARKERS

A. Description: Permanent, detectable, red colored, continuous printed, polyethylene tape with suitable warning legend describing burial electrical lines. Taps shall be minimum 6 inches wide by 4 mils thick.

B. Color:

1. (Normal Power) : Black lettering on white background;

2. (Emergency Power): White lettering on red background.

C. Legend:

1. Medium Voltage System: 5k, 15kV or 35kV as applicable.
2. 480 Volt System: 480 VOLTS.
3. 208 Volt System: 208 VOLTS.

2.6 UNDERGROUND WARNING TAPE

A. Description: 6 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

2.8 PANELBOARD DIRECTORIES

A. Panelboard directories shall be typewritten or computer generated, arranged in numerical order, and shall list each circuit load and room number in which each load is located. Directories shall be mounted in a 6 by 8 inch metal frame under transparent plastic inside each panelboard door.

B. Changes to existing panelboard directories shall be made with a P-Touch or other label machine.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:

1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure

with corrosive-resistant mechanical fasteners.

3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
4. Secure nameplate to equipment front using screws, or rivets.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:

   a. Switchgear.
   b. Switchboards.
   c. Panelboards.
   d. Transformers.
   e. Disconnect Switches
   f. Motor Control Centers.
   g. Pushbutton Stations,
   h. Terminal Cabinets.
   i. Control Panels.
   j. Enclosed circuit breakers.
   k. Generators.
   l. Transfer Switches.
   m. Enclosed Controllers.
   n. Variable-Frequency Controllers.

7. Install nameplate to maintain NEMA rating of enclosure.

C. Label Installation:

1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install labels for permanent adhesion and seal with clear lacquer.
4. Wire Marker Installation:

   a. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
   b. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
   c. Install labels at data outlets identifying patch panel and port designation.

D. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 26 05 54

SECTION 26 05 73 – SHORT CIRCUIT AND OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes computer-based, fault current and overcurrent protective devices coordination including ground fault protection and arc fault hazard analysis studies to be performed by the contractor. Protective devices shall be set based on the result of the protective device coordination study. Arc fault hazard analysis warning nameplates shall be printed and affixed to the electrical system equipment after the final protective relay settings have been applied and confirmed operational. Settings and adjustments of the relays shall be performed by an independent qualified agency familiar with this work and the agency is to be retained by the contractor. The person performing this work shall have a minimum of five years experience.

> **NOTE:** This coordination study shall include the existing distribution equipment that feeds the new equipment and is in addition to the short circuit study performed by the Electrical Engineer of Record during the course of preparing his design.

B. Contractor shall retain a 3rd party independent consultant to perform the study indicated in this section.

C. It is the responsibility of the entity performing the Short Circuit and Coordination Study to collect all data to fully perform the study, including but not limited to engine generator data, motor data, circuit breakers, utility company short circuit, available new and existing device ratings, conductor data, transformer ratings, etc.

D. The study shall present an organized time-current analysis of each protective device in series from the individual device back to the source. The study shall reflect the operation of each device ratings, conductor data, transformer ratings, etc.

E. The short circuit portion of the study shall be submitted prior to or along with the switchgear submittal, and shall include all equipment which has an AIC rating. The short circuit study shall reflect that all equipment with an AIC rating is properly rated for its specific application. The submitted switchgear (including all equipment which has and AIC rating) shall reflect the findings of short circuit study (i.e, the AIC ratings of the equipment shall exceed the available short circuit current and any required derating factors at each point in the system). Series ratings are not acceptable.

1.2 REFERENCES

A. Institute of Electrical and Electronics Designers:

1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

1.3 DESIGN REQUIREMENTS

A. Complete Short Circuit and Protective Device Coordination Study to meet requirements of NFPA 70.

B. Report Preparation:

1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
2. Perform study with aid of computer software program.
3. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:

   a. Utility supply bus.
   b. Medium voltage air interrupter switchgear.
   c. Automatic transfer switch.
   d. Manual transfer switch.
   e. Engine generator.
   f. Medium voltage motor controllers.
   g. Low-voltage switchgear.
   h. Switchboards.
   i. Motor control centers.
   j. Distribution panelboards.
   k. Branch circuit panelboards.

4. Each other significant equipment location throughout system.

C. Report Contents (similar to SKM Power Tools):

1. Include the following:

   a. Calculation methods and assumptions.
   b. Base per unit value selected.
   c. One-line diagram, with short circuit values, arc flash values, feeder values and lengths.
   d. Source impedance data including power company system available power and characteristics.

e. Typical calculations.

(1) Fault impedance.
(2) X to R ratios.
(3) Asymmetry factors.
(4) Motor fault contribution.
(5) Short circuit kVA.
(6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
(7) Tabulations of calculation quantities and results.

f. One-line diagram revised by adding actual instantaneous short circuits available.
g. State conclusions and recommendations.

(1) Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.
(2) Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.
(3) Prepare detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
(4) Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following:

h. Power company relay characteristics.
i. Power company fuse characteristics.
j. Medium voltage equipment protective relay characteristics.
k. Medium voltage equipment protective fuse characteristics.
l. Low voltage equipment circuit breaker trip device characteristics.
m. Low voltage equipment fuse characteristics.
n. Cable damage point characteristics.
o. Pertinent transformer characteristics including:

(1) Transformer full load current.
(2) Transformer magnetizing inrush.
(3) ANSI transformer withstand parameters.
(4) Significant symmetrical fault current.

p. Pertinent motor characteristics.
q. Generator characteristics including:

(1) Phase and ground coordination of generator protective devices.

(2) Decrement curve and damage curve.
(3) Operating characteristic of protective devices.
(4) Actual impedance value.
(5) Time constants.
(6) Current boost data.
(7) Do not use typical values for generator.

r. Transfer switch characteristics.
s. Other system load protective device characteristics.

1.4 SUBMITTALS

A. Qualifications Data: Submit the following for review prior to starting study.

1. Submit qualifications and background of firm.
2. Submit qualifications of Professional Engineer performing study.

B. Software: Submit for review information on software proposed to be used in performing study.

C. Product Data: Submit the following:

1. Report: Summarize results of study in report format including the following:

a. Descriptions, purpose, basis, and scope of study.
b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.
c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
d. Fault current calculations including definition of terms and guide for interpretation of computer printout.

D. Submit copies of final report signed by Professional Engineer. Make additions or changes required by review comments.

E. Short Circuit Study:

1. Systematically calculate the fault impedance to determine the available short circuit and ground fault currents at each bus. Incorporate the motor contribution in determining the momentary and interrupting ratings of the protective devices.
2. Entire system shall be modeled under both normal and emergency power. If any closed transition transfer switches are used, normal and emergency power shall be combined.
3. The short circuit study shall incorporate the actual feeder types, sizes and lengths proposed to be used by the Professional Engineer.
4. The calculations may be prepared by means of a digital computer. All

pertinent data and the rationale employed in developing the calculations shall be incorporated in the introductory remarks of the study.

5. Present the data determined by the short circuit study in a table format. Include the following:

    a. Device identification.
    b. Operating voltage.
    c. Protective device.
    d. Device rating.
    e. Calculated short circuit current, indicating worst-case fault current incorporating all system models as outlined above.

F. Coordination Curves:

1. Prepare the coordination curves to determine the required settings of protective devices to assure selective coordination. Graphically illustrate on log-log paper that adequate time separation exists (where possible) between series devices, including the utility company upstream device. Plot the specific time-current characteristics of each protective device in such a manner that all upstream devices will be clearly depicted on one sheet. Where a switchboard or panelboard has multiple devices of different sizes, it is not necessary to plot curves for each device when coordination for one device is demonstrated graphically and it is intuitively obvious that the other devices coordinate as well.
2. The following specific information shall also be shown on the coordination curves:

    a. Device identification.
    b. Voltage and current ratio for curves.
    c. 3-phase and 1-phase ANSI damage points for each transformer.
    d. No-damage, melting, and clearing curves for fuses.
    e. Cable damage curves.
    f. Transformer inrush points.
    g. Maximum short circuit cutoff point.
    h. Short-time withstand capability of main 480V circuit breakers.
    i. Coordination between the directional overcurrent relays and the main 480V breaker.

3. Develop a table to summarize the settings selected for the protective devices. Include in the table the following:

    a. Device identification.
    b. Relay CT ratios, tap, time dial, and instantaneous pickup.
    c. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
    d. Fuse rating and type.
    e. Ground fault pickup and time delay.

1.5 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

B. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of three years documented availability approved by LAWA.

C. Perform study in accordance with IEEE 242.

1.6 QUALIFICATIONS

A. Study Preparer: Company specializing in performing work of this section with minimum five years documented experience and having completed projects of similar size and complexity within the past three years.

B. Perform study under direct supervision of Professional Engineer experienced in design of this Work and licensed at in State of California with minimum of five years experience in power system analysis.

C. Demonstrate company performing study has capability and experience to provide assistance during system start up.

1.7 SEQUENCING

A. The short circuit portion of the study shall be submitted prior to or along with the switchgear submittal, and shall include all equipment which has an AIC rating. The short circuit study shall reflect that all equipment with an AIC rating is properly rated for its specific application. The submitted switchgear (including all equipment which has an AIC rating) shall reflect the findings of short circuit study (i.e., the AIC ratings of the equipment shall exceed the available short circuit current and any required derating factors at each point in the system.). No series rated devices will be allowed.

B. When formal completion of study will cause delay in equipment manufacturing, obtain approval from LAWA for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.8 SCHEDULING

A. Schedule work to expedite collection of data to ensure completion of study for final approval of distribution equipment shop drawings prior to release of equipment for manufacturing.

1.9 COORDINATION

A. Coordinate work with local power company.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Provide assistance to electrical distribution system equipment manufacturer during start up of electrical system and equipment.

B. Select each primary protective device for delta-wye connected transformer so device’s characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.

C. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.

D. Separate medium-voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

E. Analyze the short circuit calculations, and highlight any equipment that is determined to be underrated as specified. Propose approaches to effectively protect the underrated equipment. Provide minor modifications to conform with the study (Examples of minor modifications are trip sizes within the same frame, the time curve characteristics of induction relays, CT ranges, etc.).

F. After developing the coordination curves, highlight areas lacking coordination. Present a technical valuation with a discussion of the logical compromises for best coordination.

3.2 ADJUSTING

A. Protective devices shall be set based on the results of the protective device coordination study.

B. Arc fault hazard analysis warning labels shall be printed and affixed to the electrical system equipment after the final protective relay settings have been applied and confirmed operational.

C. Settings and adjustments of the relays shall be performed by and independent qualified agency familiar with this work and the agency is to be retained by the contractor. The person performing this work shall have a minimum of five years experience.

D. Accomplish necessary field settings, adjustments, and minor modifications to conform with the study without cost to LAWA.

END OF SECTION 26 05 73

SECTION 26 09 13 – WEB-BASED POWER MONITORING COMMUNICATIONS SYSTEM

PART 1 - GENERAL

> **NOTE:** For compatibility purposes, throughout LAX, all new web based power monitoring systems shall match the installation at Bradley West.

1.1 SUMMARY

A. This section describes the metering, communications, and visualization requirements for a modular, scalable Web-based Power Monitoring Communications System. The goal of this system is to provide the user the ability to monitor and manage their power system without the installation of any software other than an internet browser. This system may require the user to store web links in their browser to each of the web enabled devices; however the intent of this approach is to significantly reduce installation, configuration and operational costs of the system.

1. The PMCS shall comply with new construction installations utilizing web-based components to function independently or to co-exist with other Eaton Cutler-Hammer IMPACC system components or other Modbus RTU communicating devices in a heterogeneous environment.

B. The Contractor shall furnish and install the equipment specified herein. The equipment shall be as outlined below.

C. This section includes the supply and installation of a complete Power Monitoring Communications System (PMCS) as described in this specification. The PMCS is defined to include, but not to be limited to, remote devices for metering, monitoring, control and protection, a network time server, all Ethernet communications gateways, intercommunication wiring, ancillary equipment, startup and training services, and ongoing technical support.

> **NOTE:** All Tenant power feeders are to be metered by this web based monitoring system.

1.2 REFERENCES

A. The PMCS shall comply with the applicable portions of ANSI/IEEE 802.3 and NEMA standards. In addition, the master control unit shall comply with FCC Emission Standards specified in Part 15, Subpart J for Class A application.

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. System description including an overview of the system provided with detailed

description of system architecture. A customized system diagram showing location of computers, repeaters, gateways and assemblies/devices to be connected to the system, as well as types of wiring required (twisted pair, coax, fiber), and a general layout of wiring referencing the specific building/facility layout shall also be part of this description

2. Bill of material including a complete listing of all hardware, software, training, software configuration, and startup services.
3. Hardware and software description shall be provided in detail for all communications hardware, software, including sensor devices and gathering data to be transmitted over the network, and master display unit. This description will include a list of all the communicating devices to be connected to the network.
4. Typical software screen displays shall be provided in printout form and/or on disk.

1.4 SUBMITTALS – FOR INFORMATION

A. The Contractor shall provide a submittal for information to include a detailed listing of customer required actions, with timetable, to insure trouble-free startup of the PMCS. This information shall include any equipment access requirement, office requirements and manpower requirements. This submittal shall include the projected system startup time-line, including training dates. In addition, a proposed detailed wiring specification in compliance with these plans and specifications shall be included. The communication wiring specification shall include proposed communication cable, including general cable ratings, communication characteristics, cable routing proposed, termination requirements, and splicing/connections proposed to be made.

1.5 SUBMITTALS – FOR CONSTRUCTION

A. In addition, the systems operation manual shall include the following information:

1. A system description overview, descriptive bulletins and/or sales aids covering all components in the system
2. A maintenance section including all instruction leaflets and technical data necessary to set up, change setup parameters and maintain the communicating devices and sensors

B. A section on communication wiring which includes:

1. Type of communication wire utilized.
2. General cable ratings and communications characteristics.
3. Cable routing diagram including terminations and splicing connections made.

C. A detailed startup report, including a list of trained customer personnel shall be provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cutler-Hammer

B. Square D

C. General Electric

2.2 GENERAL

A. The PMCS is defined to include, but not to be limited to, remote devices for metering, monitoring, control and protection, a network time server, all Ethernet communications gateways, intercommunication wiring, printer, ancillary equipment, startup and training services, and ongoing technical support.

2.3 WEB-ENABLED POWER MONITORING COMMUNICATION SYSTEM

A. The web-enabled power monitoring communication system shall use Ethernet as the primary communication backbone between the equipment and the users or legacy systems.

B. The web-enabled power monitoring communication system shall support multiple protocols over Ethernet to ensure the system can easily be integrated into existing systems. These protocols shall include:

1. HTML web pages to display data to users using a browser
2. Modbus TCP/IP to support integration into third party systems
3. BacNet Web Services to support integration into third party systems
4. SNMP to support integration into Data Center management systems

C. The web enabled power monitoring communication system shall provide connectivity to the actual power system in one of two ways:

1. Web enabled meters that measure the critical power system parameters as described herein.
2. Web enabled gateways that communicate to power system devices over device specific communication links as described herein. Web enabled gateways will support the following device communication protocols:

   a. Eaton's INCOM protocol
   b. ModBus RTU over RS-485
   c. Eaton's QC Port over RS-485

3. The web enabled gateway shall support devices as required.
4. The devices connected to the Web enabled gateway shall communicate using the protocols described in Section 2.03 F2 over a local area network Interconnected with #18 gauge twisted pair shielded cable, 600 V Class Belden 9463 family, in properly sized conduit (when run outside of factory assembled equipment for the

communication channel).

D. The web enabled power monitoring communication system shall provide support for configuration of all web enabled meters and gateways directly via the web pages on the device. No additional software shall be required.

1. To support the configuration of legacy devices on the device networks connected to the gateway, the gateway shall support a “pass thru mode” to allow the legacy configuration software to connect from any computer on the users network to the device via the gateway.

E. All devices in the web enabled power monitoring communication system that are connected directly to Ethernet shall support the ability to synchronize their time clock using NTP. The purpose for this support is to ensure all device clocks are accurate so that event sequences can be adequately analyzed.

1. For devices that support clock synchronization and are on the device networks connected to the gateways, they shall support the ability to sync their clock to the clock in the gateway.

F. A User Guide shall be provided with the web enabled equipment to describe the commissioning process for setting the equipment’s Ethernet address, and ensuring trouble-free data access from any computer on the network, using a standard Internet browser.

G. In all web enable devices, a common user interface shall be implemented across all types of power equipment, from Medium-Voltage Switchgear to Low-Voltage Switchgear, Switchboards, Motor Control Centers (MCCs), Power Distribution Units (PDUs) and Uninterruptible Power Supplies (UPSs). The purpose of this is to reduce end user training time and improve system usability.

2.4 ETHERNET SWITCHES

A. A single web access point: 4 or 6 port Ethernet switch shall be provided in the equipment to allow a single access point for the user and the ability to connect more than one network device directly on the customer’s Ethernet Local Area Network (LAN).

B. Ethernet switch shall support standard copper RJ45 connectors and/or 100BaseFX Fiber-Optic via ST connectors.

PART 3 - EXECUTION

3.1 WARRANTY

A. The manufacturer shall warrant the equipment supplied hereunder. The warranty shall include:

1. Two (2) year free telephone technical support
2. Warranty on all hardware supplied under this system shall be for two (2) years.

3.2 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section:

1. Configure and load all software
2. Test and operate computer and software in a simulated system mode for minimum of 24 hours
3. Demonstrate full system functionality

3.3 INSTALLATION

A. The Contractor shall furnish, install and terminate all communication conductors and associated conduits external to any factory supplied equipment.

B. All communication conductor wiring and routing shall be per the manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

A. The contractor shall furnish the services of a manufacturer's representative to assist LAWA in starting up and programming the system. The manufacturer's representative shall be factory-trained and shall have a thorough knowledge of the software, hardware, and system programming. The manufacturer's representative shall provide the following services:

1. Setting all the addresses of all devices in the equipment
2. Verifying and troubleshooting the integrity of the data line (run by others)
3. Assisting LAWA in correcting any data line problems
4. Coordinating any possible warranty problems with the PMCS
5. Configure the PMCS software to match the field devices

3.5 FIELD ADJUSTMENTS

3.6 FIELD TESTING

A. Verify complete system operation including all hardware, software and communication devices.

B. Verify networking performance with all interfacing systems by other manufacturers.

3.7 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 five (5) copies of the manufacturer's representative's certification.

3.8 TRAINING

A. The Contractor shall furnish the services of a manufacturer's representative for a period of one (1) 8-hour days to train the LAWA's personnel in operation and programming of the system. The manufacturer's representative shall be factory-trained and shall have a thorough knowledge of the software, hardware and system programming. The training session shall include:

1. Hands-on training of site personnel
2. Explanation of system operation
3. Explanation of devices
4. Explanation of LAWA's system

3.9 AFTER STARTUP SUPPORT

A. The PMCS manufacturer shall provide a 24-hour 800 telephone number manned with Engineers/Technicians expert in PMCS devices, software and communication system troubleshooting or capable of providing technical information.

B. The PMCS Manufacturer shall provide a 1 year service contract to maintain the software and system devices. The contract shall be renewable on an annual basis at a fixed charge and shall include a minimum of 2 site visits yearly to perform system maintenance. The service contract shall include as a minimum:

1. Installation of Software patches and Upgrades to System Operating Software as required
2. Anti-Virus Software upgrades as required
3. PMCS Software upgrades as required.
4. Database maintenance and archiving of data

END OF SECTION 26 09 13

SECTION 26 09 23 – LIGHTING CONTROL DEVICES AND CONTROL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Remote control lighting relays.
2. Lighting contactors.
3. Switches.
4. Switch plates.
5. Occupancy sensors.
6. Photocells.
7. Photocell control unit.

NOTE: The devices are to be connected to the Network Lighting Control System.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contractors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.
5. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
6. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
7. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.3 SYSTEM DESCRIPTION

A. Distributed switching control using self contained individually mounted lighting relays.

1.4 SUBMITTALS

A. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.

1. One Line Diagram: Indicating system configuration indicating panels, number

and type of switches or devices.

2. Include typical wiring diagrams for each component.

B. Product Data: Submit manufacturer’s standard product data for each system component.

C. Manufacturer's Installation Instructions: Submit for each system component.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record the following information:

1. Actual locations of components and record circuiting and switching arrangements.
2. Wiring diagrams reflecting field installed conditions with identified and numbered, system components and devices.

B. Operation and Maintenance Data:

1. Submit replacement parts numbers.
2. Submit manufacturer’s published installation instructions and operating instructions.
3. Recommended renewal parts list.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with standard.

B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept components on site in manufacturer’s packaging. Inspect for damage.

B. Protect components by storing in manufacturer’s containers indoor protected from weather.

1.9 WARRANTY

A. Furnish five year manufacturer warranty for components.

PART 2 - PRODUCTS

2.1 REMOTE CONTROL LIGHTING RELAYS

A. Manufacturers:

1. **LC & D**
2. **Lutron**
3. **General Electric.**

B. Product Description: Heavy duty, single-coil momentary contact mechanically held remote control relays.

C. Contacts: Rated 20 amperes at 120 or 277 volts. Rated for lighting applications with high intensity discharge (HID), quartz halogen, tungsten, or fluorescent lamps.

D. Line Voltage Connections: Clamp type screw terminals.

E. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4.

2.2 LIGHTING CONTACTORS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **Square D.**
3. **General Electric.**

B. Product Description: NEMA ICS 2, magnetic lighting contactor.

C. Configuration: Mechanically held, 3 wire control.

D. Coil Operating Voltage: 120 or 277 volts, 60 Hertz.

E. Poles: To match circuit configuration and control function.

F. Contact Rating: 20A

G. Accessories:

1. Cover Mounted Pilot Devices: NEMA ICS 5, standard-duty heavy-duty oiltight

type with Form Z contacts, rated A150.
2. Pushbutton: ON/OFF function, with unguarded recessed covered configuration.
3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
4. Auxiliary Contacts: One field convertible in addition to seal-in contact.
5. Relays: NEMA ICS 2.
6. Control Power Transformers: 120 volt secondary, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

H. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4.

2.3 SWITCHES

A. Manufacturers:

1. Hubbell Incorporated.
2. Leviton Manufacturing Co., Inc.
3. Pass and Seymour.

B. Wall Switch: Specification Grade unlighted, momentary pushbutton type for overriding relays.

1. Material: Plastic.
2. Color: White.

C. Wall Switch: Industrial Grade non-pilot light toggle switches for overriding relays.

1. Color: White

D. Key Switch: Cylinder lock type. Match non-key switch ratings.

2.4 SWITCH PLATES

A. Manufacturers:

1. Hubbell Incorporated.
2. Leviton Manufacturing Co., Inc.
3. Pass and Seymour.

B. Product Description: Specification Grade.

1. Material: Stainless steel, type 302.
2. Color: to be selected by Designer.

2.5 OCCUPANCY SENSOR

A. Manufacturers:

1. **LC & D.**
2. **Novitas.**
3. **Watt Stopper.**

B. Compatible with modular relay panels. Capable of being wired directly to Class 2 wiring without auxiliary components or devices.

C. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 30 seconds to 12 minutes.

D. Furnish with manual override.

E. Operation: Silent.

F. Room Sensors: Dual Technology.

G. Corridor and Hallway Sensors:

1. Capable of detecting motion 14 feet wide and 80 feet long with one sensor mounted 10 feet above floor.
2. Capable of detecting motion in warehouse aisle 10 feet wide and 60 feet long or 100 feet long when mounted 22 feet above floor.
3. Capable of being wired in master-slave configuration to extend area of coverage.

2.6 PHOTOCELLS

A. Manufacturers:

1. **LC & D.**
2. **Novitas.**
3. **Watt Stopper.**

B. General: Consist of sensor mounted with separate control-calibration module. Sensor connected to control-calibration module via single shielded conductor with maximum distance of 500 feet (150 m).

C. Control-Calibration Module: Furnish with the following:

1. Capable of being switched between 4 measurement ranges.
2. Separate trip points for high and low response settings.
3. Momentary contact device to override photocell relays.
4. Three minute time delay between switching outputs to avoid nuisance tripping.

D. Sensor Devices: Each sensor employs photo diode technology to allow linear response to daylight within illuminance range.

1. Exterior Lighting: Hooded sensor, horizontally mounted, employing flat lens, and working range 1-10 footcandles in 10 percent increments. Entire sensor encased in optically clear epoxy resin.
2. Indoor Lighting: Sensor with Fresnel lens providing for 60 degree cone shaped response area to monitor indoor office lighting levels.
3. Atriums: Sensor with translucent dome with 180 degree field of view and respond in range of 100-1,000 footcandles.
4. Skylights: Sensor with translucent dome with 180 degree field of view and respond in range of 1,000-10,000 footcandles.

2.7 PHOTOCELL CONTROL UNIT

A. Manufacturers:

1. LC & D.
2. Novitas.
3. Watt Stopper.

B. Product Description: Photodiode control unit with PHOTOCELL ENABLE and MASTER OVERRIDE inputs for remote control, 3 minute time delay, and with selectable ranges for 1-10 footcandle, 10-100 footcandle, 100-1000 footcandle, and 1000-10,000 footcandle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount switches, occupancy sensors, and photocells.

B. Use only properly color coded, stranded wire, installed in conduit.

C. Label each low voltage wire clearly indicating connecting relay panel.

D. Mount relays. Provide wiring to numbered relays in panel to control each load.

E. Install relays to be accessible. Allow space around relays for ventilation and circulation of air.

F. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to indicate originating panel designation.

G. Label each low voltage wire with relay number at each switch or sensor.

3.2 MANUFACTURER'S FIELD SERVICES

A. Furnish services for minimum of one day for check, test, and start-up. Perform the following services:

1. Check installation of panelboards.
2. Test operation of remote controlled devices.
3. Repair or replace defective components.

3.3 ADJUSTING

A. Test each system component after installation to verify proper operation.

B. Test relays, contactors, switches and sensors after installation to confirm proper operation.

C. Confirm correct loads are recorded on directory card in each panel.

3.4 DEMONSTRATION

A. Demonstrate operation of the following system components to staff to be trained:

1. Operation of switches.
2. Operation of each type of occupancy sensors.
3. Operation of each type of photocell.

B. Furnish 4 hours to instruct LAWA's personnel in operation and maintenance of system. Schedule training with LAWA, provide at least 7 days notice to Designer of training date.

C. Provide manuals for attendees.

END OF SECTION 26 09 23

SECTION 26 09 43 – NETWORK LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

> **NOTE:** This system controls those devices specified in Lighting Control Devices and Control Panels.

1.1 SUMMARY

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system. All Labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section.

B. Furnish and install a complete system for the control of lighting and other equipment and as further defined herein.

C. The system shall include but not be limited by the following list: Pre-wired, microprocessor controlled relay panels with electrically held, electronically latched relays controlled via a complete list of communications based accessories including digital switches, digital photocells, Digital Time Clock (DTC) and interface cards to dimming systems, building automation systems, thermostats, and any contact closure or analog based device. The type of lighting control equipment and wiring specified in this section is covered by the description: Microprocessor Controlled Digital Relay Lighting Control system with RS 485 Bus communications. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways and electrical boxes and fittings required for installation of control equipment and wiring. They are not the work of this section.

1.2 SUBMITTALS

A. Shop Drawings: Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, DTC, photocells and other interfaces.

B. Product Data: Submit for approval 6 copies of manufacturer's data on the specific lighting control system and components. Submittal shall be in both electronic and hard copy formats. To prevent departures from approved system operation, electronic file submitted shall be able to be directly downloaded to the specified system at manufacturer facility. Submit a complete bill of materials with part numbers, description and voltage specifications.

C. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component. Submittals that show typical riser diagrams are not acceptable. Provide completely filled out control schedules, switch engraving schedules and panel schedules.

1.3 QUALITY ASSURANCE

> **NOTE:** Verify the BMS protocol with your designated LAWA Representative. This protocol may involve providing a connection to the Central Utility Plant (CUP).

A. Manufacturers:

1. **LC&D**
2. **Lutron**

B. Control wiring shall be in accordance with the NEC requirements for Class 2 remote control systems, Article 725 and manufacturer specification.

C. A licensed electrician shall functionally test each system component after installation, verify proper operation and confirm that all relay panel and switch wiring conform to the wiring documentation, and as per manufacturer recommendations.

D. Comply with NEC and all local and state codes as applicable to electrical wiring work.

E. Lighting control panels shall be ETL listed to UL 916. LCPs controlling emergency circuits shall be ETL listed to UL 924.

F. The lighting control system shall also be listed or approved by all national, state and local energy codes to include but not limited to California Title 24 and Los Angeles Building Code.

G. System shall have open software protocol to interface with BMS and central utility plant monitoring systems.

H. Specifications are based on LC&D system. Lutron shall comply with the compatibility and functionality to achieve the design intent.

1.4 MAINTENANCE MATERIALS

A. Execution Requirements: Spare parts and maintenance products.

B. Provide 8 spare relays per LCP, 4 Micro panels.

C. Provide extra CD version of manufacturers operating software to include graphical interface software.

D. Provide 2 extra sets of as-built and operating manuals.

1.5 SUBSTITUTIONS

A. No substitutions are permitted.

PART 2 - PRODUCTS

2.1 MATERIAL AND COMPONENTS

A. Smart Panelboards shall be made up of the following components:

1. NEMA rated enclosure with hinged door, available with main lug or main breaker and in voltages of 120/240, 208Y/120 and 480Y/277. Continuous main current ratings as indicated on the panelboard schedule. Minimum AIC rating to be 10,000. NEMA4 rating for outdoor installation.
2. Control electronics mounted internally to each smart panelboard shall be capable of driving up to 42 controllable breakers, control any individual or group of breakers, store all programming in non-volatile memory, after power is restored return system to current state, provide programmable blink warn timers for each breaker and every zone and be able to control a Micro Relay panel located downstream of non-controllable breaker.
3. Lighting control system shall be digital and consist of a Master LCP with up to 31 controllable, Slave LCPs with up to 42 controllable breakers in each panel, a Micro LCP with up to 4 individual relays, digital switches and digital interface cards (see interfaces). One individual bus network each for North Concourse + North Core and South Concourse + South Core. All system components shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time two-way communication with each system component. Analog systems are not acceptable.
4. Lighting control system shall have the capability to output 4 independent 0v to 10v signals in a Micro LCP. Micro LCP shall control 4 independent 20a fluorescent lighting circuits. Each circuit shall have an adjustable fade rate and take inputs from a wall device, DTC system controller or a digital photocell.
5. Quantity and rating of breakers as required.
6. 16 AWG steel barrier shall separate the high voltage and low voltage compartments of the panel and separate 120v and 277v.

B. Controllable Breakers

1. Solenoid operated thermal magnetic breakers.
2. Ratings of 120/240V AC; 15, 20 and 30 Amp; 1- and 2-pole, 277/480V AC, 15, 20 and 30 amp: 1 and 2-Pole.
3. Rated at 20 Amp, 277VAC Ballast, Tungsten, HID, 1 HP at 120 Vac, 2 HP at 240 Vac.

C. Standard Output Relays

1. Electrically held, electronically latched SPST relay.
2. Relays shall be individually replaceable. Relay terminal blocks shall be capable

of accepting two

a. #10AWG wires on both the line and the load side. Systems that do not allow for individual relay replacement or additions are not acceptable.

3. Rated at 20 Amp, 277VAC Ballast, Tungsten, HID, 1 HP at 120 Vac, 2 HP at 240 Vac.
4. Relays to be rated for 250,000 operations minimum at 20a lighting load, use Zero Cross circuitry and be Normally Closed (NCZC). All incandescent circuits shall be energized by use of a Normally Closed SoftStart™ (NCSS) relay rated at 100,000 operations at full 20a load. No exceptions.
5. Optional relay types available shall include: Normally Open (NO) relay rated for 100,000 operations, a 600v 2-pole NO and NC and a Single Pole, Double Throw (SPDT) relay.

D. Switches

1. All switches shall be digital and communicate via RS 485. Contact closure style switches shall not be acceptable. Any switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.
2. Switches shall be available in 1 through 6-button version with engraveable buttons, red LED annunciation for each button and a constantly on green LED locator.
3. Switches may be programmed to be Momentary ON, Momentary OFF, Toggle or Maintained. These functions shall be able to be changed locally (at the DTC or a PC) or remotely, via modem.
4. Contractor to verify all switch types and quantities per plans and specifications.
5. Accessories available to include digital key switch and digital key enable switch.

E. DTC - Digital Electronic Time Clock:

1. A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs.
2. DTC shall be capable of up to 32 schedules. Each schedule shall consist of one set of On and Off times per day for each day of the week and for each of two holiday lists. The schedules shall apply to any individual relay or group of relays.
3. The DTC shall be capable of controlling up to 126 digital devices on a single bus and capable of interfacing digitally with other individual busses using manufacturer supplied interface cards.
4. The DTC shall accept control locally using built in button prompts and use of a 8 line 21-letter display or from a computer or modem via an on-board RS 232 port. All commands shall be in plain English. Help pages shall display on the DTC screen.
5. The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 15 years with loss of power.
6. Software pre-installed to accept standard Unity Graphical Management Software (GMS) pages. GMS software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to

change the status of any individual device, relay or zone.

7. Pre-Installed modem that allows for remote programming from any location using a PC. Modem to include all necessary software for local or remote control.
8. DTC shall provide system wide timed overrides. Any relay, group or zoned that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.

F. Interfaces: For future expansion capability, system to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans.

1. A dry contact input interface card that provides 14 programmable dry contact closure inputs. Use shielded cable to connect input devices to interface card.
2. Interface card providing digital communication from one system bus to another system bus, allowing up to 12,000 devices to communicate.
3. An exterior (PCO) or interior (PCI) photocell that provides readout on the DTC screen in number values analogous to foot-candles. Each photocell shall provide a minimum of 14 trigger points. Each trigger can be programmed to control any relay or zone. Each trigger shall be set through programming only. Photocells which requires the use of setscrews or which must be programmed at the photocell control card shall be not acceptable.
4. An interface card that allows the DTC to control up to 32 digital XCI brand thermostats. Programming of thermostats to be able to done locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet.
5. A voice prompted telephone override interface module. Interface module shall accept up to 3 phone lines and allow up to 3 simultaneous phone calls. Voice prompted menu and up to 999 unique pass codes shall be standard with each interface module.
6. Software pre-installed to run Unity GX Graphical Management Software (GMS-GX) pages. GMS-GX software shall provide via local or remote PC a visual representation of a specific area or the total area of the project. GMS full graphic pages shall be designed to the LAWA’s specifications. Provide 2 GMS pages.
7. Direct digital interface to Smart Panelboards. Smart Panelboard circuits shall appear on the system software as distinct items and maintain all functions and features of the system software to include GMS pages.
8. Direct digital interface to DMX 512 based systems. Lighting control system shall provide 14 global DMX commands, each of which can be modified locally or remotely using lighting controls manufacturer supplied software. DMX interface shall be integral to the system bus and shall connect and be controlled via a single Category 5, 4 twisted pair cable, providing real time two¬way communication between lighting control system and a DMX based system.
9. BMS interface to be provided and coordinated with mechanical controls contractor as required.

2.2 MODES OF OPERATIONS

A. DTC – Digital Electronic Time Clock: DTC shall control any relay or group of relays by the following modes: ON only, OFF only, Maintained, Maintained with timer and OFF sweep warning (Blink warn), maintained with timer (No blink warning). Timers adjustable from 1 minute to 4 hours. When the scheduled program in the DTC is ON the associated timers are disabled. When the scheduled program in the DTC is off and a relay or zone is overridden, the DTC will put that relay or zone into the timer mode and automatically sweep off at the end of the programmed timer period (Maximum 2-Hour Timed Override). All DTC settings, schedules, photocell trip points, temperature settings, longitude and latitude, time zone offset to sunrise and sunset and any other LAWA settings shall be able to be changed though software locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet. No exceptions.

B. Switches: All system switches shall be digital and daisy chained on a single category 5, 4 twisted pair cable with all LCPs. Any switch button shall be able to control any relay or group of relays anywhere on the system in the following modes: ON, OFF, Mixed (Some relays ON some OFF), Toggle (first push ON, next OFF etc.) Maintain. Timer ON with a time set from 1 minute to 4 hours. Timer ON with Off sweep warning, (Blink warning 5 min or as programmed prior to OFF sweep.) Timer ON with Horn Warning (Horn output turns ON for the warning 5 min or as programmed prior to OFF sweep.) Any switch function shall be able to changed locally (at the DTC or a PC) or remotely, via modem, Internet or Ethernet. Any relay, group or zoned that is overridden On, before or after hours, shall automatically be swept Off by the DTC a maximum of 2 hours later.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Mount smart breaker panelboards to wall. Attach to backing or structure similar to standard panelboards. Locate strategically to allow access to low and live voltage compartments. Vacuum all construction debris prior to installing electronics.

B. Switches: Provide outlet boxes, single or multi-gang, as shown on the plans for the low voltage digital switches. Mount switches as per plans. Supply faceplates per plans and specifications. EC is specifically responsible to supply and install the required low voltage cable, Category 5, 4 twisted pair, with pre-assemble RJ45 connectors and snagless boots (commonly referred to as a Cat 5 patch cable) between all switches and panels. Field-test all Cat 5 patch cable with a recognized cable tester. All low voltage wire to be run in conduit, per local codes.

C. Wiring

1. Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
2. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.
3. Place manufacturer supplied “terminators” at each end of the system bus per manufacturer instructions.
4. Neatly lace and rack wiring in cabinets.
5. Plug in Category 5, 4-twisted pair patch cable that has been field tested with a recognized cable tester at the indicated RJ45 connector provided with each lighting control device, per manufacturer instructions.

6. Use Category 5, 4 twisted pair patch cable for all system low voltage connections. Additional conductors may be required to compensate for voltage drop with specific system designs. Contact LC&D or refer to the GR2400 manual for further information. Use shielded cable for dry contact inputs to lighting control system.
7. Do not exceed 4000ft-wire length for the system bus.
8. All items on the bus shall be connected in sequence (daisy chained). Star and spur topologies are not acceptable.
9. The specified lighting control system shall be installed by the electrical contractor who shall make all necessary wiring connections to external devices and equipment, to include photocell. EC to wire per manufacturer instructions.

3.2 DOCUMENTATION

A. Each Smart breaker Panelboard shall have properly filled up directory. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to LAWA, copies placed inside the door of each LCP.

3.3 SERVICE AND SUPPORT

A. Start Up: EC shall contact manufacturer at least 7 days before turnover of project. Manufacturer will remotely dial into the lighting control system, run diagnostics and confirm system programming. EC shall be available at the time of dial in to perform any corrections required. EC is responsible for coordinating with GC and LAWA the installation of a dedicated telephone line or a shared phone line with A/B switch. Phone jack to be mounted within 12" of Master LCP. Label jack with phone number. EC to connect phone line from jack to Master LCP.

B. Telephone factory support shall be available at no additional cost to the LAWA both during and after the warranty period. Factory to pre-program the lighting control system per plans and approved submittal, to the extent data is available. The specified manufacturer, at no added cost, shall provide additional programming via modem as required by LAWA for the operation life of the system. Manufacturer warrants that the DTC software can be upgraded and monitored remotely. Upon request manufacturer to provide remote dial up software at no added cost to LAWA. No exceptions.

C. Provide a factory technician for on-site training of the LAWA's representatives and maintenance personnel. Coordinate timing with General Contractor. Provide 2 days of factory on-site training for a minimum of ten people.

D. On Call Service

1. Control contractor shall perform monthly system diagnostics (viewing system log files and review of performance/error data logged in the system).
2. Provide one technician for 120 hours total (duration of site visit determined on

time required to perform the system review) for a period of six (6) months after final acceptance of the project. Time may also be utilized by LAWA to provide as-needed modifications, troubleshooting, and/or clarifications to the system. Use of time is as the sole discretion of LAWA.

3.4 CLEANING

A. Execution Requirements: Final cleaning.

B. Remove dirt and debris from all LCP enclosures.

C. Clean photocell lens as recommended by manufacturer.

D. Clean all switch faceplates.

3.5 WARRANTY

A. Two (2) years parts and labor.

B. Five (5) years limited parts and labor warranty for repair and replace of defective system components.

END OF SECTION 26 09 43

SECTION 26 13 13 – METAL-CLAD SWITCHGEAR (VACCLAD) – MEDIUM VOLTAGE

PART 1 - GENERAL

NOTE: This section applies to any electrical new work at Terminal 1 due to the existing 4160V System that is exclusive to this Terminal.

1.1 SUMMARY

A. The Contractor shall furnish and install the equipment as specified herein.

1.2 REFERENCES

A. The metal-clad switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA SG-4 and SG-5, and but not limited to, ANSI/IEEE 37.20.2.

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to LAWA:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line diagram
6. Nameplate schedule
7. Component list
8. Conduit entry/exit locations
9. Assembly ratings including:
10. Short-circuit rating
11. Voltage
12. Continuous current
13. Basic impulse level for equipment over 600 volts
14. Major component ratings including:

    a. Voltage
    b. Continuous current
    c. Interrupting ratings

15. Cable terminal sizes
16. Product data sheets

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

1. Busway connection

2. Connection details between close-coupled assemblies
3. Composite floor plan of close-coupled assemblies
4. Key interlock scheme drawing and sequence of operations
5. Descriptive bulletins

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. The AIC ratings of all submitted equipment must conform to the approved Short Circuit and Overcurrent Protective Device Coordination Study.

E. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

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 1.3, and shall incorporate all changes made during the manufacturing process.
2. Wiring diagrams
3. Certified production test reports
4. Installation information including equipment anchorage provisions
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 twenty-five (25) years. When requested by LAWA, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide Seismic tested equipment as follows:

1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) & California Building Code (CBC) Sections 1704 through 1708 for Site Classification D application and highest 1.5 importance factor. Guidelines for the installation consistent with these requirements shall be provided by the

switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, IBC: a peak of 2.45g's (3.2-11 Hz), and a ZPA of 0.98g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz. The certificate of compliance with the requirements shall show that the shake table tested forces that the equipment can withstand exceed the Site Classification D requirements by a 15% margin. Equipment must utilize the shake table test method; computer modeling, calculations or historical data are not acceptable.

2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

   a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
   b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
   c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

E. All switchgear shall have Los Angeles Department of Building and Safety approved lab test certification.

1.6 REGULATORY REQUIREMENTS

1.7 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.

B. Shipping groups shall be designed to be shipped by truck, rail, or ship. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

C. Split shipping packages are a must to accommodate designed access hatchway.

D. Switchgear shall be equipped to be handled by crane. Where cranes are not available, switchgear shall be suitable for skidding in place on rollers using jacks to raise and lower the groups.

NOTE: All new switchgear delivered to the jobsite, shall be stored in a covered and conditioned area where it is protected from the corrosive marine environment at the airport.

E. Switchgear being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors, indoor gear shall be covered and heated, and outdoor gear shall be heated.

1.8 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 switchgear described in this specification shall be designed for medium voltage, three-phase, 3 wire, solidly grounded, 60-hertz system.

B. Each circuit breaker shall have the following ratings:

Maximum Voltage	5 kV

BIL Rated	170 kV Peak
Continuous Current	1200A for mains and tie. Feeders – 600 A.
Short-Circuit Current at rated Maximum kV	40 kA RMS sym
Rated Voltage Range Factor K	1.0
Closing and Latching Capability	108 kA Crest
Maximum Symmetrical Interrupting and 3-Second Rating	40 kA RMS SYM
Rated Interrupting Time	Cycle 3

NOTE: Values in this table are to be verified by the engineer of reocord and compared to the specific voltage requirements for any new terminal improvement work at the airport.

2.3 CONSTRUCTION

A. The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit. Hinged rear doors, complete with provisions for padlocking, shall be provided.

B. The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. The circuit breakers shall be a roll-out design to allow withdrawal for inspection and maintenance without the use of a separate lifting device.

2.4 BUS

A. The main bus shall be copper with fluidized bed epoxy flame-retardant and track-resistant insulation. The bus supports between units shall be flame-retardant, track-resistant, cycloaliphatic epoxy for medium voltage class. The switchgear shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers. Insulated copper main bus shall be provided and have provisions for future extension. All bus joints shall be plated, bolted and insulated with easily installed boots. The bus shall be braced to withstand fault currents equal to the close and latch rating of the breakers. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests.

B. A copper ground bus shall extend the entire length of the switchgear.

2.5 WIRING/TERMINATIONS

A. The switchgear manufacturer shall provide suitable terminal blocks for secondary wire terminations and a minimum of 10% spare terminals shall be provided. One control circuit cutout device shall be provided in each circuit breaker housing. Switchgear secondary wire shall be #14 AWG, type SIS rated 600 volt, 90 degrees C, furnished with wire markers at each termination. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams.

B. Incoming line and feeder cable lugs of the type and size indicated elsewhere shall be furnished.

2.6 CIRCUIT BREAKERS

A. The circuit breakers shall be horizontal drawout type, capable of being withdrawn on rails. The breakers shall be operated by a motor-charged stored energy spring mechanism, charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts shall be silver-plated copper.

B. Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily. The vacuum interrupter pole unit shall be mounted on cycloaliphatic epoxy supports for medium voltage class. A contact wear gap indicator for each vacuum interrupter, which requires no tools to indicate available contact life, shall be easily visible when the breaker is removed from its compartment. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

C. The secondary contacts shall be silver-plated and shall automatically engage in the breaker operating position, which can be manually engaged in the breaker test position.

D. Interlocks shall be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the operating and test positions.

E. The breakers shall be electrically operated by the following control voltages: 240 volt AC close and AC capacitor trip.

F. Each breaker shall be complete with control switch and red and green indicating lights to indicate breaker contact position.

G. AC control voltage shall be derived from control transformers mounted in the switchgear. A separate control transformer shall be provided on each side of the tie breaker. An automatic throwover control scheme shall be provided and factory wired to provide reliable control power to the entire lineup when one incoming source has failed, but the other source is available. Each control transformer shall be sized to handle the control load of the entire lineup.

2.7 PROTECTIVE RELAYS

A. The switchgear manufacturer shall furnish and install, in the metal-clad switchgear, the quantity, type and rating of protection relays and described hereafter in this specification.

B. Microprocessor-Based Protective Relay

C. FP-5000 Protective Relay

1. The protective relays for the Mains/Tie & Feeder circuit protection shall be a single multifunction, microprocessor-based relay that provides three-phase and ground instantaneous and time overcurrent protection, ANSI 50/51, 50/51G, or 50/51N, and voltage protection, metering and control functions as described below. The relay shall be Cutler-Hammer device type FP-5000 or approved equal having all the features and functions herein specified.
2. The relay shall be a solid-state microprocessor-based multifunctional type that operates from the 5 ampere secondary output of current transformers. The relay shall provide ANSI 50/51 protective functions for each of the three (3) phases, and ANSI 50/51N or 50/51G ground fault protection functions as shown on the plans or as determined by the coordination study. The relay shall be true rms sensing of each phase and ground. Ground element shall be capable of being utilized in residual, zero sequence, ground source connection schemes, or deactivated.
3. The relay shall provide the following protection functions:

    a. Phase overcurrent (forward/ reverse (67) or both (50/51)): Two inverse time overcurrent (51P-1, 51P-2) functions and two instantaneous overcurrent (50P-1, 50P-2) functions with adjustable time delay
    b. Directional Ground inverse time overcurrent and two instantaneous overcurrent functions from calculated values with adjustable time delay (forward/reverse (67G), or both (51G, 50G-1, 50G-2))
    c. Directional Ground inverse time overcurrent and two instantaneous overcurrent functions from measured values with adjustable time delay (forward/reverse (67G), or both (51X, 50X-1, 50X-2))
    d. Ground directional option for Zero Sequence Voltage Polarizing, Negative Sequence Polarizing or Ground Current Polarizing
    e. Negative sequence overcurrent protection with adjustable time delay (46)
    f. Three-phase overvoltage protection with adjustable time delay (59)
    g. Three-phase undervoltage protection with adjustable time delay (27)
    h. Overfrequency protection with adjustable time delay (81O)

        (1) Negative sequence overvoltage protection with adjustable time delay (47)

    i. Underfrequency protection with adjustable time delay (81U)

j. Breaker failure protection with adjustable time delay (50BF).
k. Reverse/Forward Power (32-1, 32-2)
l. Sync Check (25)
m. Power Factor (55)

(1) The primary current transformer ratings being used for phase and ground protection feeding the device shall be programmable for current transformers with primary current ratings from 1 through 6,000 amperes, in 1 ampere steps.
(2) The ground current input and ground protection elements shall be independent of the phase inputs and shall be capable of being connected to the phase residual current transformer connection or to a zero sequence current transformer.
(3) Both the phase and ground protection curves shall be independently field selectable and programmable with or without load. Curves shall be selectable from the following:
ANSI/IEEE: Moderately inverse, very inverse, and extremely inverse
IEC: A, B or C
Thermal:
Flat, It, I2t, I4t
Thermal curves shall be similar to those on low voltage trip units for close coordination with downstream devices.
(4) The relay shall have six trip rated contact outputs that may be programmed for any protection function operation output.
(5) The relay shall have a front panel display of relay condition, breaker status and trip condition.
(6) The relay shall have a built-in alphanumeric display capable of displaying the following information with metering accuracy phase current +/- 0.5% or +/- 0.025A from 0.02 to 20.0 per unit, ground current +/- 0.5% of full scale (In) from 0.2 to 2.0 per unit.

n. Individual phase and ground currents with phase angles
o. Phase-to-ground and phase-to-phase voltages with phase angles
p. Watts
q. Vars
r. VA
s. Frequency
t. Power factor – apparent and displacement
u. Demand and Peak demand (ampere, Watt, VAR, and VA) with date and time stamp since last reset

(1) Forward, reverse and net watthours with start date and time stamp

v. Lead, lag and net var hours with start date and time stamp
w. VA-hours with start date and time stamp
x. Minimum/maximum values of current, voltage, watts, vars, VA,

frequency, apparent pf and displacement pf with date and time stamping
y. Percent THD of voltage and current
z. Positive, negative and zero sequence components of voltage and current with phase angles.

4. Relay shall have the following features:

a. Integral manual testing capability for both phase and ground overcurrent protection functions
b. Zone selective interlocking capability for phase and ground fault protection. This function shall be provided and factory wired. Where zone selective interlocking is not an integral part of the protective device, a full bus differential scheme shall be required for both phase and ground, in addition to specified time overcurrent and instantaneous overcurrent phase and ground fault protection. Bus differential scheme shall be provided with separate differential current transformers for all incoming and outgoing loads, as well as appropriate differential relays (ANSI 87 and 87G) as approved by LAWA.
c. Real-time clock for stamping of events, trips and minimum/maximum values with 1 mS time resolution
d. Trip coil-monitoring circuits
e. User interface for programming and retrieving data from the front of the unit without additional equipment
f. Eight (8) contact inputs that are user programmable
g. Continuous self-testing of internal circuitry
h. Self-diagnostic capability and a relay healthy alarm output
i. Integral test program for testing the relay operation by simulating current and voltage conditions internally
j. Unit failure alarm contact for customer use
k. Programmable lockout/self-reset after trip function
l. Programmable set points for device curve selection
m. Programmable inputs, such as current transformer ratios
n. Access to program and test modes shall be via sealable hinged cover and password protected for security.

5. Relay shall record information on the last 16 faults including:

a. Date, time, currents and voltages at the time of fault
b. Waveforms of the voltages and currents.

6. Relay shall record the last 100 events into an event log with date and time stamping
7. Relay shall have programmable logic control functions including logic gates and timer for control of auxiliary functions
8. Relay shall provide and retain relay communication address and check sum setting verification in non-volatile memory chip within the permanently installed case.
9. Relay shall be suitable for operating temperatures from -30 degrees to 55 degrees C. Relay shall be suitable for operating with humidity from 0 to 95% relative humidity (non-condensing).

10. Relay shall have the following communications ports:

    a. A rear communication port that is FSK based and supports local area network compatible to Cutler-Hammer PowerNet or IMPACC systems.
    b. A rear communication port that is RS-485 based and supports the Modbus RTU protocol.
    c. A front communication port supporting ASCI communications to a personal computer or laptop computer.
    d. Relay shall be capable of the following over the communication network: Ability to transmit all information contained in the relay such as currents, set points, cause of trip, magnitude of trip current, waveforms and open-close trip status. Ability to close and open the associated breaker with proper access code from remote location over the communication network when the relay is configured in remote close/open mode.

11. Relay shall have communication ability to open and close the breaker remotely via password protected access or locally from the front of the relay.
12. Relay shall store four setting groups which can be called for via communications, front panel operation or contact input.
13. Relay trip contacts shall not change state if power is lost or an undervoltage occurs. These contacts shall only cause a trip upon detection of an overcurrent or fault condition based upon programmed settings.
14. A relay healthy alarm output shall be normally energized and shall drop out if a relay failure is detected in the self-test function or if control power is lost.
15. The relay shall be suitable for operating on control power with a nominal input voltage of 125 Vac or 250 Vac (60 Hz). When AC control power schemes required, in addition to control power transformer or remote control power are specified, a single-phase uninterruptable power supply shall be included to supply control power to protective devices.

2.8 AUXILIARY DEVICES

A. Ring type current transformers shall be furnished. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

B. Voltage and control power transformers of the quantity and ratings indicated in the detailed specification shall be supplied. Voltage transformers shall be mounted in drawout drawers contained in an enclosed auxiliary compartment. Control power transformers up to 15 kV, 15 kVA, single-phase shall be mounted in drawout drawers. Rails shall be provided as applicable for each drawer to permit easy inspection, testing and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn.

C. A mechanical interlock shall be provided to require the secondary breaker to be open before the CPT drawer or CPT primary fuse drawer can be withdrawn.

2.9 AUTOMATIC THROWOVER SYSTEM – OPEN TRANSITION

A. Dual Source, With Tie, Open Transition Automatic Transfer Control System

1. Provide an automatic transfer control system for control of three circuit breakers. The logic of the transfer control system functions shall be provided via a microprocessor. The set points shall be field adjustable without the use of special tools
2. The transfer control system shall be provided with a local display. The display shall show the status of the system as it is operating. When timers are functioning, the display shall show the timer counting down. All time delays shall be capable of being set from the front of the display using a timer setting screen
3. The transfer control system includes the following features:

   a. Time delay to transfer on loss of Source 1, adjustable.
   b. Time delay to transfer on loss of Source 2, adjustable.
   c. Time delay re-transfer to Source 1, adjustable.
   d. Time delay re-transfer to Source 2, adjustable.
   e. Time delay neutral (main and tie open), adjustable.
   f. The local system display shall show the following: Main- Tie- Main one line diagram; main and tie breaker status (open, closed, tripped, out of cell); readout marked “Source 1” and “Source 2” to indicate that respective source voltages are available; automatic/manual mode select pushbutton; pushbuttons for manual breaker control; and alarm information (loss of source, breaker trip).

4. Sequence of Operation – Automatic Mode

   a. Under normal conditions, the main breakers are closed and the tie breaker is open.
   b. Upon phase loss or loss of phase-to-phase voltage of either utility source to between 80% and 100% of nominal, and after a time delay, adjustable from 1 to 60 seconds to override momentary dips and outages the transfer control system shall open the affected main breaker and close the tie breaker.
   c. When normal voltage has been restored after a time delay, adjustable from 10 to 600 seconds (to ensure the integrity of the source), the transfer control system shall open the tie breaker. The transfer control system shall have an adjustable neutral position timer (0-10 seconds) to allow voltage to decay sufficiently before the affected main breaker is then closed (open transition retransfer).
   d. If Source 2 should fail while carrying the load, transfer to Source 1 shall be made instantaneously upon restoration of Source 1 to satisfactory conditions.
   e. If both sources should fail simultaneously, no action shall be taken.
   f. If the main or tie breakers trip due to a fault, the transfer control system shall be reset to manual mode and manual operation of that breaker shall be prevented until its overcurrent trip switch is reset.

5. Sequence of Operation – Manual Mode

   a. While in manual mode, breakers shall be capable of being opened and closed using control switches or pushbuttons on the transfer control system display. Electrical interlocking shall be provided to prevent the closing of both mains and the tie simultaneously.

6. Provide a control power transformer for each source with control power transfer scheme
7. Provide electrically operated main and tie circuit breakers
8. Provide a programmable logic controller with 24 volts dc ride-through power supply
9. Provide an industrial display panel

2.10 LAWA **METERING**

A. Provide a separate LAWA metering devices and compartment with front hinged doors. Include associated instrument transformers.

B. Provide current transformers for metering. 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 metering system. Power Xpert 8000

1. Provide a microprocessor based line of Power Quality complete 8000 Meters, designated PX-M consisting of a Power Quality Meter Base(s) designated PX-B along with an integrally mounted Power Quality Meter Display designated PX-D. The PX-M shall be equal to Cutler-Hammer type PowerXpert 8000 as herein specified. PX-B shall be NEMA 1 rated and PX-D shall be NEMA 12 rated.
2. Complete PX-8000 shall be have the following minimum listings and/or certifications:

   a. Safety: UL 61010A-1, EN 610101.
   b. Accuracy: ANSI C12.20 Class 0.2, IEC/EN60687 0.2 for revenue meters.
   c. EMC: FCC Part 15 Subpart B Class A immunity.
   d. IEC Standards: 50081-2, 61000-3, 61000-4, and 61000-6.

3. Meter shall be supplied suitable for standard 120/240 Vac as required.
4. Current inputs for each channel shall be from standard instrument current transformers.

   a. The analog current input shall be converted to 1024 samples per cycle with a delta-sigma converter digitally filtered down to 256 samples per cycle for anti-aliasing.
   b. Meter burden shall be less than 10 milliohms.

c. Overload withstand capability shall be a minimum of 500A for 1 second, non-repeating.
d. Input range capability shall be 0.005 to 20 amperes.

5. Voltage inputs for each channel shall allow for connection into circuits with the following parameters:

a. Input range of 600V L-L, 347V L-N direct connected.
b. PT primary input of 120 volts to 500,000 volts.
c. Nominal full-scale value of 700 volts rms.
d. Input impedance of 2 mega ohms.
e. The analog voltage input shall be converted to 1024 samples per cycle by means of a delta sigma converter and digitally filtered down to 256 samples per cycle for anti-phasing.

6. The PX-Metering series shall be capable of monitoring, displaying, and communicating the below true rms minimum information where applicable with the accuracy as indicated of read or calculated values based on 3 to 300% full scale. The PX-Metering series shall be suitable for installation in single phase, two or three wire systems or in three phase, three or four wire systems

a. AC current (amperes) in A, B and C phase, 3-phase average, Neutral (N) and Ground (G). A total of five (5) current inputs shall be provided. Accuracy of all current inputs shall be 0.05% reading, +/- 0.01% of full scale. Provide neutral and ground current transformers. The 5 ampere current inputs shall withstand 40 amperes continuous and 300 amperes for 1 second. Current transformer ratios shall be selectable.
b. AC voltage (volts) for A-B, B-C and C-A, phase average, A-N, B-N and C-N, average phase to N, and N to G. Accuracy of all voltage inputs shall be +/- 0.1% reading, +/-0.05% maximum of full scale. Capable of metering up to 600 volt without external Potential Transformers (PTs) and up to 500 kV with appropriate PTs.
c. Real Power (Watts), Reactive Power (vars), Apparent Power (VA), for each phase and system. Accuracy +/- 0.10% reading and +/- 0.0025% full scale. Forward/Reverse indication shall be provided.
d. Accumulated, Incremental and conditional measurement for Real Energy (WH), Reactive Energy (VARH), Apparent Energy (VAH) for each phase and system. Accuracy +/- 0.10% reading and +/- 0.0025% full scale. Forward/Reverse and Net difference indication shall be provided.
e. Frequency (Hz) Accuracy +/- 0.01 hertz.
f. Demand values including present, running average, last complete interval and peak for System Current (Amperes). Demand values including present, running average, last complete interval, peak and coincident with peak kVA and kW demand for System Real Power (Watts), System Reactive Power (vars), and System Apparent Power (VA).
g. Power Factor for both Displacement only 60-cycle fundamental Watts to VA and Apparent total Watts to total vars including harmonics for A, B and C phase and 3 phase average. Accuracy +/- 0.10% at unity PF and +/-0.30% at 0.5 PF.
h. Current percent Total Harmonic Distortion (THD) in A, B and C phase

and N.

(1) Voltage percent THD in A-B, B-C and C-A phase, A-N, B-N and C-N.

i. K-Factor (sum of the squares of harmonic currents times the square of their harmonic numbers).
j. Transformer Derating Factor (1.414 divided by the Crest Factor).
k. Crest Factor (ratio of peak current to rms current).
l. CBEMA (ITIC) curve data
m. Flicker data
n. Nines (9's) availability data.
o. Power Quality Index

7. The PX series shall provide the following sampling capabilities:

a. A/D technology, sampling at 1024 samples per cycle.
b. Over-sampling and quantizing filtering to eliminate false signal noise.
c. ITIC representation of power events.
d. DV/dt triggers for sub-cycle oscillatory transients. Both dv/dt and absolute threshold triggering shall be supported on all voltage inputs, including N-G voltage.
e. Six (6) MHz/ one (1) MHz capture of impulsive transients. 20 ms of data shall be captured at six (6) MHz or 120 ms of data shall be captured at one (1) MHz.
f. Waveform recorded at 100,000 high rate samples per cycle. Waveforms shall be displayed on standard web browser without requiring separately purchased and installed software.
g. Three-phase voltage and neutral-to-ground fast transient capture.
h. Absolute threshold and dV/dt triggering.

8. The PX series shall provide the following advanced analysis features:

a. Calculation of harmonic magnitudes and phase angle for each phase voltage and current through the 85th harmonic.
b. Waveforms shall be available in non-volatile memory and retrievable via file transfer protocol (FTP) in COMTRADE file format over the Internet network. No special software shall be required to download or view waveforms. Waveforms shall be viewable within standard web browser.
c. Historical Trending: Historical trend logging for graphical viewing from the Local PX-D display or from an embedded WEB server. The graphical views of historical data shall support both pan and zoom functions. All standard metering parameters shall be logged as part of the standard meter functionality including minimum, maximum and average for each metered parameter. The minimum and maximum readings shall be based on 200ms calculations. The averages shall be calculated over the user selected time interval period. Minimum storage capacity for standard trend plots shall be as follows:

(1) One-minute intervals for 9 days.
(2) Sixty-minute intervals for 540 days.
(3) Data storage up to 512 MB.

d. Time of Use Monitoring: Time of use monitoring shall include:

(1) Four rate periods for time of use revenue metering.
(2) Total rate independent of time of use.
(3) Up to 4 rate schedules (weekdays and weekends).

e. Energy Profile: Energy profile data shall include recording of real and reactive energy forward, reverse, net and absolute sum as well as apparent energy (KVAH). Up to eight (8) status inputs shall be configurable as energy accumulators for counting KYZ pulse inputs. These readings shall be stored over a configurable interval from 1 to 60 minutes as well as in daily and weekly totals. Storage capacity shall be as follows:

(1) Sixty-two (62) days of fifteen (15) minute interval energy and pulse interval data. (Fixed interval capacity shall equal 5,952 intervals configurable from 1 to 60 minutes).
(2) Three hundred and seventy-two (372) days of 1 day accumulated energy and pulse interval data.
(3) Two Hundred and eight (208) weeks of one (1) week accumulated energy and pulse interval data.

f. Event Triggers: The PX-M shall have a quantity of five (5) types of configurable event triggers configurable using a web browser consisting of 1) Out of limits, 2) Demand overload, 3) ITIC, 4) Sub-Cycle disturbance and 5) Fast Transient. The web browser shall not require any user-installed software. These triggers shall permit pickup, reset and pickup delay to be user configurable. When a trigger occurs, actions shall include Performance monitoring (Nines (9s) analysis, Capturing Waveform, Capture all metered parameters, and ability to send by email and/or activate a relay output. The meter graphic display PX-MD shall flash an LED to annunciate the alarm condition and an audible alarm shall be available. The following trigger options shall be included:

(1) Out of limits – one hundred and five (105) triggers.
(2) Demand overload – Ten (10) triggers.
(3) ITIC curve display sag or swell voltage events – Eight (8) triggers.
(4) Fast transient – dV/dt and absolute per phase.
(5) Sub-cycle disturbance – dV/dt and absolute.

g. Event Logging: The PX-M or embedded WEB Server shall allow the user to view a list of triggered events along with any captured parameters, event details, and triggered waveforms. In addition, a separate event log shall include logging of activities including acknowledged triggers, new minimum and maximum events, and systems operations, such as resets. The size of each event log shall be virtually unlimited based only on the memory option selected.

h. ITIC Analysis Plot: The PX-M or embedded WEB Server shall include a graphic display of the Information Technology Industry Council (ITIC) plot with counts of disturbances and transients that have occurred. The ITIC plot shall organize events into eight (8) distinct disturbance zones corresponding to the severity of the event and a ninth (9th) zone for transients. A pass/fail count shall be displayed to indicate how many events are outside the ITIC limits. Operator clicking of any counter, or the event itself in the ITIC WEB page shall link the user to the event view and display all triggered events in the selected zone making it easy to view disturbance waveforms associated with the ITIC plot.

i. Sag/Swell and Waveform recording: Sixty (60) cycles of waveform shall be recorded at 256 samples per cycle including 30 cycles of pre and post event data. The embedded WEB server shall be capable of supporting viewing of all triggered waveforms one channel at a time and shall include the ability to zoom and to scroll horizontally using a slider bar. Waveforms shall be stored in non-volatile flash memory using industry standard COMTRADE format. Waveforms shall be automatically sent out as COMTRADE attachments to an email following an event, or shall be retrievable from an FTP directory structure from the meter's memory.

j. Minimum and Maximum values for the following parameters:

(1) Voltage L-L and L-N
(2) Current per phase
(3) Apparent Power Factor and Displacement Power Factor
(4) Real, Reactive, and Apparent total Power
(5) THD voltage L-L and L-N
(6) THD Current per phase
(7) Frequency

9. The PX-8000 meter base and display shall have a digital Input/Output (I/O) card which shall include:

a. Eight (8) digital inputs – self sourced 24 Vdc. These shall be interrupt driven, allowing for 1ms accuracy of digital events time stamps when utilizing local NTP server. Inputs shall be configurable for demand synch, and pulse counting. Inputs selected for pulse counting shall be scalable. Interval by interval pulse recordings shall be maintained in the PX-M/PX-B profile memory and shall be capable of being displayed graphically.

b. Three (3) relay outputs – 5A maximum form C continuous, 380Vac maximum, 125Vdc maximum. Outputs shall be suitable for KYX or alarm annunciation. Relay outputs shall have the following minimum ratings:

(1) Make: 30A, 30 Vdc, 120-240 Vac.
(2) Break: 5A, 30 Vdc, 120-240 Vac.
(3) Resistive load: 0.5A, 125Vdc; 0.25A, 250 Vdc.
(4) Mechanical Operations: 1,000,000 no-load and100,000 under rated voltage and current.
(5) Output Relay when event triggered shall be capable of operating in timed, normal or latched mode.

c. Two (2) solid state outputs – 80 mA maximum continuous, 30 Vdc maximum.

10. The PX-8000 base and display shall be provided with multiple communications ports and protocols, including the following minimum capability:

    a. RS-232
    b. RS-485
    c. RJ-45 10/100 Base-T Local Ethernet Configuration Port for local WEB server connection
    d. Modbus RTU
    e. Modbus TCP
    f. HTML web pages
    g. File transfer protocol (FTP)
    h. Ethernet TCP/IP

11. The PX-8000 graphically display shall utilize a simple “twist and click” navigation control dial to easily navigate the menus, select links to related pages, and to drill down into increasing levels of further details. A “back” key shall be provided for easy navigation to higher level screens. The graphical display shall have the following features:

    a. Backlight LCD remote graphics display with 320 x 240 pixels. This display must supporting reviewing, displaying and scrolling through waveform capture**s** without requiring a separate computer or separately purchased software.
    b. Capable of being mounted to the Meter base unit or remote mounting of display up to 2000 ft away with capability of displaying up to 16 base units or complete Meters.
    c. A set of screens including real time data, trend lots, waveform views and ITIC plot.
    d. Allow basic device setup and password protected resets.
    e. An audible alarm to annunciate alarm conditions.

12. The WEB server shall provide the user with remote WEB access to all the metered, trend and waveform information. The WEB server shall include real time monitored information in both numeric and graphical visual formats.
13. The meter shall be cable of providing the graphically display of the following Main Meter Menu Screens:

    a. Meter Screen providing:

        (1) Volts: L-L and L-N, and average
        (2) Frequency
        (3) Current and average phase A, B, and C, N & G

    b. Power Screen providing:

        (1) Energy
        (2) Demand

(3) Power Factor

c. Quality Screen providing:

(1) Total Harmonic Distortion (THD) of volts and current
(2) Flicker
(3) Percent Nines (9s) reliability

d. Events screen providing:

(1) Latest events
(2) Enabled Triggers
(3) Historical Events

e. Set-up screen providing:

(1) View set-up
(2) Edit set-up
(3) Login
(4) Logout

14. A tool bar for screen selection which is always present and viewable shall be provided along the bottom of the graphical display. Selection of one of the main screens shall be by turning the navigation knob and highlighting the desired screen. Once selected, pressing the knob shall make the selection.

2.11 ENCLOSURES

A. The switchgear described in these specifications shall be indoor construction.

2.12 NAMEPLATES

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

A. 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 wiring diagrams.

2.13 FINISH

A. The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

2.14 ACCESSORIES

A. The switchgear manufacturer shall furnish accessories for test, inspection, maintenance and operation, including:

1. One – Maintenance tool for manually charging the breaker closing spring and manually opening the shutter
2. One – Levering crank for moving the breaker between test and connected positions
3. One – Test jumper for electrically operating the breaker while out of its compartment
4. One – Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails, when applicable
5. One – Set of rail extensions and rail clamps, when applicable
6. One – Test cabinet for testing electrically operated breakers outside housing
7. One – Electrical levering device

2.15 CORONA FREE DESIGN

A. The switchgear shall be corona free by design and shall be tested for partial discharges in accordance with EEMAC standard G11-1. The corona discharges measured during the tests shall be less than 100 picocoulombs.

2.16 PARTIAL DISCHARGE SENSING EQUIPMENT

A. The switchgear shall be equipped with factory installed partial discharge sensors and relay for continuous monitoring of the partial discharges under normal operation. The purpose of partial discharge sensing is to identify potential insulation problems (insulation degradation) by trending of PD data over time so that corrective actions can be planned and implemented before permanent insulation deterioration develops.

B. The PD sensing and monitoring system shall consist of sensors and relay specifically developed for such applications, such as Eaton’s RFCT sensor and InsulGard relay, or equivalent. One RFCT sensor shall be installed over floating stress shields of specially designed bus or line side primary bushings, at every two vertical section for detection of partial discharges within the switchgear compartments. An RFCT sensor shall also be provided for installation around ground shields of the incoming or outgoing power cable termination for detection of PD activity in the cables up to 100 feet from the switchgear. Output signals from each RFCT shall be factory wired to PD monitoring relay for continuous monitoring.

2.17 CONTROLS & CONTROL TRANSFORMERS

A. The metal-clad switchgear auxiliary section for control and instrumentation shall include the following:

1. Line-to-line voltage transformers.

2. Current transformers.
3. Single-phase control power transformers with automatic throwover system. The size of the transformers shall be determined by the VacClad lineup manufacturer and each transformer shall handle the full control power load of the lineup (tie breaker closed, single source available).
4. Microprocessor-based PowerXpert 8000 metering system

2.18 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing in accordance with NEMA PB 2.

B. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI standards.

1. Alignment test with master cell to verify all interfaces and interchangeability
2. Circuit breakers operated over the range of minimum to maximum control voltage
3. Factory setting of contact gap
4. One-minute dielectric test per ANSI standards
5. Final inspections and quality checks

B. The following production test shall be performed on each breaker housing:

1. Alignment test with master breaker to verify interfaces
2. One-minute dielectric test per ANSI standards on primary and secondary circuits
3. Operation of wiring, relays and other devices verified by an operational sequence test
4. Final inspection and quality check

C. The manufacturer shall provide three (3) certified copies of factory test reports.

D. Factory tests as outlined above under 3.02.B shall be witnessed by LAWA.

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 startup 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.

3.4 TRAINING

A. The Contractor shall provide a training session for up to ten (10) LAWA's representatives for 3 normal workdays at a job site location determined by LAWA.

B. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, circuit breaker, protective devices, and other major components.

3.5 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and contract drawings.

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

3.6 FIELD ADJUSTMENTS

A. The relays shall be set in the field by:

1. A qualified representative of the manufacturer, retained by the Contractor, in

accordance with settings designated in a coordinated study of the system as required elsewhere in the contract documents.

END OF SECTION 26 13 13

SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. Section includes two-winding transformers; K- factor rated shielded transformer.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
2. NEMA ST 20 - Dry Type Transformers for General Applications.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

B. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

C. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of transformers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. **Cutler Hammer**
2. **General Electric.**
3. **Square D.**

B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers.

C. Primary Voltage: 480 volts, 3 phase or unless otherwise noted.

D. Secondary Voltage: 208Y/120 volts, 3 phase or unless otherwise noted.

E. Insulation system and average winding temperature rise for rated kVA as follows:

1. 1-15 kVA: Class 185 with 115 degrees C rise.
2. 16-500 kVA: Class 220 with 115 degrees C rise.

F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.

G. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

H. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:

1. 1-5 kVA: 30 dB.
2. 6-25 kVA: 40 dB.
3. 26-150 kVA: 42 dB.
4. 151-225 kVA: 43 dB.
5. 226-300 kVA: 47 dB.
6. 301-500 kVA: 51 dB.

I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

J. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

K. Mounting:

1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

L. Coil Conductors: Continuous copper windings with terminations brazed or welded.

M. Enclosure: NEMA ST 20, Type 1 indoor, dry locations and Type 3R for wet locations. Furnish lifting eyes or brackets.

N. Isolate core and coil from enclosure using vibration-absorbing mounts.

O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 K-FACTOR TRANSFORMERS

A. Manufacturers:

1. Cutler-Hammer
2. General Electric
3. Square D.

B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers. K- factor 13 rated, 220 degree C insulation.

C. Primary Voltage: 480 volts, 3 phase or unless otherwise noted.

D. Secondary Voltage: 208Y/120 volts, 3 phase or unless otherwise noted.

E. 200% neutral.

F. Insulation system and average winding temperature rise for rated kVA as follows:

1. 16-500 kVA: Class 220 with 115 degrees C rise.

G. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.

H. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

2. Transformers 15 kVA and Larger: NEMA ST 20.

I. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:

1. 6-25 kVA: 40 dB.
2. 26-150 kVA: 42 dB.
3. 151-225 kVA: 43 dB.
4. 226-300 kVA: 47 dB.
5. 301-500 kVA: 51 dB.

J. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

K. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

L. Mounting:

1. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
2. Larger than 75 kVA: Suitable for floor mounting.

M. Coil Conductors: Continuous copper windings with terminations brazed or welded.

N. Enclosure: NEMA ST 20, Type 1 indoor, dry locations and Type 3R for wet locations. Furnish lifting eyes or brackets.

O. Isolate core and coil from enclosure using vibration-absorbing mounts.

P. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

Q. Provide an electrostatic shield.

2.3 Source Quality Control

A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Support transformers.

1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
3. Mount trapeze-mounted transformers.

D. Provide seismic restraints.

NOTE: Electrical transformer for toilets, urinals and sensors shall be located in ceiling and provided with ceiling access panels to the extent possible.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.4 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 26 22 00

SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. Section includes two-winding transformers; K- factor rated shielded transformer.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
2. NEMA ST 20 - Dry Type Transformers for General Applications.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

B. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

C. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of transformers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. **Cutler Hammer**
2. **General Electric.**
3. **Square D.**

B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers.

C. Primary Voltage: 480 volts, 3 phase or unless otherwise noted.

D. Secondary Voltage: 208Y/120 volts, 3 phase or unless otherwise noted.

E. Insulation system and average winding temperature rise for rated kVA as follows:

1. 1-15 kVA: Class 185 with 115 degrees C rise.
2. 16-500 kVA: Class 220 with 115 degrees C rise.

F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.

G. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

H. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:

~~1. 1-5 kVA: 30 dB.~~
~~2. 6-25 kVA: 40 dB.~~
~~3. 26-150 kVA: 42 dB.~~
~~4. 151-225 kVA: 43 dB.~~
~~5. 226-300 kVA: 47 dB.~~
~~6. 301-500 kVA: 51 dB.~~

1. 0-9 kVA: 40 dB.
2. 10-50 kVA: 45 dB.
3. 51-150 kVA: 50 dB.
4. 151-300 kVA: 55 dB.
5. 301-500 kVA: 60 dB.
6. 501-700 kVA: 62 dB.

I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

J. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

K. Mounting:

1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor mounting.

L. Coil Conductors: Continuous copper windings with terminations brazed or welded.

M. Enclosure: NEMA ST 20, Type 1 indoor, dry locations and Type 3R for wet locations. Furnish lifting eyes or brackets.

N. Isolate core and coil from enclosure using vibration-absorbing mounts.

O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 K-FACTOR TRANSFORMERS

A. Manufacturers:

1. Cutler-Hammer
2. General Electric
3. Square D.

B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers. K- factor 13 rated, 220 degree C insulation.

C. Primary Voltage: 480 volts, 3 phase or unless otherwise noted.

D. Secondary Voltage: 208Y/120 volts, 3 phase or unless otherwise noted.

E. 200% neutral.

F. Insulation system and average winding temperature rise for rated kVA as follows:

1. 16-500 kVA: Class 220 with 115 degrees C rise.

G. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.

H. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

I. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:

~~1. 6-25 kVA: 40 dB.~~
~~2. 26-150 kVA: 42 dB.~~
~~3. 151-225 kVA: 43 dB.~~
~~4. 226-300 kVA: 47 dB.~~
~~5. 301-500 kVA: 51 dB.~~
1. 0-9 kVA: 40 dB.
2. 10-50 kVA: 45 dB.
3. 51-150 kVA: 50 dB.
4. 151-300 kVA: 55 dB.
5. 301-500 kVA: 60 dB.
6. 501-700 kVA: 62 dB.

J. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

K. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

L. Mounting:

1. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
2. Larger than 75 kVA: Suitable for floor mounting.

M. Coil Conductors: Continuous copper windings with terminations brazed or welded.

N. Enclosure: NEMA ST 20, Type 1 indoor, dry locations and Type 3R for wet locations. Furnish lifting eyes or brackets.

O. Isolate core and coil from enclosure using vibration-absorbing mounts.

P. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

Q. Provide an electrostatic shield.

2.3 Source Quality Control

A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Support transformers.

1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
3. Mount trapeze-mounted transformers.

D. Provide seismic restraints.

NOTE: Electrical transformer for toilets, urinals and sensors shall be located in ceiling and provided with ceiling access panels to the extent possible.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.4 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 26 22 00

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

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install, a deadfront type, low voltage metal-enclosed switchgear assembly utilizing drawout power circuit breakers.

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.

E. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

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 twenty-five (25) years. When requested by LAWA, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Provide Seismic tested equipment as follows:

E. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through Site Classification D. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, CBC: a peak of 2.15g’s, and a ZPA of 0.86g’s applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

F. The manufacturer may certify the equipment based on a detailed computer analysis of the entire assembly structure and its components. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment

G. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.6 REGULATORY REQUIREMENTS

A. The switchgear shall bear a UL 1558 label.Certified copies of production test reports shall be supplied demonstrating compliance with these standards.

1.7 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.

1.8 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-tosilver 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 personel 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 timecurrent curve shaping adjustments. The short-time pickup adjustment shall be dependant 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 currect 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. NEMA 1 Enclosure for indoors, or NEMA 3R for outdoors.

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.

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.

2.14 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing in accordance with NEMA PB 2.

B. Make completed switchboard available for inspection at manufacturer’s factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer’s test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

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

C. 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

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

E. Securing assemblies to foundation or floor channels

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

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

END OF SECTION 26 23 00

SECTION 26 24 13-SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes main and distribution switchboards.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C12.1 - Code for Electricity Metering.
2. ANSI C39.1 - Requirements, Electrical Analog Indicating Instruments.

B. Institute of Electrical and Electronics Engineers:

1. IEEE C57.13 - Standard Requirements for Instrument Transformers.
2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

C. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
3. NEMA PB 2 - Deadfront Distribution Switchboards.
4. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

D. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

E. Underwriters Laboratories Inc.:

1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

A. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details.

B. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.

C. The electrical contractor shall submit ¼”=1’0” scale drawings including interior elevations of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. These drawings shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches will be returned and not reviewed.

NOTE: The equipment depicted on the plans and interior elevations shall match the equipment indicated on the shop drawings.

D. Test Reports: Indicate results of factory production and field tests.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.

B. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. The manufacturer of the switchboard assembly shall be the same as the manufacturer of the circuit breakers installed within the assembly.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept switchboards on site. Inspect for damage.

B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 DISTRIBUTION SWITCHBOARDS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA PB 2, enclosed switchboard.

C. Switchboards shall be “fully-rated” for the available short circuit current. “Series-rated” equipment is not acceptable. Main 480 volt service switchboards in the terminals shall be rated 100kAIC.

D. Device Mounting:

1. Main Section: Panel mounted.
2. Distribution Section: Panel mounted.

E. Bus:

1. Material: Copper with silver or tin plating standard size.
2. Connections: Bolted, accessible from front for maintenance.
3. Provide bus extensions on ends for future sections.

F. Ground Bus: Extend length of switchboard.

G. Line and Load Terminations: Accessible from front only of switchboard, suitable for conductor materials.

H. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, insulated and braced for short circuit currents. Leave space in design for one spare section to be added. Provide footprint area for future expansion.

I. Switchboard Height: 90 inches, excluding floor sills, lifting members and pull boxes.

J. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

2.2 MOLDED CASE CIRCUIT BREAKER

> **NOTE:** Molded Case Circuit Breakers are for typical frame sizes ranging from 110A to 2500A.

A. Manufacturers:

1. **Cutler-Hammer.**
2. **General Electric.**
3. **Square D.**

B. Product Description: UL 489, molded-case circuit breaker.

C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time short time continuous current; short time long time pickup current setting for automatic operation.

D. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.

E. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing instantaneous trip; and adjustable short time trip.

F. Accessories:

1. Shunt Trip Device.
2. Undervoltage Trip Device.
3. Auxiliary Switch.
4. Alarm Switch.
5. Electrical Operator.
6. Handle Lock: Provisions for padlocking.
7. Grounding Lug: In each enclosure.

2.3 INSULATED CASE CIRCUIT BREAKER

> **NOTE:** Molded Case Circuit Breakers are for typical frame sizes ranging from 800A to 6000A.

A. Manufacturers:

1. **Cutler-Hammer.**
2. **General Electric.**
3. **Square D.**

B. Product Description: UL 489, enclosed, insulated-case circuit breaker.

C. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing instantaneous trip; and adjustable short time trip.

NOTE: Incorporating any of the below accessories is dependent on the design of the new electrical system.

D. Accessories:

1. Shunt Trip Device.
2. Undervoltage Trip Device.
3. Auxiliary Switch.
4. Alarm Switch.
5. Electrical Operator.
6. Handle Lock: Provisions for padlocking.
7. Grounding Lug: In each enclosure.

2.4 POWER METERS

NOTE: Power meters are to meter the entire switchboard. Tenant sub metering may be required.

A. Provide electronic power meter to indicate the following parameters.

1. Voltage: Phase-Phase and Phase-Neutral.
2. Current in Each Phase.
3. KW.
4. KVA.
5. KVAR.
6. Power Factor.
7. Current Demand.
8. Maximum Demand.
9. Kwhour.

2.5 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing in accordance with NEMA PB 2.

B. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with NEMA PB 2.1.

B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

C. Install engraved nameplates.

D. Install breaker circuit directory.

E. Ground and bond switchboards.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.3 ADJUSTING

A. Adjust operating mechanisms for free mechanical movement.

B. Tighten bolted bus connections.

C. Adjust circuit breaker trip and time delay settings to values as indicated on short circuit study. Refer to Overcurrent Protective Device Coordination Study.

> **NOTE:** These above adjustments shall be performed by a third party. These adjustments shall include but are not limited to, the following studies: short circuit study, coordination study and arc flash study.

END OF SECTION 26 24 13

SECTION 26 24 13-SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes main and distribution switchboards.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C12.1 - Code for Electricity Metering.
2. ANSI C39.1 - Requirements, Electrical Analog Indicating Instruments.

B. Institute of Electrical and Electronics Engineers:

1. IEEE C57.13 - Standard Requirements for Instrument Transformers.
2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

C. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
3. NEMA PB 2 - Deadfront Distribution Switchboards.
4. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.

D. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

E. Underwriters Laboratories Inc.:

1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

A. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details.

B. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.

C. The electrical contractor shall submit ¼”=1’0” scale drawings including interior elevations of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. These drawings shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches will be returned and not reviewed.

NOTE: The equipment depicted on the plans and interior elevations shall match the equipment indicated on the shop drawings.

D. Test Reports: Indicate results of factory production and field tests.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.

B. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. The manufacturer of the switchboard assembly shall be the same as the manufacturer of the circuit breakers installed within the assembly.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept switchboards on site. Inspect for damage.

B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 DISTRIBUTION SWITCHBOARDS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA PB 2, enclosed switchboard.

C. Switchboards shall be "fully-rated" for the available short circuit current. "Series-rated" equipment is not acceptable. Main 480 volt service switchboards in the terminals shall be rated 100kAIC.

D. Device Mounting:

1. Main Section: Panel mounted.
2. Distribution Section: Panel mounted.

E. Bus:

1. Material: Copper with silver or tin plating standard size.
2. Connections: Bolted, accessible from front for maintenance.
3. Provide bus extensions on ends for future sections.

F. Ground Bus: Extend length of switchboard.

G. Line and Load Terminations: Accessible from front only of switchboard, suitable for conductor materials.

H. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, insulated and braced for short circuit currents. Leave space in design for one spare section to be added. Provide footprint area for future expansion.

I. Switchboard Height: 90 inches, excluding floor sills, lifting members and pull boxes.

J. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

~~J.~~K. Short Circuit Rating: The short circuit rating of the equipment shall exceed 130% of the available short circuit current at the equipment.

2.2 MOLDED CASE CIRCUIT BREAKER

> **NOTE:** Molded Case Circuit Breakers are for typical frame sizes ranging from 110A to 2500A.

A. Manufacturers:

1. **Cutler-Hammer.**
2. **General Electric.**
3. **Square D.**

B. Product Description: UL 489, molded-case circuit breaker.

C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time short time continuous current; short time long time pickup current setting for automatic operation.

D. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.

E. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing instantaneous trip; and adjustable short time trip.

F. Accessories:

1. Shunt Trip Device.
2. Undervoltage Trip Device.
3. Auxiliary Switch.
4. Alarm Switch.
5. Electrical Operator.
6. Handle Lock: Provisions for padlocking.
7. Grounding Lug: In each enclosure.

2.3 INSULATED CASE CIRCUIT BREAKER

> **NOTE:** Molded Case Circuit Breakers are for typical frame sizes ranging from 800A to 6000A.

A. Manufacturers:

1. **Cutler-Hammer.**
2. **General Electric.**
3. **Square D.**

B. Product Description: UL 489, enclosed, insulated-case circuit breaker.

C. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing instantaneous trip; and adjustable short time trip.

NOTE: Incorporating any of the below accessories is dependent on the design of the new electrical system.

D. Accessories:

1. Shunt Trip Device.
2. Undervoltage Trip Device.
3. Auxiliary Switch.
4. Alarm Switch.
5. Electrical Operator.
6. Handle Lock: Provisions for padlocking.
7. Grounding Lug: In each enclosure.

2.4 POWER METERS

NOTE: Power meters are to meter the entire switchboard. Tenant sub metering may be required.

A. Provide electronic power meter to indicate the following parameters.

1. Voltage: Phase-Phase and Phase-Neutral.
2. Current in Each Phase.
3. KW.
4. KVA.
5. KVAR.
6. Power Factor.
7. Current Demand.
8. Maximum Demand.
9. Kwhour.

2.5 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing in accordance with NEMA PB 2.

B. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with NEMA PB 2.1.

B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

C. Install engraved nameplates.

D. Install breaker circuit directory.

E. Ground and bond switchboards.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.3 ADJUSTING

A. Adjust operating mechanisms for free mechanical movement.

B. Tighten bolted bus connections.

C. Adjust circuit breaker trip and time delay settings to values as indicated on short circuit study. Refer to Overcurrent Protective Device Coordination Study.

> **NOTE:** These above adjustments shall be performed by a third party. These adjustments shall include but are not limited to, the following studies: short circuit study, coordination study and arc flash study.

END OF SECTION 26 24 13

SECTION 26 24 16-PANELBOARDS

PART 1 – GENERAL

NOTE: For all panelboards above 800A, use switchboards.

1.1 SUMMARY

A. Section includes distribution and branch circuit panelboards.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
6. NEMA PB 1 - Panelboards.
7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:

1. UL 67 - Safety for Panelboards.
2. UL 1283 - Electromagnetic Interference Filters.
3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

B. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. The manufacturer of the panelboard shall be the same manufacturer of the major components within the assembly, including circuit breakers and fusible switches.

1.6 MAINTENANCE MATERIALS

A. Furnish two of each panelboard key. Panelboards keyed alike to LAWA's current keying system.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

> **NOTE:** Due to the corrosive exterior environment at the airport, <u>all</u> panelboards are to be located indoors, as much as possible. In the event that an exterior installation is the only option, <u>all</u> exterior panelboards are to be a **<u>NEMA Type 4, Type 3R Stainless Steel, or better.</u>**

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA PB 1, circuit breaker type panelboard.

C. Panelboard Bus: Copper, current carrying components, and furnish copper ground bus in each panelboard.

D. Minimum integrated short circuit rating: Amperes rms symmetrical shall be 42,000A rms symmetrical. Panelboards shall be fully rated; series rated equipment is not acceptable.

E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

F. Circuit Breaker Accessories: Trip units and auxiliary switches.

G. Enclosure: NEMA PB 1, Type 1 for indoors, Type 4, Type 3R Stainless Steel, or better for outdoors.

H. Cabinet Front: Surface door-in-door type, fastened with screws, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel – NC16.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, current carrying components. Furnish copper ground bus in each panelboard with full sized neutral; furnish insulated ground bus.

D. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panelboards; 42,000 amperes min, rms symmetrical for 480 volt panelboards.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, Type 1 or for indoor, or NEMA 4, Type 3R Stainless Steel, or better for outdoors.

H. Cabinet Box: 6 inches deep, 20 inches inches wide for 240 volt and less panelboards, 20 inches inches wide for 480 volt panelboards. Surface mounted.

I. Cabinet Front: Flush or Surface cabinet, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel. No concealed trim clamps.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb.

C. Install recessed panelboards flush with wall finishes.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Refer to LAWA standard before revising directory to reflect circuiting changes to balance phase loads.

G. Install engraved nameplates per LAWA standards.

H. Install spare conduits out of each recessed panelboard to accessible location above ceiling or below floor. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

I. Ground and bond panelboard enclosure. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 26 24 16

SECTION 26 24 16-PANELBOARDS

PART 1 – GENERAL

NOTE: For all panelboards above 800A, use switchboards.

1.1 SUMMARY

A. Section includes distribution and branch circuit panelboards.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
6. NEMA PB 1 - Panelboards.
7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:

1. UL 67 - Safety for Panelboards.
2. UL 1283 - Electromagnetic Interference Filters.
3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

B. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. The manufacturer of the panelboard shall be the same manufacturer of the major components within the assembly, including circuit breakers and fusible switches.

1.6 MAINTENANCE MATERIALS

A. Furnish two of each panelboard key. Panelboards keyed alike to LAWA's current keying system.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

> **NOTE:** Due to the corrosive exterior environment at the airport, <u>all</u> panelboards are to be located indoors, as much as possible. In the event that an exterior installation is the only option, <u>all</u> exterior panelboards are to be a **<u>NEMA Type 4, Type 3R Stainless Steel, or better.</u>**

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA PB 1, circuit breaker type panelboard.

C. Panelboard Bus: Copper, current carrying components, and furnish copper ground bus in each panelboard.

D. Minimum integrated short circuit rating: Amperes rms symmetrical shall be 42,000A rms symmetrical. Panelboards shall be fully rated; series rated equipment is not acceptable. The short circuit rating of the equipment shall exceed 130% of the available short circuit current at the equipment.

E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

F. Circuit Breaker Accessories: Trip units and auxiliary switches.

G. Enclosure: NEMA PB 1, Type 1 for indoors, Type 4, Type 3R Stainless Steel, or better for outdoors.

H. Cabinet Front: Surface door-in-door type, fastened with screws, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel – NC16.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, current carrying components. Furnish copper ground bus in each panelboard with full sized neutral; furnish insulated ground bus.

D. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208 volt panelboards; ~~42,000~~ 14,000 amperes min, rms symmetrical for 480 volt panelboards. Panelboards shall be fully rated; series rated equipment is not acceptable. The short circuit rating of the equipment shall exceed 130% of the available short circuit current at the equipment.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers. Do not use tandem circuit breakers.

G. Enclosure: NEMA PB 1, Type 1 or for indoor, or NEMA 4, Type 3R Stainless Steel, or better for outdoors.

H. Cabinet Box: 6 inches deep, 20 inches inches wide for 240 volt and less panelboards, 20 inches inches wide for 480 volt panelboards. Surface mounted.

I. Cabinet Front: Flush or Surface cabinet, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel. No concealed trim clamps.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.

B. Install panelboards plumb.

C. Install recessed panelboards flush with wall finishes.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Refer to LAWA standard before revising directory to reflect circuiting changes to balance phase loads.

G. Install engraved nameplates per LAWA standards.

H. Install spare conduits out of each recessed panelboard to accessible location above ceiling or below floor. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

I. Ground and bond panelboard enclosure. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 26 24 16

SECTION 26 24 19-MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes motor control centers.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
5. NEMA ICS 3 - Industrial Control and Systems: Factory Built Assemblies.
6. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
7. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
8. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
9. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time and current curves of equipment and components.

B. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.

C. Submit dimensioned room layout complete with all equipment shown to scale.

D. Submit control schematics for each starter within.

E. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations, configurations, and ratings of motor control centers and major components.

B. Operation and Maintenance Data: Submit replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

PART 2 - PRODUCTS

2.1 MOTOR CONTROL CENTER

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA ICS 3, Class I, Type B heavy duty, industrial grade motor control center.

C. Service Conditions: NEMA ICS 2.

D. Main Overcurrent Protection: Molded case circuit breaker.

E. Feeder Tap Units: Molded case thermal-magnetic circuit breakers.

F. Voltage Rating: 480 or 120/208 volts, three phase, three or four wire, 60 Hertz.

G. Horizontal Bus: Copper, with continuous current rating. Include copper ground bus entire length of control center.

H. Vertical Bus: Copper.

I. Configuration: Units front mounting only, accessible from front only.

J. Enclosure: NEMA ICS 6, Type 1 or 3R, non-walk-in or 3R, walk-in or 12.

K. Finish: Manufacturer's standard gray enamel.

L. All indicating and pilot lights shall be LED with metal housing and easily replaceable parts.

M. All control wiring shall be installed in Panduit wiring ducts. Control wiring shall be stranded copper.

2.2 FULL-VOLTAGE NON-REVERSING CONTROLLERS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

C. Overload Relay: NEMA ICS 2; bimetal or melting alloy.

D. Product Options and Features:

1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
4. Pushbuttons: Unguarded type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type, Hand-Off-Auto.
7. Relays: NEMA ICS 5.
8. Control Power Transformers: In each motor controller as scheduled. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.3 TWO-SPEED CONTROLLERS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Include integral time delay transition between FAST and SLOW speeds.

C. Control Voltage: As required.

D. Overload Relay: NEMA ICS 2; bimetal or melting alloy.

E. Product Options and Features:

1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
4. Pushbuttons: Unguarded type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type, with “High-Low”.
7. Relays: NEMA ICS 5.
8. Control Power Transformers: In each motor controller as scheduled. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.4 FULL-VOLTAGE REVERSING CONTROLLERS

A. Manufacturers:

1. **Cutler-Hammer.**
2. **GE Electrical.**
3. **Square D.**

B. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.

C. Control Voltage: As required.

D. Overload Relay: NEMA ICS 2; bimetal or melting alloy.

E. Product Options and Features:

1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
4. Pushbuttons: Unguarded type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type.
7. Relays: NEMA ICS 5.

8. Control Power Transformers: In each motor controller as scheduled. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.5 MOLDED CASE CIRCUIT BREAKER

A. Manufacturers:

   1. Cutler-Hammer.
   2. GE Electrical.
   3. Square D.

B. Product Description: NEMA AB 1, molded-case circuit breaker.

C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting long time, short time, continuous current and long time pickup current setting for automatic operation.

2.6 SOURCE QUALITY CONTROL

A. Shop inspect and perform standard productions tests for each controller in accordance with manufacturer's standards.

B. Make completed motor control center available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces are suitable for motor control center installation.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.16.

C. Inspect and test variable frequency controllers according to NEMA ICS 7.1.

3.3 INSTALLATION

A. Install engraved nameplates.

B. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage rating, and phase rating. Place label in clear plastic holder.

C. Ground and bond motor control centers.

D. Provide wire markers or tags for all control wiring at all termination points. See Identification for Electrical Systems.

E. Each plug-in unit shall control only one motor, no dual starters.

F. Provide a circuit breaker for the unit disconnect device, not a fusible switch.

G. Provide side mounted, latched pull-apart terminal blocks for all remote control wiring. Provide 25% spare terminals.

H. No interlock for A-B motor configuration.

I. Overload reset button shall be operable without wires blocking access.

J. Wire ties shall be attached to the unit with screws or epoxy, not adhesive tape.

END OF SECTION 26 24 19

SECTION 26 25 00 - ENCLOSED BUS ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes busway and fittings.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA BU 1 - Busways.
3. NEMA BU 1.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less.
4. NEMA FU 1 - Low Voltage Cartridge Fuses.
5. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
6. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
7. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Shop Drawings: Indicate ratings, dimensions and finishes. Include dimensioned layout diagram; installation details; locations of supports and fittings; and firestops and weatherseals at penetrations. Include details of wall and floor penetrations. Include isometric layouts/views of bus duct configuration.

B. Product Data: Submit catalog data for components.

C. Coordination Drawings: Indicate busway layout and support locations.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of busway routing.

B. Operation and Maintenance Data: Submit joint re-tightening schedule.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

C. All busway components shall be of the same manufacturers as the busway.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle in accordance with NEMA BU 1.1 and manufacturer's written instructions.

B. Protect from moisture by using appropriate coverings. Store in dry interior locations.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install indoor busway until building is closed in and suitable temperature conditions are controlled.

B. Conform to NEMA BU 1 service conditions during and after installation of busway.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 SEQUENCING

A. Sequence Work to avoid interferences with building finishes and installation of other products.

PART 2 - PRODUCTS

2.1 BUSWAY

A. Manufacturers:

1. **Cutler Hammer.**
2. **General Electric.**
3. **Square D.**

B. Product Description: NEMA BU1, 3 phase, 4wire enclosed busway. Indoor: Sprinkler proof. Outdoor; NEMA 3R. Feeder type or plug-in type as applicable or as required.

1. Voltage: 277/480 volts, 60 Hz, or as required.
2. Ampere Ratings: As required.
3. Full neutral.
4. Insulated ground bus.

C. Conductors: Copper bars, fully insulated except at joints.

D. Joints: Single bolt type, with silver-plated contact surface for bus and splice plate.

E. Fittings: According to manufacturer's recommendations.

F. Finish: Manufacturer's standard gray enamel.

2.2 SOURCE QUALITY CONTROL

A. Inspect and test according to NEMA BU1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with NEMA BU1.1.

B. Tighten joints using torque wrench, to manufacturer's specified values.

C. Install busway length with expansion fitting at each location where busway run crosses building expansion joint.

D. Support busway at maximum 10 feet intervals or as recommended by manufacturer. Support vertical riser at each floor.

E. Install busway with integral fire stops located where busway penetrates fire-rated walls and floors. Seal around opening to maintain fire-rating equal to wall or floor rating.

F. Install concrete curb around interior floor penetrations.

G. Install engraved nameplates.

H. Ground and bond busway.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.4.

END OF SECTION 26 25 00

SECTION 26 27 16 - ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

A. Furnish two of each key.

PART 2 - PRODUCTS

> **NOTE:** Due to the corrosive exterior environment at the airport, all electrical cabinets and enclosures are to be located indoors, as much as possible. In the event that an exterior installation is the only option, these items are to be a **NEMA Type 4x – Stainless Steel.**

2.1 HINGED COVER ENCLOSURES

A. Manufacturers:

1. **Hoffman Electrical Products.**
2. **Square D**
3. **General Electric**

B. Construction: NEMA 250, Type 1 for indoors or **4X stainless steel enclosure** for outdoor installations.

C. Covers: Continuous hinge, held closed by flush latch operable by key.

D. Furnish interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel.

E. Enclosure Finish: Manufacturer's standard enamel.

2.2 CABINETS

A. Manufacturers:

1. **Hoffman Electrical Products.**
2. **Square D.**
3. **General Electric.**

B. Boxes: Galvanized steel with removable end walls.

C. Backboard: Furnish 3/4 inch thick plywood backboard for mounting terminal blocks. Paint matte white.

D. Fronts: Steel, flush or surface type with screw cover front, door with concealed hinge. Finish with gray baked enamel.

E. Knockouts: as required for conduit entry.

F. Furnish metal barriers to form separate compartments wiring of different systems and voltages.

G. Furnish accessory feet for free-standing equipment.

2.3 TERMINAL BLOCKS

A. Terminal Blocks: NEMA ICS 4.

B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

D. Furnish ground bus terminal block, with each connector bonded to enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.

B. Install cabinet fronts plumb.

3.2 CLEANING

A. Clean electrical parts to remove conductive and harmful materials.

B. Remove dirt and debris from enclosure.

C. Clean finishes and touch up damage.

END OF SECTION 26 27 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes wall switches; wall dimmers; receptacles; multioutlet assembly; and device plates and decorative box covers.

> **NOTE:** The colors for all new wiring devices shall be compatible with the interior design aesthetic established for the public areas of the terminal.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.
2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

B. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.5 EXTRA MATERIALS

A. Furnish two of each style, size, and finish wall plate.

PART 2 - PRODUCTS

> **NOTE:** All wiring devices for emergency circuits shall be red.

2.1 WALL SWITCHES

A. Manufacturers:

1. **Leviton.**
2. **Hubbell.**
3. **Pass & Seymour.**

B. Product Description: NEMA WD 1 Industrial, Heavy-Duty, AC only general-use snap switch, Leviton Decora, or similar.

C. Indicator Light: Lighted handle type switch.

D. Locator Light: Lighted handle type switch; clear color handle.

E. Ratings:

1. Voltage: 120-277 volts, AC.
2. Current: 20 amperes.

2.2 WALL DIMMERS

A. Manufacturers:

1. **Hubbell.**
2. **Leviton.**
3. **Lutron.**

B. Product Description: NEMA WD 1, Type I semiconductor dimmer for incandescent lamps and for fluorescent lamps. Coordinate ballast type with dimmable fluorescent lamps.

C. Voltage: 120V or as required for application.

D. Power Rating: As required for application.

E. Accessory Wall Switch: Match dimmer appearance.

2.3 RECEPTACLES

A. Manufacturers:

1. **Hubbell.**
2. **Leviton.**
3. **Pass & Seymour.**

B. Product Description: NEMA WD 1, industrial, Heavy-duty and general-duty general-use receptacle, Leviton Decora or similar.

C. Configuration: NEMA WD 6, type as required.

D. Convenience Receptacle: Type 5-20.

E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.4 WALL PLATES

A. Manufacturers:

1. Hubbell.
2. Pass & Seymour.
3. Leviton.

B. Indoor Cover Plate: Stainless Steel, for indoor switches, dimmers and receptacles.

C. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover for outdoor wiring devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and completely covered by wall plates.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install devices plumb and level.

B. Install switches with OFF position down.

C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Install receptacles with grounding pole on top.

F. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

G. Install cover plates on switch, dimmer, receptacle, and blank outlets in all areas.

H. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

1. Use jumbo size plates for outlets installed in masonry walls.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas and above accessible ceilings.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes to obtain required mounting heights.

B. Install wall switch 48 inches above finished floor, unless otherwise noted.

C. Install convenience receptacle 18 inches above finished floor, unless otherwise noted.

D. Install convenience receptacle 6 inches above back splash of counter.

E. Install dimmer 48 inches above finished floor, unless otherwise noted.

3.5 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fuses.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 DESIGN REQUIREMENTS

A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.

B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

1.4 FUSE PERFORMANCE REQUIREMENTS

A. Motor Load Feeder Switches: Class RK1 (time delay).

B. General Purpose Branch Circuits: Class RK1 (time delay).

C. Motor Branch Circuits: Class RK1 (time delay).

1.5 SUBMITTALS

A. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 MAINTENANCE MATERIALS

A. Furnish two fuse pullers for each type of fuses.

PART 2 - PRODUCTS

2.1 FUSES

A. Manufacturers:

1. **Bussman**
2. **Gould.**
3. **Littlefuse.**

B. Dimensions and Performance: NEMA FU 1, Class as required.

C. Voltage: Rating suitable for circuit phase-to-phase voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuse with label oriented so manufacturer, type, and size are easily read.

B. Install spare fuse cabinet.

END OF SECTION 26 28 13

SECTION 26 28 19 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fusible and non-fusible switches.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.
2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
2. Underwriters Laboratory, Inc. (UL).

a. 98 B Enclosed and Dead-Front Switches,
b. 198C B High Interrupting Capacity Fuses, Current Limiting Types.
c. 198E B Class R Fuses.
d. 512 B Fuseholders.

1.3 SUBMITTALS

A. Product Data: Submit switch ratings and enclosure dimensions.

B. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:

1. **General Electric.**
2. **Cutler Hammer.**
3. **Square D.**

B. Product Description: NEMA KS 1, Type HD, quick-make/quick break with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Fuse clips: Designed to accommodate NEMA FU 1.

D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4, Type 3R Stainless Steel, or better.

E. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:

1. **General Electric.**
2. **Cutler Hammer.**
3. **Square D.**

B. Product Description: NEMA KS 1, Type HD quick make/quick-break with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4, Type 3R Stainless Steel, or better.

D. Furnish switches with entirely copper current carrying parts.

2.3 SWITCH RATINGS

A. Switch Rating: Number of poles, voltage, current and horsepower rating as required for particular installation.

B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches plumb. Provide supports.

B. Height: 5 feet to operating handle.

C. Install fuses for fusible disconnect switches.

D. Install engraved nameplates.

E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 26 28 19

SECTION 26 28 23 - ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes molded-case and insulated-case circuit breakers in individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. 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.

B. AIC ratings shown on the single line diagrams are approximate values only. The AIC ratings of all submitted equipment must conform to the approved Short Circuit and Overcurrent Protective Device Coordination Study.

C. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

D. Product Data: Submit catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and continuous current ratings of enclosed circuit breakers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 MOLDED CASE CIRCUIT BREAKER

A. Manufacturers:

1. **General Electric.**
2. **Cutler Hammer.**
3. **Square D.**

B. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1 and FS-W-C

C. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 400 amperes and larger have mechanism for adjusting long time, short time, continuous current setting for automatic operation.

D. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.

E. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; instantaneous trip; and adjustable short time trip.

F. Accessories: Conform to NEMA AB 1.

NOTE: Accessories will be dependent on the system design.

1. Shunt Trip Device: 120 volts, AC.
2. Undervoltage Trip Device: 120 volts, AC.
3. Auxiliary Switch: 120 volts, AC.
4. Alarm Switch: 120 volts, AC.
5. Electrical Operator: 120 volts, AC.
6. Handle Lock: Provisions for padlocking.

G. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4, Type 3R Stainless Steel, or better.

H. Series Rating: Series rated breakers shall not be used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements.

C. Verify that required utilities are available, in proper location and ready for use.

D. Beginning of installation means that installer accepts conditions.

3.2 INSTALLATION

A. Install enclosed circuit breakers plumb. Provide supports.

B. Height: 5 feet to operating handle.

C. Locate and install engraved nameplates.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.

3.4 ADJUSTING

A. Adjust trip settings to coordinate circuit breakers with other overcurrent protective devices in circuit.

B. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

END OF SECTION 26 28 23

SECTION 26 28 26 - ENCLOSED TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes transfer switches in individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Underwriters Laboratories Inc.:

1. UL 1008 - Transfer Switch Equipment.

1.3 SUBMITTALS

A. 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.

B. AIC ratings shown on the single line diagrams are approximate values only. The AIC ratings of all submitted equipment must conform to the approved Short Circuit and Overcurrent Protective Device Coordination Study.

C. The electrical contractor shall submit 3@=1=0@ scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

D. Product Data: Submit catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, control schematics, short circuit ratings, dimensions, and enclosure details.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of enclosed transfer switches.

B. Operation and Maintenance Data: Submit routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

1.6 MAINTENANCE SERVICE

A. Furnish service and maintenance of transfer switches for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH

A. Manufacturers:

1. **Russelectic Inc.**
2. **ASCO.**
3. **Onan.**

B. Manufacturer

1. The combination transfer bypass/isolation switch manufacturer shall employ a nationwide factorydirect, field service organization, available on a 24-hour a day, 365 days a year, call basis.
2. The manufacturer shall maintain records of each combination transfer bypass/isolation switch, by serial number, for a minimum 20 years.

C. Product Description: Automatic transfer switch with by-pass isolation switches.

D. Rating: State voltage and current rating and number of poles.

E. Interrupting Capacity: As required from coordination study.

2.2 CONSTRUCTION

A. General

1. The automatic transfer switch (ATS) and its associated bypass/isolation (BPS) shall be furnished. Voltage and continuous current ratings and number of poles shall be as required.
2. All ATS shall be a true 4-pole switch supplied with all four poles mounted on a common shaft as a 3 pole switch. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.
3. The combination automatic transfer bypass/isolation switch shall be mounted in a freestanding NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12-gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008.
4. Both units shall be bused together with silver plated copper bus and/or cable interconnection bus to provide a complete pre-tested assembly. Construction shall be such that the contractor needs to install only the power and control connections.
5. Bypass/isolation switches shall provide a safe and convenient means for manually bypassing and isolating the automatic transfer switch, regardless of the condition or position of the ATS, with the ability to be used as an emergency back-up system in the event the transfer switch should fail. In addition, the bypass/isolation switch shall be utilized to facilitate maintenance and repair of the automatic transfer switch.
6. The automatic transfer switch shall be completely isolated from the bypass/isolation switch by means of insulating barriers and separate access doors to positively prevent hazard to operating personnel while servicing the automatic transfer switch.
7. The combination automatic transfer bypass/isolation switch shall be top and bottom accessible.
8. The main contacts shall be capable of being replaced without removing the main power cables.
9. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.
10. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.
11. The complete combination automatic transfer bypass/isolation switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

B. Bypass/Isolation Construction

1. All main contacts and operating linkages of the bypass/isolation section shall be identical to the ATS, except that the operation shall be manual.
2. The bypass/isolation switch shall be load break type and shall have the same electrical ratings of ampacity, voltage, short circuit withstand, and temperature rise capability as the associated ATS. The bypass/isolation switch shall be the load-break type. The main contacts of the bypass switch shall be mechanically locked in both the normal bypass and emergency bypass positions without the use of hooks, latches, magnets, or springs and shall be silver-tungsten alloy,

protected by arcing contacts with magnetic blowouts on each pole. The switching mechanism shall provide "quick-make", "quick-break" operation of the contacts.

3. The primary buss work of the draw-out automatic transfer switch shall be connected to the stationary bus stabs in the freestanding cubicle by silver plated, segmented, self-aligning, primary disconnect fingers to facilitate proper alignment between the removable draw-out when the ATS is withdrawn and shall be available for inspection without disturbing or de-energizing the main bus.
4. The secondary control disconnect contacts mounted on the ATS shall be self-aligning and shall plug into the stationary elements mounted on the freestanding cubicle. Separate, manual, secondary control disconnect plugs are not acceptable.
5. The isolating portion of the bypass/isolation shall allow the automatic transfer switch to be disconnected from all sources of power and control without opening the enclosure door. The transfer switch shall have a true draw-out configuration that does not require disconnection of any electrically or mechanical device by maintaining personnel. The automatic transfer switch shall be provided with rollers or casters to allow it to be removed from its enclosure simply by rolling it out. Positive mechanical interlocks shall be provided to insure that the bypass/isolation functions can be accomplished without the danger of a short circuit. Overlapping contact bypass/isolation switches, that are dependent upon the position of the automatic transfer switch for proper operation, are not acceptable.
6. A fourth pole, switched neutral shall be provided if the associated automatic transfer switch is designed as 4-pole. Basic 4-pole, bypass/isolation switch construction shall be identical to the associated automatic transfer switch construction.
7. Necessary controls shall be provided to ensure that the "engine run" circuit remains closed when the switch is in the bypass-to-emergency position, even though the associated transfer switch is in the "normal" position or completely removed from the enclosure.

C. Automatic Transfer Switch

1. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.
2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable.
3. The transfer switch shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The external

manual operator shall be safely operated from outside of the transfer switch enclosure while the enclosure door is closed.

D. Automatic Transfer Switch Controls

1. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have two asynchronous serial ports. The controller shall have a real time clock with NiCad battery back up.
2. The CPU shall be equipped with self diagnostics which perform periodic checks of the memory I/O and communication circuits, with a watchdog/power fail circuit
3. The controller shall use industry standard open architecture communication protocol for highspeed serial communications via multi-drop connection to other controllers and to a master terminal with up to 4000 ft of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.
4. The serial communication port shall allow interface with the manufacturer field service representative and BMS network.
5. The controller shall have password protection required to limit access to qualified and authorized personnel.
6. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.
7. The controller shall include three-phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
8. The controller shall be capable of storing the following records in memory for access either locally or remotely:

    a. Number of hours transfer switch is in the emergency position (total since record reset).
    b. Number of hours emergency power is available (total since record reset).
    c. Total transfer in either direction (total since record reset).
    d. Date, time, and description of the last four source failures.
    e. Date of the last exercise period.
    f. Date of record reset.

9. The controller shall also be capable of monitoring, logging and trending power data and shall include the following:

    a. The controller shall be accurate to 1% measured. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics). The controller shall be capable of operating at nominal frequencies of 45 to 66 Hz.
    b. The controller shall accept inputs from industry standard current transformers (5A secondary). Direct phase voltage connections, 600 VAC and under, shall be possible without the use of PT=s.
    c. The controller shall be capable of being applied in single or 3-phase, three and four wire circuits.

d. The controller shall use industry standard open architecture communication protocol for serial communications via multi-drop connection to other controllers and to a master terminal with up to 4000 feet of cable, or further, with the addition of a communication repeater. The serial communication port shall be RS422/485 compatible.

e. All setup parameters required by the controller for power monitoring shall be stored in nonvolatile memory and retained in the event of a control power interruption.

f. The following metered readings shall be communicated by the Controller, via local display and serial communication. And to the master Control Cubicle at the Emergency Generator Control and Distribution Switch Gear:

(1) Current, per phase RMS and neutral
(2) Current Unbalance %
(3) Voltage, phase-to-phase and phase-to-neutral
(4) Voltage Unbalance %
(5) Real power (KW), per phase and 3-phase total
(6) Apparent power (KVA), per phase and 3-phase total
(7) Reactive power (KVAR), per phase and 3-phase total
(8) Power factor, 3-phase total & per phase
(9) Frequency
(10) Accumulated Energy, (KWH, KVAH, and KVARH)

g. Displaying each of the metered quantities shall be accomplished through the use of menu scroll buttons.

h. Setup for systems requirements shall be allowed through the local access display. Setup provisions shall include:

(1) CT rating
(2) System type (single; three phase, 3 or 4 wire)

i. Reset of the following electrical parameters shall also be allowed from the local access display:

(1) Real Energy (KWH)
(2) Apparent Energy (KVAH)
(3) Reactive Energy (KVARH)

j. All reset and setup functions shall have a means for protection against unauthorized/accidental changes.

k. The Controller shall be capable of storing records in memory for access either locally or remotely for up to 100 events. The reports shall include date, time and a description of the event and shall be maintained in a non volatile memory.

E. Sequence of Operation

1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increase to 110%, or 20%

voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.

2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.

F. Automatic Transfer Switch Accessories

1. Programmable three phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
2. Programmable three phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout out at 110% of rated voltage programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds, if not otherwise specified.
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.
5. Time delay on retransfer to normal, programmable 0-9999 seconds, factory set at 300 seconds if not otherwise specified, with overrun to provide programmable 0-9999 second time delay, factory set at 300 seconds, unloaded engine operation after retransfer to normal.
6. Time delay on transfer to emergency, programmable 0-9999 seconds, factory set at 3 seconds.
7. A maintained type load test switch shall be included to simulate a normal power failure.
8. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
9. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
10. Contact, rated 10 Amps 30 volts DC, to close on failure of normal source to initiate engine starting.
11. Contact, rated 10 Amps 30 volts DC, to open on failure of normal source for customer functions.
12. Light emitting diodes shall be mounted on the microprocessor panel to indicate:

switch is in normal position, switch is in emergency position and controller is running.

13. A plant exerciser shall be provided with (10) 7-day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise generating
14. Provision to select either "no commit" or "commit" to transfer operation in the event of a normal power failure shall be included. In the "no commit position," the load will transfer to the emergency position unless normal power returns before the emergency source has reach 90% of it's rated values (switch will remain in normal). In the "commit position" the load will transfer to the emergency position after any normal power failure. Keypad initiated.
15. Four auxiliary contacts rated 10 Amp, 120 volts AC (for switches 100 to 800 amps) 15 amp, 120 volts AC (for switches 1000 to 4000 amps), shall be mounted on the main shaft, two closed on normal, two closed on emergency. All contacts will be wired to a terminal strip for ease of customer connections.
16. A three phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.
17. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
18. An LCD readout shall display normal source and emergency source availability.
19. Include two time delay contacts that open simultaneously just (milliseconds) prior to transfer in either direction. These contacts close after a time delay upon transfer. Programmable 0-9999 seconds after transfer.
20. A block transfer function shall be included, energized from a 24 VDC signal from the generator control switchgear, to allow transfer to emergency.
21. A load-shed function shall be included, energized from a 24 VDC signal from the generator control switchgear, to disconnect the load from the emergency source when an overload condition occurs.

G. Bypass/Isolation Switch

1. Operation of the bypass/isolation shall be assured, regardless of the position of the automatic transfer switch.
2. Light emitting diodes shall be provided to indicate: bypass position, fully isolated position, and source availability.
3. Positive sequencing of all contacts, with no possible intermediate position, shall be accomplished through the manual operators from a dead front location. Electrical testing during maintenance of the automatic transfer switch shall be possible in the bypass position.
4. Inherent double-throw (break-before-make) operation shall provide positive assurance against accidental short circuitry of the normal and emergency power sources. Arrangements utilizing interlocking of single-throw devices are not acceptable. The operating speed of the contacts shall be independent of the speed at which the handle is moved.
5. The switch shall be fully manually operated and shall not be dependent upon electrical operators, relays, or interlocks for operation.
6. The bypass/isolation switch shall be listed by Underwriters= Laboratories, Inc., Standard UL-1008 and meet the identical withstand ratings of its associated transfer switch.

7. Both the automatic transfer switch and bypass/isolation switch shall be supplied by the same manufacturer. The manufacturer shall verify that the design has been in continuous production for not less than 10 years, with at least 100 similar installations operating continuously and successfully for that period of time.
8. Bypass/isolation switch must have mechanical separation of normal and emergency to assure against accidental connection of unsynchronized sources. Electrical interlocking will not be considered acceptable.

H. Approval

1. As a condition of approval, the manufacturer of the combination automatic transfer bypass/isolation switches shall verify that their switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3 cycle short circuit closing and withstand higher than available fault and minimum ratings as follows:

Root Mean Square (RMS) Symmetrical Amperes 480 VAC		
Current Limiting (Amperes)	Withstand & Closing Ratings (WCR) also: Maximum Coordinated Breaker Rating (Amperes)	Current Limiting Fuse Rating (Amperes)
100-400	42,000	200,000
600-800	65,000	200,000
1000-1200	85,000	200,000
1600-4000	100,000	200,000

2. The AIC ratings of automatic transfer switch shall exceed the available fault current.
3. During the 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle tests shall be performed without the use of current limiting fuses. The test shall verify that contact separation has not occurred, and there is contact continuity across all phases. Test procedures shall be in accordance with UL-1008, and testing shall be certified by Underwriters' Laboratories, Inc.
4. When conducting temperature rise tests to UL-1008, the manufacture shall include post-endurance temperature rise tests to verify the ability of the combination transfer bypass/isolation switch to carry full rated current after completing the overload and endurance tests.
5. The microprocessor controller shall meet the following requirements:

   a. Storage conditions - 25 degrees C to 85 degrees C
   b. Operation conditions - 20 degrees C to 70 degrees C ambient
   c. Humidity 0 to 99% relative humidity, non-condensing
   d. Capable of withstanding infinite power interruptions
   e. Surge withstand per ANSI/IEEE C-37.90A-1978

6. Manufacturer shall provide copies of test reports upon request.

2.3 SOURCE QUALITY CONTROL

A. Furnish shop inspection and testing of each transfer switch.

B. Make completed transfer switch available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install 4" concrete housekeeping pads.

B. Install engraved nameplates.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.3.

3.3 MANUFACTURER'S FIELD SERVICES

A. Check out transfer switch connections and operations and place in service.

3.4 ADJUSTING

A. Adjust control and sensing devices to achieve specified sequence of operation.

3.5 TRAINING

A. Demonstrate operation of transfer switch in normal and emergency modes to LAWA's staff to be trained.

B. Provide manuals for attendees.

C. Training shall be provided at times for each of 3 shifts.

END OF SECTION 26 28 26

SECTION 26 29 13 – ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA FU 1 - Low Voltage Cartridge Fuses.
3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
5. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
6. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

A. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, control schematics, dimensions, and enclosure details.

B. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and ratings of enclosed controllers.

B. Operation and Maintenance Data: Submit Replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 MANUAL MOTOR CONTROLLER

A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, one NO and one NC auxiliary contact, and toggle operator.

B. Enclosure: NEMA ICS 6, Type 1 or to meet conditions of installation. NEMA Type 4, Type 3R Stainless Steel, or better for outdoor installations.

2.2 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.

B. Enclosure: NEMA ICS 6, Type 1 or to meet conditions of installation.

2.3 MOTOR STARTING SWITCH

A. Product Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with red pilot light and toggle operator.

B. Enclosure: NEMA ICS 6, Type 1 or to meet conditions of installation. NEMA Type 4, Type 3R Stainless Steel, or better for outdoor installations.

2.4 FULL-VOLTAGE AND REDUCED VOLTAGE NON-REVERSING CONTROLLERS

A. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.

B. Control Voltage: as required.

C. Overload Relay: NEMA ICS 2; melting alloy. D.Product Features:

1. Auxiliary Contacts: NEMA ICS 2, with 4 each normally closed field convertible contacts in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

4. Pushbuttons: Shielded, Covered and Lockable type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type.
7. Relays: NEMA ICS 2.
8. Control Power Transformers: 120 volt secondary. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
9. Reduced-Voltage starters to have delta/wye wiring arrangement.

E. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

F. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.

1. Interior Dry Locations: Type 1.
2. Exterior Locations: Type 4, Type 3R Stainless Steel, or better.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed controllers plumb. Provide supports.

B. Height: 5 feet to operating handle.

C. Install fuses for fusible switches.

D. Select and install overload heater elements in motor controllers to match installed motor characteristics.

E. Install engraved nameplates.

F. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION 26 29 13

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes engine generator set, exhaust silencer and fittings, fuel fittings and sub base tank, remote control panel, battery, and charger.

NOTE: All generators shall be located outdoors. New underground fuel tanks are **not** allowed at the airport.

1.2 REFERENCES

A. National Electrical Manufacturers Association

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
3. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
4. NEMA MG 1 - Motors and Generators.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 30 - Flammable and Combustible Liquids Code.
2. NFPA 110 - Standard for Emergency and Standby Power Systems.

1.3 SYSTEM DESCRIPTION

A. Description: Engine generator assembly and accessories to provide source of power for Level 1 and 2 applications in accordance with NFPA 110.

B. Capacity: As required with standby rating using specified engine cooling scheme.

C. Diesel generator muffler, flex and mounting hardware.

D. 8 hour minimum fuel capacity with dual wall sub-base fuel storage tank. Tank shall be constructed of corrosion resistance steel material.

E. Provide engine generators approved by SCAQMD and local environmental agency for use as emergency backup and Tier 4 regulations compliance.

1.4 SUBMITTALS

A. Shop Drawings: Indicate electrical characteristics and connection requirements. Include plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

B. Product Data: Submit data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, transfer switch, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, and remote radiator.

C. Test Reports: Indicate results of performance testing.

D. Manufacturer's Field Reports: Indicate inspections, findings, and recommendations.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions and service manuals for normal operation, routine maintenance, oil sampling and analysis for engine wear, and emergency maintenance procedures. Include list of spare parts.

1.6 FACTORY PROTOTYPE TESTING

A. The system manufacturer must certify that engine, generator and controls have been tested as a complete system of representative engineering models (not on equipment sold). The manufacturer shall supply equipment that is a current factory standard production model.

B. Prototype testing shall include:

1. Fuel consumption at 1/4, 1/2, 3/4 and full load.
2. Exhaust emissions.
3. Mechanical and exhaust noise.
4. Governor speed regulation at 1/4, 1/2, 3/4 and full load; and during transients
5. Motor starting kVA.
6. Generator temperature rise in accordance with NEMA MG1-22.40 and 16.40
7. Harmonic analysis, voltage waveform deviation and telephone influence factor.
8. Generator short circuit capability.
9. Cooling system performance.
10. 3 phase short circuit tests.
11. Maximum power (kW)
12. Generator revolving field assembly for 2 hours at 2700 rpm (150% overspeed) and 70 degrees C and each production unit tested at 2250 rpm (125% overspeed) at room temperature.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.

B. Supplier: Authorized distributor of specified manufacturer with minimum ten years documented experience.

1.8 WARRANTY

A. Five Year Manufacturer Warranty: The manufacturer’s standard warranty shall in no event be for a period of less than five years form date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing distributor. An extended warranty for an additional five years shall be offered as an option. Submittals received without written warranties as specified will be rejected in their entirety.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of engine generators for five years from Date of Substantial Completion.

1.10 MAINTENANCE MATERIALS FOR EACH ENGINE GENERATOR

A. Furnish one set of tools required for preventative maintenance of engine generator system. Package tools in adequately sized metal tool box.

B. Furnish two of each fuel, oil and air filter element.

PART 2 - PRODUCTS

2.1 ENGINE

A. Manufacturers:

1. **Caterpillar.**
2. **Kohler.**
3. **Cummins.**

B. Product Description: Air-cooled in-line or V-type, four-stroke cycle, compression ignition Diesel internal combustion engine.

C. Rating: Sufficient to operate under 10 percent overload for one hour in ambient of 90 ° F.

D. Fuel System: No. 2 fuel oil.

E. Engine speed: 1800 rpm.

F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.

G. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Furnish remote starting control circuit, with MANUALOFF-REMOTE selector switch on engine-generator control panel.

H. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 or 208 volts AC.

I. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.

J. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Furnish fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.

K. Mounting: Furnish unit with suitable spring-type vibration isolators and mount on structural steel base.

2.2 GENERATOR

A. Manufacturers:

1. As provided by engine generator manufacturer.

B. Product Description: NEMA MG1, three phase, four pole, reconnectable brushless synchronous generator with brushless exciter.

NOTE: Generator voltage, ampere and power factor ratings are required to be shown on the drawings.

C. Insulation: The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F. The excitation system shall be of brushless construction.

D. Temperature Rise: 80 degrees C Standby, maximum as measured by resistance and based on 40 degrees C ambient temperature.

E. Enclosure: NEMA MG1, open drip proof

F. Total Harmonic Distortion (THD): Not to exceed three percent.

G. Telephone Influence: Below 50.

H. Exciter (Self-Excited): The self-excited, brushless exciter shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes.

I. Automatic Voltage Regulator: The digital automatic voltage regulator (DVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, over excitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

2.3 GOVERNOR

A. Manufacturers:

1. As provided by engine generator manufacturer.

B. Product Description: Isochronous governor to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

2.4 CIRCUIT BREAKER

A. Circuit Breaker Specifications: Provide a generator mounted circuit breaker, molded case or insulated case construction, rating as indicated. Breaker shall itilze a thermal megneic trup unit and 24VDC shunt trip. The breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Breaker shall be set to protect the generator from short circuit damage. Breaker shall be housed in an extension terminal box mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders, shall be supplied on the load side of breaker.

B. Provide an additional circuit breaker for the radiator mounted load bank.

2.5 CONTROL PANEL

A. Generator Mounted Control Panel: Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation; adjustable cycle cranking, digital AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cool down timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.

B. Digital Readouts: Provide the following digital readouts:

1. Engine oil pressure
2. Coolant temperature
3. Engine RPM
4. System DC Volts
5. Engine running hours
6. Generator AC volts
7. Generator AC amps
8. Generator frequency
9. KW meter
10. Percentage of rated Power
11. KVA meter
12. KVAr meter
13. Power Factor meter
14. KWHR meter

C. Alarm NFPA 110: Provide the following indications for protection and diagnostics according to NFPA 110 level 1:

1. Low oil pressure
2. High water temperature
3. Low coolant level
4. Overspeed
5. Over crank
6. Emergency stop depressed
7. Approaching high coolant temperature
8. Approaching low oil pressure
9. Low coolant temperature
10. Low voltage in battery
11. Control switch not in auto. position
12. Low fuel main tank
13. Battery charger ac failure
14. High battery voltage
15. EPS supplying load
16. Basemounted tank low fuel level
17. Basemounted tank high fuel level
18. Spare

D. Remote Annunciator NFPA 110: Provide one remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator will be installed by contractor.

The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.

> **NOTE:** The location of the remote annunciator shall be clearly identified on the electrical and architectural drawings.

E. Programmable Control Panel: Provide programmable protective relay functions inside the control panel to include the following:

1. Undervoltage
2. Overvoltage
3. Over frequency
4. Under frequency
5. Reverse power
6. Overcurrent (phase and total)
7. KW level (overload)
8. Three spare LED's
9. Four spare inputs

2.6 FUEL SYSTEM

A. Fuel Filter: Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.

B. Fuel Piping: All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted.

C. Fuel Line Rating: Flexible fuel lines rated 300 degrees F and 100 PSI.

D. Sub-Base Fuel Tank.

2.7 SUB-BASE FUEL TANK

A. Manufacturers:

1. IBI
2. International Supply Co.
3. Tramont

A. Provide a sub-base <u>concrete encased</u> fuel tank for the generator set, sized to allow 8 hours of operation.

1. All Protected Base Tanks are UL Secondary Containment list and labeled. It is comprised of a UL142 steel tank, surrounded by a minimum of 6” light weighted insular concrete, enclosed by a UL142 steel outer shell with a interstitial monitoring tube. All steel tanks are tightness tested at the manufacturer’s facility,

in accordance with testing procedures specified by UL142 for AST's, and meet UL requirements for standard and emergency venting. The interior of the primary tank has been cleaned and free of any loose material, mill scale, or debris. Sub base tanks are UL 2085 listed for the UL 2 hour fire burn test. Tanks must be ballistic and impact rated per UL 2085 specification.

2. The base tank shall be furnished as a complete, factory assembled and tested assembly and listed as an assembly by Underwriters Laboratories, to UL 142 and UL 2085 factory installed.
3. Primary tanks shall be of minimum thickness per UL 142. Inner tanks will be of rectangular configuration per UL standard 142. All welds must comply with AWS, and ASME IX and ASME B31.1.
4. Secondary containment consists of UL 142 primary tank, completely enclosed by a UL 142 secondary containment tank, which is 110% of the primary. Primary and secondary tank will be Rectangular in configuration. Both tanks are pressure tested to between 3PSI and 5PSI per UL requirements. Insulation material will be of a lightweight concrete design. Concrete will be poured in a monolithic method to eliminate voids. The minimum insulation thickness will be 6". The exterior of the tank will be steel.
5. All tank systems and sub-assemblies shall be installed in strict accordance with the manufacturer's recommendations and applicable fire and environmental codes.
6. All tanks are primed with a Rustoleum Shop Coat Enamel. Top coat is an Alkyd High Gloss Enamel paint (Sherwin WilliamsSW6004 Mink.)
7. All tanks to be installed on reinforced engineered concrete slab. Protective barriers shall be installed as required by state and local codes.
8. Tanks shall be marked on a visible side with "Flammable", "Combustible", and "No Smoking", product identification, and other signs as required by state and local codes.
9. The system installation (end user) shall be inspected and approved by the system installer or its certified contractor. The system installer shall submit a comprehensive checklist of quality and safety items associated with the installation of the system and its sub-assemblies to verify that the installation is in compliance with applicable local fire and environmental codes.

B. Features

1. Emergency tank and basin vents.
2. Mechanical level gauge.
3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA requirements.
4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
5. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.
6. Basin drain.
7. Integral lifting provisions

2.8 TIER 4 COMPLIANT CATALYTIC EXHAUST TREATMENT SYSTEM

A. Provide and install as per manufacturer recommendations.

B. Silencer: A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Mounting shall be provided by the contractor. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer.

C. Exhaust System: The muffler and all indoor exhaust piping shall be "lagged" by the contractor to maintain a surface temperature not to exceed 150 degrees F. The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting.

D. Muffler shall be critical type similar to Nelson-300 or equal. Provide engine exhaust roof thimbles with flexible tubes and pipes as required.

2.9 STARTING SYSTEM

A. Starting Motor: The engine shall be started by two 24 V DC electric starting motors. Crank termination switch and 24 V DC fuel solenoid valve shall be provided for remote automatic start/stop capability.

B. Jacket Water Heater: A unit mounted forced circulation type water heater. The heater Watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F, and shall be a 480 volt, three phase, 60 hertz.

C. Batteries: Lead acid batteries of sufficient capacity for four 15 second crank periods with 10 second rest intervals shall be furnished. Battery voltage of 24 V DC shall be derived from four 12 V DC, 205 amp hour high performance batteries, dry charged. Two battery interconnection cables and four battery-tostarter cables.

1. Battery Trays: A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.
2. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. Ac input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be no less than ten (10) amperes. Charger shall be wall-mounting type in NEMA 1 enclosure.

2.10 RADIATOR MOUNTED LOAD BANK

A. Furnish a continuous duty load bank, complying with UL 508A, mounted directly on the skid base, on the exhaust side of the radiator, complete with all necessary pilot and power control, wiring and devices to furnish a functional system for the intended use. Load bank shall comply with all applicable NEMA, NEC and ANSI Standards. Load bus configuration and load terminations shall be clearly identified.

B. The load bank shall have the capability of maintaining a constraint load for the Emergency Power Supply Source (EPSS), during both exercising and actual use condition. Rating shall be a minimum of 100% of the generator output rating and matched to the EPSS voltage. Load steps at a minimum of three (3) incremental loads, manually controlled.

C. Enclosure shall be suitable for installation on the exhaust side of the engine radiator. It shall match dimensionally the radiator's duct flange height and width without adaptive duct work. The control section shall have a hinged and gasketed access door(s).

D. Manufacturer shall be Avtron load bank K-711 Series, or equal.

E. Construction shall be aluminum or galvanized steel. All fasteners shall be stainless steel. Load elements shall be helically wound and rated to operate at 50% of the maximum continuous wire rating. Each 50 kW element shall have current limiting fuses. (Furnish three (3) sets of three (3) fuses as spares.)

2.11 VIBRATION ISOLATORS FOR EACH ENGINE GENERATOR

A. For unit to base provide spring type with neoprene acoustical pads, leveling devices and vertical limit stops. Minimum static deflection shall be 1 inch.

B. For base to concrete pad spring mountings, provide adjustable type to provide minimum clearance of 4 inches between structural base and floor, with alignment and lift off restraints.

C. Provide for engine-generator set base, engine-generator set base and remote radiator and silencer and exhaust pipe.

2.12 SPARE PARTS

A. Deliver 1 set of filter elements (air, fuel and oil), complete set of fuses, for each size used and one belt for every belt drive to LAWA at final acceptance.

2.13 ENCLOSURE

A. Provide a weather proof enclosure.

NOTE: Acoustic mitigation measures may be required due to the generator's proximity to acoustically sensitive areas such as, but not limited to, office areas, conference rooms. etc..

2.14 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Make completed engine-generator assembly available for inspection at manufacturer’s factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer’s test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations, and all applicable codes.

B. Install engraved plastic nameplates.

C. Ground and bond generator and other electrical system components.

3.2 START-UP AND TESTING

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.

C. Coordinate all start-up and testing activities with LAWA.

D. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

1. Verify that the equipment is installed properly.
2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.
3. Test all alarms and safety shutdown devices for proper operation and annunciation.
4. Check all fluid levels.
5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
6. Verify proper voltage and phase rotation at the transfer switch before

connecting to the load.

7. Perform a 4-hour load bank test at .80 power factor at full nameplate load using a reactive load bank and cables supplied with the generator. Observe and record the following data at 15-minute intervals:

   a. Service meter hours
   b. Volts AC - All phases
   c. Amps AC - All phases
   d. Frequency
   e. Power factor or Vars
   f. Jacket water temperature
   g. Oil Pressure
   h. Fuel pressure
   i. Ambient temperature

8. Connect the generator to building load and verify that the generator will start and run all designated loads in the building.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare and start up engine-generator assembly.

3.5 ADJUSTING

A. Adjust generator output voltage and engine speed to meet specified ratings.

3.6 CLEANING

A. Clean engine and generator surfaces. Replace oil and fuel filters with new.

3.7 TRAINING

A. Furnish eight hours of instruction to be conducted at project site with manufacturer's representative to LAWA choice of staff to be trained. Provide training session for each of 3 shifts.

B. Describe loads connected to emergency and standby system and restrictions for future load additions.

C. Simulate power outage by interrupting normal source, and demonstrate system operates to provide emergency and standby power.

D. Provide manuals for attendees.

END OF SECTION 26 32 13

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes engine generator set, exhaust silencer and fittings, fuel fittings and sub base tank, remote control panel, battery, and charger.

NOTE: All generators shall be located outdoors. New underground fuel tanks are **not** allowed at the airport.

1.2 REFERENCES

A. National Electrical Manufacturers Association

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
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B. International Electrical Testing Association:

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C. National Fire Protection Association:

1. NFPA 30 - Flammable and Combustible Liquids Code.
2. NFPA 110 - Standard for Emergency and Standby Power Systems.

1.3 SYSTEM DESCRIPTION

A. Description: Engine generator assembly and accessories to provide source of power for Level 1 and 2 applications in accordance with NFPA 110.

B. Capacity: As required with standby rating using specified engine cooling scheme.

C. Diesel generator muffler, flex and mounting hardware.

D. 8 hour minimum fuel capacity with dual wall sub-base fuel storage tank. Tank shall be constructed of corrosion resistance steel material.

E. Provide engine generators approved by SCAQMD and local environmental agency for use as emergency backup and Tier 4 regulations compliance.

1.4 SUBMITTALS

A. Shop Drawings: Indicate electrical characteristics and connection requirements. Include plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

B. Product Data: Submit data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, transfer switch, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, and remote radiator.

C. Test Reports: Indicate results of performance testing.

D. Manufacturer's Field Reports: Indicate inspections, findings, and recommendations.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit instructions and service manuals for normal operation, routine maintenance, oil sampling and analysis for engine wear, and emergency maintenance procedures. Include list of spare parts.

1.6 FACTORY PROTOTYPE TESTING

A. The system manufacturer must certify that engine, generator and controls have been tested as a complete system of representative engineering models (not on equipment sold). The manufacturer shall supply equipment that is a current factory standard production model.

B. Prototype testing shall include:

1. Fuel consumption at 1/4, 1/2, 3/4 and full load.
2. Exhaust emissions.
3. Mechanical and exhaust noise.
4. Governor speed regulation at 1/4, 1/2, 3/4 and full load; and during transients
5. Motor starting kVA.
6. Generator temperature rise in accordance with NEMA MG1-22.40 and 16.40
7. Harmonic analysis, voltage waveform deviation and telephone influence factor.
8. Generator short circuit capability.
9. Cooling system performance.
10. 3 phase short circuit tests.
11. Maximum power (kW)
12. Generator revolving field assembly for 2 hours at 2700 rpm (150% overspeed) and 70 degrees C and each production unit tested at 2250 rpm (125% overspeed) at room temperature.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.

B. Supplier: Authorized distributor of specified manufacturer with minimum ten years documented experience.

1.8 WARRANTY

A. Five Year Manufacturer Warranty: The manufacturer's standard warranty shall in no event be for a period of less than five years form date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall not be a limiting factor for the system warranty by either the manufacturer or servicing distributor. An extended warranty for an additional five years shall be offered as an option. Submittals received without written warranties as specified will be rejected in their entirety.

1.9 MAINTENANCE SERVICE

A. Furnish service and maintenance of engine generators for five years from Date of Substantial Completion.

1.10 MAINTENANCE MATERIALS FOR EACH ENGINE GENERATOR

A. Furnish one set of tools required for preventative maintenance of engine generator system. Package tools in adequately sized metal tool box.

B. Furnish two of each fuel, oil and air filter element.

PART 2 - PRODUCTS

2.1 ENGINE

A. Manufacturers:

1. **Caterpillar.**
2. **Kohler.**
3. **Cummins.**

B. Product Description: Air-cooled in-line or V-type, four-stroke cycle, compression ignition Diesel internal combustion engine.

C. Rating: Standby rating in accordance with ISO-8528 and ISO-3046.~~Sufficient to operate under 10 percent overload for one hour in ambient of 90 ° F.~~

D. Fuel System: No. 2 fuel oil.

E. Engine speed: 1800 rpm.

F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.

G. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Furnish remote starting control circuit, with MANUALOFF-REMOTE selector switch on engine-generator control panel.

H. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 or 208 volts AC.

I. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.

J. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Furnish fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.

K. Mounting: Furnish unit with suitable spring-type vibration isolators and mount on structural steel base.

2.2 GENERATOR

A. Manufacturers:

1. As provided by engine generator manufacturer.

B. Product Description: NEMA MG1, three phase, four pole, reconnectable brushless synchronous generator with brushless exciter.

> **NOTE:** Generator voltage, ampere and power factor ratings are required to be shown on the drawings.

C. Insulation: The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F. The excitation system shall be of brushless construction.

D. Temperature Rise: 80 degrees C Standby, maximum as measured by resistance and based on 40 degrees C ambient temperature.

E. Enclosure: NEMA MG1, open drip proof

F. Total Harmonic Distortion (THD): Not to exceed three percent.

G. Telephone Influence: Below 50.

H. Exciter (Self-Excited): The self-excited, brushless exciter shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes.

I. Automatic Voltage Regulator: The digital automatic voltage regulator (DVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design, which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, over excitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

2.3 GOVERNOR

A. Manufacturers:

1. As provided by engine generator manufacturer.

B. Product Description: Isochronous governor to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

2.4 CIRCUIT BREAKER

A. Circuit Breaker Specifications: Provide a generator mounted circuit breaker, molded case or insulated case construction, rating as indicated. Breaker shall utilize a thermal magnetic trip unit and 24VDC shunt trip. The breaker shall be UL listed with shunt trip device connected to engine/generator safety shutdowns. Breaker shall be set to protect the generator from short circuit damage. Breaker shall be housed in an extension terminal box mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders, shall be supplied on the load side of breaker.

B. Provide an additional circuit breaker for the radiator mounted load bank.

2.5 CONTROL PANEL

A. Generator Mounted Control Panel: Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation; adjustable cycle cranking, digital AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cool down timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.

B. Digital Readouts: Provide the following digital readouts:

1. Engine oil pressure
2. Coolant temperature
3. Engine RPM
4. System DC Volts
5. Engine running hours
6. Generator AC volts
7. Generator AC amps
8. Generator frequency
9. KW meter
10. Percentage of rated Power
11. KVA meter
12. KVAr meter
13. Power Factor meter
14. KWHR meter

C. Alarm NFPA 110: Provide the following indications for protection and diagnostics according to NFPA 110 level 1:

1. Low oil pressure
2. High water temperature
3. Low coolant level
4. Overspeed
5. Over crank
6. Emergency stop depressed
7. Approaching high coolant temperature
8. Approaching low oil pressure
9. Low coolant temperature
10. Low voltage in battery
11. Control switch not in auto. position
12. Low fuel main tank
13. Battery charger ac failure
14. High battery voltage
15. EPS supplying load
16. Base-mounted tank low fuel level
17. Base-mounted tank high fuel level
18. Spare

D. Remote Annunciator NFPA 110: Provide one remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator will be installed by contractor. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.

NOTE: The location of the remote annunciator shall be clearly identified on the electrical and architectural drawings.

E. Programmable Control Panel: Provide programmable protective relay functions inside the control panel to include the following:

1. Undervoltage
2. Overvoltage
3. Over frequency
4. Under frequency
5. Reverse power
6. Overcurrent (phase and total)
7. KW level (overload)
8. Three spare LED's
9. Four spare inputs

2.6 FUEL SYSTEM

A. Fuel Filter: Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.

B. Fuel Piping: All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted.

C. Fuel Line Rating: Flexible fuel lines rated 300 degrees F and 100 PSI.

D. Sub-Base Fuel Tank.

2.7 SUB-BASE FUEL TANK

A. Manufacturers:

1. **IBI**
2. **International Supply Co.**
3. **Tramont**

A. Provide a sub-base <u>concrete encased</u> fuel tank for the generator set, sized to allow 8 hours of operation.

1. All Protected Base Tanks are UL Secondary Containment list and labeled. It is comprised of a UL142 steel tank, surrounded by a minimum of 6” light weighted insular concrete, enclosed by a UL142 steel outer shell with an interstitial

monitoring tube. All steel tanks are tightness tested at the manufacturer's facility, in accordance with testing procedures specified by UL142 for AST's, and meet UL requirements for standard and emergency venting. The interior of the primary tank has been cleaned and free of any loose material, mill scale, or debris. Sub base tanks are UL 2085 listed for the UL 2 hour fire burn test. Tanks must be ballistic and impact rated per UL 2085 specification.

2. The base tank shall be furnished as a complete, factory assembled and tested assembly and listed as an assembly by Underwriters Laboratories, to UL 142 and UL 2085 factory installed.
3. Primary tanks shall be of minimum thickness per UL 142. Inner tanks will be of rectangular configuration per UL standard 142. All welds must comply with AWS, and ASME IX and ASME B31.1.
4. Secondary containment consists of UL 142 primary tank, completely enclosed by a UL 142 secondary containment tank, which is 110% of the primary. Primary and secondary tank will be Rectangular in configuration. Both tanks are pressure tested to between 3PSI and 5PSI per UL requirements. Insulation material will be of a lightweight concrete design. Concrete will be poured in a monolithic method to eliminate voids. The minimum insulation thickness will be 6". The exterior of the tank will be steel.
5. All tank systems and sub-assemblies shall be installed in strict accordance with the manufacturer's recommendations and applicable fire and environmental codes.
6. All tanks are primed with a Rustoleum Shop Coat Enamel. Top coat is an Alkyd High Gloss Enamel paint (Sherwin WilliamsSW6004 Mink.)
7. All tanks to be installed on reinforced engineered concrete slab. Protective barriers shall be installed as required by state and local codes.
8. Tanks shall be marked on a visible side with "Flammable", "Combustible", and "No Smoking", product identification, and other signs as required by state and local codes.
9. The system installation (end user) shall be inspected and approved by the system installer or its certified contractor. The system installer shall submit a comprehensive checklist of quality and safety items associated with the installation of the system and its sub-assemblies to verify that the installation is in compliance with applicable local fire and environmental codes.

B. Features

1. Emergency tank and basin vents.
2. Mechanical level gauge.
3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA requirements.
4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
5. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.
6. Basin drain.
7. Integral lifting provisions

2.8 TIER 4 COMPLIANT CATALYTIC EXHAUST TREATMENT SYSTEM

A. Provide and install as per manufacturer recommendations.

B. Silencer: A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Mounting shall be provided by the contractor. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer.

C. Exhaust System: The muffler and all indoor exhaust piping shall be "lagged" by the contractor to maintain a surface temperature not to exceed 150 degrees F. The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting.

D. Muffler shall be critical type similar to Nelson-300 or equal. Provide engine exhaust roof thimbles with flexible tubes and pipes as required.

2.9 STARTING SYSTEM

A. Starting Motor: The engine shall be started by two 24 V DC electric starting motors. Crank termination switch and 24 V DC fuel solenoid valve shall be provided for remote automatic start/stop capability.

B. Jacket Water Heater: A unit mounted forced circulation type water heater. The heater Watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F, and shall be a 480 volt, three phase, 60 hertz.

C. Batteries: Lead acid batteries of sufficient capacity for four 15 second crank periods with 10 second rest intervals shall be furnished. Battery voltage of 24 V DC shall be derived from four 12 V DC, 205 amp hour high performance batteries, dry charged. Two battery interconnection cables and four battery-to-starter cables.

1. Battery Trays: A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.
2. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. Ac input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be no less than ten (10) amperes. Charger shall be wall-mounting type in NEMA 1 enclosure.

2.10 RADIATOR MOUNTED LOAD BANK

A. Furnish a continuous duty load bank, complying with UL 508A, mounted directly on the skid base, on the exhaust side of the radiator, complete with all necessary pilot and power control, wiring and devices to furnish a functional system for the intended use. Load bank shall comply with all applicable NEMA, NEC and ANSI Standards. Load bus configuration and load terminations shall be clearly identified.

B. The load bank shall have the capability of maintaining a constraint load for the Emergency Power Supply Source (EPSS), during both exercising and actual use condition. Rating shall be a minimum of 50%~~100%~~ of the generator output rating and matched to the EPSS voltage. Load steps at a minimum of three (3) incremental loads, manually controlled.

C. Enclosure shall be suitable for installation on the exhaust side of the engine radiator. It shall match dimensionally the radiator's duct flange height and width without adaptive duct work. The control section shall have a hinged and gasketed access door(s).

D. Manufacturer shall be Avtron load bank K-711 Series, or equal.

E. Construction shall be aluminum or galvanized steel. All fasteners shall be stainless steel. Load elements shall be helically wound and rated to operate at 50% of the maximum continuous wire rating. Each 50 kW element shall have current limiting fuses. (Furnish three (3) sets of three (3) fuses as spares.)

2.11 VIBRATION ISOLATORS FOR EACH ENGINE GENERATOR

A. For unit to base provide spring type with neoprene acoustical pads, leveling devices and vertical limit stops. Minimum static deflection shall be 1 inch.

B. For base to concrete pad spring mountings, provide adjustable type to provide minimum clearance of 4 inches between structural base and floor, with alignment and lift off restraints.

C. Provide for engine-generator set base, engine-generator set base and remote radiator and silencer and exhaust pipe.

2.12 SPARE PARTS

A. Deliver 1 set of filter elements (air, fuel and oil), complete set of fuses, for each size used and one belt for every belt drive to LAWA at final acceptance.

2.13 ENCLOSURE

A. Provide a weather proof enclosure.

> **NOTE:** Acoustic mitigation measures may be required due to the generator's proximity to acoustically sensitive areas such as, but not limited to, office areas, conference rooms, etc..

2.14 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Make completed engine-generator assembly available for inspection at manufacturer's factory prior to packaging for shipment. Notify LAWA at least seven days before inspection is allowed.

C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify LAWA at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations, and all applicable codes.

B. Install engraved plastic nameplates.

C. Ground and bond generator and other electrical system components.

3.2 START-UP AND TESTING

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.

C. Coordinate all start-up and testing activities with LAWA.

D. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

1. Verify that the equipment is installed properly.
2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.
3. Test all alarms and safety shutdown devices for proper operation and annunciation.
4. Check all fluid levels.
5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
6. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.

7. Perform a 4-hour load bank test at .80 power factor at full nameplate load using a reactive load bank and cables supplied with the generator. Observe and record the following data at 15-minute intervals:

   a. Service meter hours
   b. Volts AC - All phases
   c. Amps AC - All phases
   d. Frequency
   e. Power factor or Vars
   f. Jacket water temperature
   g. Oil Pressure
   h. Fuel pressure
   i. Ambient temperature

8. Connect the generator to building load and verify that the generator will start and run all designated loads in the building.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.22.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare and start up engine-generator assembly.

3.5 ADJUSTING

A. Adjust generator output voltage and engine speed to meet specified ratings.

3.6 CLEANING

A. Clean engine and generator surfaces. Replace oil and fuel filters with new.

3.7 TRAINING

A. Furnish eight hours of instruction to be conducted at project site with manufacturer's representative to LAWA choice of staff to be trained. Provide training session for each of 3 shifts.

B. Describe loads connected to emergency and standby system and restrictions for future load additions.

C. Simulate power outage by interrupting normal source, and demonstrate system operates to provide emergency and standby power.

D. Provide manuals for attendees.

END OF SECTION 26 32 13

SECTION 26 33 00 - BATTERY EQUIPMENT (INVERTER)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes emergency power supplies and accessories.

1.2 REFERENCES

A. National Fire Protection Association:

1. NFPA 111 - Standard on Stored Electrical Energy Emergency and Standby Power Systems.

1.3 SUBMITTALS

A. Product Data: Submit catalog and data sheets showing electrical characteristics and connection requirements. Include unit ratings, dimensions, and finishes. Include performance data for batteries.

B. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit battery maintenance and unit testing procedures.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 111.

B. Maintain two copies of document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience, and with service facilities within 100 miles of project.

1.7 WARRANTY

A. Furnish five year manufacturer warranty for batteries.

PART 2 - PRODUCTS

2.1 EMERGENCY POWER SUPPLY

A. Manufacturers:

1. **Lithonia**
2. **Chloride**
3. **Dual Lite**

B. Product Description: NFPA 111 Type A, Class 1.5 stored emergency power supply system designed for Level 1 applications and consisting of rectifier/charger unit, storage battery, and solid state inverter with static transfer switch, in one or several enclosures, unit suitable for operating HID lamps without extinguishing lamp on transfer.

C. Input Voltage:

D. Output Power:

E. Output Voltage:

F. Inverter Output Frequency: 60 Hz plus 1 percent.

G. Efficiency: 90 percent minimum.

H. Maximum Recharge Time: 12 hours following 1.5 hour discharge.

I. Total Harmonic Distortion: Less than 10 percent at full resistive load.

J. Battery: Nickel cadmium sealed type battery.

K. Charger: Dual rate, designed to maintain battery in full-charge condition during normal conditions.

L. Furnish remote trouble monitor in enclosure with manufacturer’s standard finish.

M. Accessories: Provisions for remote battery alarm.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units plumb and level.

3.2 FIELD QUALITY CONTROL

A. Verify operation of each unit by simulating outage.

3.3 DEMONSTRATION AND TRAINING

A. Demonstrate normal operation of unit.

END OF SECTION 26 33 00

26 33 53-STATIC UNINTERRUPTIBLE POWER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty three-phase, solid-state, uninterruptible power system (UPS). The UPS shall provide high-quality AC power for sensitive electronic equipment loads.

> **NOTE:** A static UPS is mandatory for all systems that require memory or control retention such as those found in baggage handling and building management systems.

1.2 STANDARDS

A. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents.

1. ANSI C62.41 (IEEE 587)
2. ASME
3. CSA 22.2, No. 107.1
4. FCC Part 15, Class A
5. ISO 9001
6. National Electrical Code (NFPA-70)
7. NEMA PE-1
8. OSHA
9. UL Standard 1778

B. The UPS shall be ETL listed per UL Standard 1778 Uninterruptible Power Supplies.

1.3 SYSTEM DESCRIPTION

A. Design Requirements - UPS Module

1. Voltage. Input/output voltage specifications of the UPS shall be:

    a. Rectifier Input: As required.
    b. Bypass Input (for dual-input modules): As required.
    c. Output: Three-phase, 4-wire-plus-ground, as required.

2. Output Load Capacity. Specified output load capacity of the UPS shall be as required at 0.8 lagging power factor.

B. Design Requirements - Matching Battery Cabinet

1. Battery Cells: Sealed, lead-acid, valve-regulated.
2. Reserve Time: 30 minutes at full load, 0.8 power factor, with ambient temperature between 20° and 30°C.
3. Recharge Time: to 95% capacity within ten (10) times discharge time.

C. Modes of Operation

1. The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:
   a. Normal - The AC equipment is to be continuously powered by the UPS inverter. The rectifier/charger derives power from a utility AC source and supplies DC power to the inverter while simultaneously float-charging a power reserve battery.
   b. Emergency - Upon failure of utility AC power, AC equipment is to be powered by the inverter, which without any switching obtains its power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
   c. Recharge - Upon restoration of utility AC power, after a utility AC power outage, the rectifier/charger shall automatically restart, walk-in, and gradually resume providing power to the inverter and also recharge the battery system.
   d. Bypass - If the UPS must be taken out of service for maintenance or repair, or should the inverter overload capacity be exceeded, the static bypass transfer switch shall perform a reverse transfer of the connected equipment from the inverter to the bypass source without interruption in power to the mission critical AC equipment.

D. Performance Requirements

1. AC Input to UPS DD
   a. Voltage Configuration for Standard Units: three-phase, 4-wire plus ground.
   b. Voltage Range: +10%, -20% of nominal.
   c. Frequency: Nominal frequency +/-5%.
   d. Power Factor: Up to 0.96 lagging at nominal input voltage and full rated UPS output with input filter.
   e. Inrush current: 800% of full load current maximum.
   f. Current Limit: 115% of nominal AC input current maximum and 100% of nominal for optional generator operation.
   g. Input Current Walk-In: 15 seconds to full rated input current maximum. Field selectable 5 or 20 seconds.
   h. Current Distortion: 10% reflected input THD maximum at full load with the optional input filter; 30% reflected input THD maximum at full load without the optional input filter.
   i. Surge Protection: The UPS shall be able to sustain input surges without damage per criteria listed in ANSI C62.41 Category A and B.

2. AC Output, UPS Inverter

   a. Voltage Configuration: three-phase, 4-wire plus ground
   b. Voltage Regulation:
      +/- 0.5% three-phase RMS average for a balanced three-phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.
      +/- 1.0% three-phase RMS average for a 100% unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.
   c. Frequency: Nominal frequency +/-0.1%.
   d. Frequency Slew Rate: 5.0 Hertz per second maximum. Field selectable from 0.1 to 5.0 Hz per second.
   e. Phase Displacement:
      +/- 0.5 degree for balanced load,
      +/- 1.0 degrees for 100% unbalanced load.
   f. Bypass Line Sync Range:
      +/- 0.5 Hertz,
      Field selectable +/- 0.5 to 5.0 Hz.
   g. Voltage Distortion:
      1% total harmonic distortion (THD) for linear loads.
      2.5% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.
   h. Load Power Factor Range: 1.0 to 0.7 lagging without derating.
   i. Output Power Rating: Rated kVA at 0.8 lagging power factor.
   j. Overload Capability:
      125% for ten minutes (without bypass source).
      150% for one minute (without bypass source).
      200% for 10 cycles, pulse paralleling with the static switch.
   k. Inverter Output Voltage Adjustment: +/-5% manual adjustment.
   l. Voltage Transient Response:

100% load step	+/- 5.0%.
Loss or return of AC input power	+/- 1.0%.
Manual transfer of 100% load	+/- 3.0%.

   m. Transient Recovery Time: to within 1% of output voltage within one cycle.
   n. Voltage Unbalance: 100% unbalanced load +/- 1%.
   o. Fault Clearing: Sub-cycle current of at least 300%.

1.4 ENVIRONMENTAL CONDITIONS

A. The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

1. Operating Ambient Temperature
   UPS Module: 32°F to 104°F (0°C to 40°C).
   Battery: 77 +/-9°F (25 +/-5°C).
2. Storage/Transport Ambient Temperature

UPS Module: -4°F to 158°F (-20°C to 70°C).
Battery: -4°F to 92°F (-20°C to 33°C)

3. Relative Humidity
0 to 95%, non-condensing.
4. Altitude
Operating: to 6,600 ft. (2,000 meters) above Mean Sea Level. Derated for higher altitude applications.
Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.
5. Audible Noise
Noise generated by the UPS under any condition of normal operation shall not exceed 65 dBA measured 1 meter from surface of the UPS.

1.5 SUBMITTALS

A. Proposal Submittals

1. Submittals with the proposal shall include:

a. System configuration with single-line diagrams.
b. Functional relationship of equipment including weights, dimensions, and heat dissipation.
c. Descriptions of equipment to be furnished, including deviations from these specifications.
d. Size and weight of shipping units to be handled by installing contractor.
e. Detailed layouts of customer power and control connections.
f. Detailed installation drawings including all terminal locations.

B. UPS Delivery Submittals

1. Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) instruction manual that shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

C. The electrical contractor shall submit ¼”=1’0” scale sketches of all electrical rooms and areas including actual dimensions of all equipment in electrical rooms and indicate clearances per NEC, as well as door swings or other obstacles. Sketches shall be submitted along with or prior to shop drawing submittals. Shop drawing submittal without sketches shall be returned and not reviewed.

1.6 WARRANTY

A. UPS Module

1. The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after the installation is accepted by LAWA.

B. Battery

1. The battery manufacturer's standard warranty shall be passed through to the end user.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. A minimum of twenty year's experience in the design, manufacture, and testing of solid-state UPS systems is required. The system shall be designed and manufactured according to world-class quality standards. The manufacturer shall be ISO 9001 certified.

B. Factory Testing

1. Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

PART 2 - PRODUCT

2.1 FABRICATION

A. Manufacturers:

1. **Liebert**
2. **Eaton Corp.**
3. **Toshiba**

B. Materials

1. All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing.
2. The maximum working voltage, current, and di/dt of all solid-state power components and electronic devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature of solid-state component sub-assembly shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the maximum rectifier charging voltage.

C. Wiring

1. Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code (NFPA 70). All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the

National Electrical Code and other applicable standards. All electrical power connections are to be torqued to the required value and marked with a visual indicator.

2. Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

D. Construction and Mounting

1. The UPS unit, comprised of input transformer (if required), rectifier/charger with input filter, inverter, static transfer switch, output transformer and maintenance bypass switch, shall be housed in a single free-standing NEMA type 1 enclosure. Cabinet doors/covers shall require a tool for gaining access. Casters and stops shall be provided for ease of installation. Front access only shall be required for expedient servicing, adjustments, and installation. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.
2. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer’s standard color. The UPS shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug connections. Like assemblies and like components shall be interchangeable.

E. Cooling

1. Cooling of the UPS shall be by forced air. Low-velocity fans shall be used to minimize audible noise output. Fan power shall be provided by the UPS output.
2. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded.

F. Grounding

1. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for local bonding shall be provided.

2.2 COMPONENTS

A. Input Transformer

1. When required, the input transformer shall be factory installed inside the UPS module cabinet without increasing the standard footprint.

B. Rectifier/Charger

1. General

a. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a phase-controlled, solid-state SCR type with constant voltage/current limiting control circuitry.

2. AC Input Current Limiting

    a. The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 115% of the full input current rating. The rectifier/charger shall operate at a reduced current limit mode whenever the critical load is powered from the UPS static bypass circuit such that the maximum UPS input current will not exceed 115% of full load input current. In addition, the rectifier/charger shall have a separate battery current limit, adjustable from 0 to 15% of the full load input current. An optional second circuit shall limit the battery recharge current to zero when activated by a customer-supplied contact closure to signal a customer function such as generator operation.

3. Input Current Walk-In

    a. The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 15-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 or 20 seconds.

4. Fuse Failure Protection

    a. Power semiconductors in the rectifier/charger shall be fused with fast-acting fuses, so that loss of any one-power semiconductor shall not cause cascading failures.

5. DC Filter

    a. The rectifier/charger shall have an output filter to minimize ripple voltage into the battery. Under no conditions shall ripple voltage into the battery exceed 1% RMS. The filter shall be adequate to insure that the DC output of the rectifier/charger will meet the input requirements of the inverter. The inverter shall be able to operate from the rectifier/charger with the battery disconnected.

6. Automatic Rectifier Restart

    a. Upon restoration of utility AC power, after a utility AC power outage and prior to a UPS automatic end-of-discharge shutdown, the rectifier/charger shall automatically restart, walk-in, and gradually resume providing power to the inverter and also recharge the battery system.

7. Battery Recharge

a. In addition to supplying power for the inverter load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

8. DC Over Voltage Protection

a. There shall be DC over-voltage protection so that if the DC voltage rises to the pre-set limit, the UPS is to shut down automatically and initiate an uninterrupted transfer of the connected equipment to the static bypass line.

C. Inverter

1. General

a. The term inverter shall denote the solid-state equipment and controls to convert DC power from the rectifier/charger or battery to regulated AC power for supporting the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. Overload Capability

a. The inverter shall be capable of supplying current and voltage for overloads exceeding 100% and up to 200% of full load current. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

3. Fault Clearing and Current Limit

a. The inverter shall be capable of supplying an overload current of 150% of its full-load rating for one minute. For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The critical load will be transferred to the static bypass automatically and uninterrupted. The inverter shall be self-protecting against any magnitude of connected output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses.

4. Step Load Response

a. The output voltage shall be maintained to within -to-5.0% with a 0 100% step load change or a 100%-to-0 step load change. The output voltage shall recover to within 1% of nominal voltage within 1 cycle.

5. Voltage Distortion

a. For linear loads, the output voltage total harmonic distortion (THD) shall not be greater than 1%. For 100% rated load of 3:1 crest factor nonlinear loads, the output voltage total harmonic distortion shall not be greater than 2.5%. The output rating is not to be derated in kVA or kW due to the 100% nonlinear load with 3:1 crest factor.

6. Output Power Transformer

a. A dry-type power transformer shall be provided for the inverter AC output. It shall have copper wiring exclusively. The transformers hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation class of material when operating at full load at maximum ambient temperature.

7. Phase Balance

a. Electronic controls shall be provided to regulate each phase so that an unbalanced loading will not cause the output voltage to go outside the specified voltage unbalance or phase displacement. With 100% load on one phase and 0% load on the other 2 phases or 100% load on 2 phases and 0% load on the other phase, the voltage balance is to be within 1% and the phase displacement is to be 120 degrees within □1 degree.

8. Fuse Failure Protection

a. Power semiconductors in the inverter shall be fused with fast-acting fuses, so that loss of any one-power semiconductor will not cause cascading failures.

9. Inverter Shutdown

a. For rapid removal of the inverter from the critical load, the inverter control electronics shall instantaneously turn off the inverter transistors. Simultaneously, the static transfer switch shall be turned on to maintain continuous power to the critical load.

10. Inverter DC Protection

a. The inverter shall be protected by the following disconnect levels:

(1) DC Over voltage Shutdown
(2) DC Under voltage Warning (Low Battery Reserve), user adjustable from 1 to 99 minutes
(3) DC Under voltage Shutdown (End of Discharge)

11. Over Discharge Protection

a. To prevent battery damage from over discharging, the UPS control logic shall automatically raise the shutdown voltage set point as discharge time increases beyond fifteen (15) minutes.

12. Inverter Output Voltage Adjustment

a. The inverter shall use a software control to adjust the output voltage from +/- 5% of the nominal value.

13. Output Frequency

a. An oscillator shall control the output frequency of the inverter. The oscillator shall be temperature compensated and hold the inverter output frequency to +/- 0.1% for steady state and transient conditions. Frequency drift shall not exceed 0.1% during a 24-hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.

D. Display and Controls

1. Monitoring and Control

a. The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. A graphical display shall be used to show a single-line diagram of the UPS, and shall be provided as part of the monitoring and controls sections of the UPS. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, status and alarms shall be displayed on the graphical LCD display. Additional features of the monitoring system shall include:

(1) Menu-driven display with pushbutton navigation
(2) Real time clock (time and date)
(3) Alarm history with time and date stamp
(4) Battery backed-up memory

2. Metering

a. The following parameters shall be displayed:
(1) Input AC voltage line-to-line
(2) Input AC current for each phase
(3) Input frequency
(4) Battery voltage
(5) Battery charge/discharge current
(6) Output AC voltage line-to-line and line-to-neutral for each phase
(7) Output AC current for each phase
(8) Output frequency
(9) Percent of rated load being supplied by the UPS

(10) Battery time left during battery operation

3. Alarm Messages

a. The following alarm messages shall be displayed:

(1) Input Line Fault
(2) Input Phase Rotation Error
(3) Input Over/Under Frequency
(4) Input Current Limit
(5) Rectifier Fail
(6) Battery Test Failed
(7) Battery Low Warning (Adjustable 1 To 99 Minutes)
(8) Battery Low Transfer
(9) DC Over Voltage Steady State
(10) Bypass Frequency Error
(11) Load On Bypass
(12) Excessive Auto Retransfers
(13) SBS SCR Shorted
(14) Bypass Sync Error
(15) Input Phase Loss
(16) I DC Peak
(17) Output Under Voltage Transfer
(18) Output Over Voltage Transfer
(19) Inverter Overload
(20) SBS Overload
(21) Inverter Overload Transfer
(22) Transfer Failed Shutdown
(23) Hardware Shutdown
(24) Output Power Supply Fail
(25) Inverter Control Fault Transfer
(26) EPO Latched (remote EPO activated)
(27) System Fan Fail
(28) Ambient Over Temperature Limit
(29) Over Temperature Timeout Shutdown

b. An audible alarm shall be provided and activated by any of the above alarm conditions.

4. Status Messages

a. The following UPS status messages shall be displayed:

(1) Normal operation
(2) On SBS
(3) Load on UPS
(4) Load on bypass
(5) User Shutdown
(6) Battery Discharging

5. Controls

a. UPS start-up, shutdown, and bypass operations shall be accomplished through the front-panel pushbutton controls. Menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. Pushbuttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms. A mimic diagram screen shall be available on the LCD screen to depict a single-line diagram of the UPS and indicate switch positions and power flow.

6. On-Line Battery Test

a. The UPS shall be provided with a menu-driven On-Line Battery Test feature. The test shall ensure the capability of the battery to supply power to the inverter while the load is supplied power in the normal mode. If the battery fails the test, the system shall automatically do the following:

(1) Maintain the load through the UPS
(2) Display a warning message
(3) Sound an audible alarm

b. The battery test feature shall have the following user selectable options:

(1) Interval between tests (2 to 9 weeks)
(2) Date and time of initial test
(3) Enable/disable test

E. Static Transfer Switch

1. General

a. A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be a naturally commutated high-speed static (SCR-type) device rated to conduct full load current continuously. The switch shall have an overload rating of 110% rated load continuously, 200% rated load for five seconds. The static transfer switch shall also have fault-clearing capabilities of 1100 amperes for 1 second, 3000 amperes for 10 cycles, and 6000 amperes peak for the first half cycle.

b. The static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

2. Uninterrupted Transfer

   a. The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:

      (1) Inverter overload capacity exceeded
      (2) AC output over voltage or under voltage
      (3) Battery protection period expired
      (4) UPS fault condition

   b. The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

      (1) Inverter/bypass voltage difference exceeding preset limits
      (2) Bypass frequency out of limits
      (3) Bypass out-of-synchronization range with inverter output

3. Uninterrupted Retransfer

   a. Retransfer of the mission critical AC equipment from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

      (1) Bypass out of synchronization range with inverter output
      (2) Inverter/bypass voltage difference exceeding preset limits
      (3) Overload condition exists in excess of inverter full load rating
      (4) UPS fault condition present

F. Internal Maintenance Bypass Switch

1. General

   a. A manually operated maintenance bypass switch shall be incorporated into the UPS cabinet to directly connect the critical load to the bypass AC input power source, bypassing the rectifier/charger, inverter, and static bypass transfer switch.

2. Isolation

   a. All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come in contact with energized parts or terminals. A means to de-energize the static bypass switch shall be provided when the UPS is in the maintenance bypass mode of operation.

3. Maintenance Capability

a. With the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery, and static bypass transfer switch.

4. Battery Cabinet System

a. The matching battery cabinet shall include sealed, lead-acid valve regulated battery cells housed in a separate cabinet that matches the UPS cabinet styling to form an integral system line-up. Battery cells shall be mounted on slide-out trays for ease of maintenance. A battery disconnect circuit breaker with under voltage release (UVR) shall be included for isolation of the battery system from the UPS module. The UPS shall automatically be disconnected from the battery by opening the breaker when the battery reaches the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery cabinet for ease of installation. When the application calls for the battery cabinet to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut to the correct length and cable lugs installed, by the UPS manufacturer.

G. Accessories

NOTE: Specific accessories will be dependent on design.

1. Input Filter

a. The rectifier/charger shall include an input filter to reduce reflected input current distortion to 10% THD at full load with nominal input voltage. Another benefit of the input filter shall be to maintain the input power factor at 0.90-0.96 lagging minimum from full load to half load with nominal input voltage.

2. External Maintenance Bypass Cabinet

a. A matching external maintenance bypass cabinet shall be provided to enable the UPS module to be completely isolated from the electrical system while the critical load is powered through the external maintenance bypass line. This optional cabinet shall provide make-before-break operation for transfers to and from the external maintenance bypass line with a single rotary switch. The following components shall be standard: single rotary switch with auxiliary contacts, inter-cabinet wiring, casters, and leveling feet. The following components shall be optional: input circuit breaker, shielded isolation transformer, and output circuit breaker. This matching cabinet shall bolt to the side of the UPS module with a barrier shield to separate the two cabinets. Only front access shall be required for installation and service.

3. Slim-Line Distribution Cabinet

a. A matching distribution cabinet shall be provided for flexible cable distribution of power from the UPS output to the critical loads. The distribution cabinet shall include one or two 42-pole panel boards. Both plug-in and bolt-in style panel boards shall be available to accommodate specific site requirements. A main circuit breaker shall be provided with each panel board.

b. The Slim-Line distribution cabinet shall be designed as a bolt-on section to the UPS module or Maintenance Bypass cabinet for field installation by the installing contractor. The Slim-Line distribution cabinet shall add no more than ten (10) inches to the width of the UPS system.

4. 1+1 Redundant Paralleling

a. The UPS shall be available in a version capable of parallel-redundant operation. Two modules with the paralleling option board shall be connected to a simple parallel cabinet requiring no system-level controls or displays. The parallel cabinet shall include two module isolation circuit breakers and one system output breaker. All control and load-sharing logic shall be independent and contained within each module. The only control connection between the two modules shall be a single Category 5 Ethernet cable. The UPS modules shall load share within 1% when the Ethernet cable is attached. As a fail-safe operating mode, the UPS modules shall be capable of load sharing within 5% even if the Ethernet cable is removed or damaged after system start-up. In like manner, the system shall be capable of operating normally (including overload and fault handling, manual transfers and automatic transfers to bypass) for an indefinite period with no inter-module signals available.

5. Load Bus Synchronization

a. The Load Bus Sync® circuit shall synchronize the output of two independent UPSs even if the UPSs are operating from asynchronous bypass sources (e.g. backup generator sets) or on battery power. The Load Bus Sync (LBS) circuit shall consist of a control enclosure and an option card inside each UPS module. The LBS control enclosure shall enable the operator to designate which bypass source will be the Designated Master source, and both UPS systems will synchronize their outputs to that source.

6. Programmable Relay Board

a. Eight sets of isolated Form C contacts shall be provided to indicate a change of status of any of the alarm conditions. Any of the UPS alarms can be programmed onto any channel of the programmable relay board.

7. Remote Status Panel

a. A remote status panel shall be provided and shall include the following:

(1) Load on UPS LED
(2) Load On Bypass LED

(3) Battery Discharge LED
(4) Low Battery Reserve LED
(5) UPS Alarm Condition LED
(6) New Alarm Condition LED (for a second UPS alarm condition)
(7) Audible Alarm with Reset pushbutton
(8) Lamp Test/Reset pushbutton

b. The remote status panel shall be provided in a NEMA Type 1 enclosure for wall mounting.

8. Battery Circuit Breaker

a. A battery circuit breaker shall be provided to isolate the battery from the UPS. This breaker shall have an under voltage release (UVR) and auxiliary contacts, and shall be in a separate wall mounted NEMA-1 enclosure. The battery breaker provides a manual disconnecting means, short circuit protection, and over current protection for the battery system. When opened, there shall be no battery voltage in the UPS enclosure. The UPS shall be automatically disconnected from the battery by opening the breaker when the battery reaches the minimum discharge voltage level.

9. Internal Modem

a. The UPS shall come with an internal modem capable of dialing out from the UPS to notify up to two remote computers, terminals, PC's, or pocket pagers when important events occur. The modem will also be capable of accepting incoming calls, with the appropriate security, and connecting to a remote terminal, computer or PC, to perform all those functions normally available on the front panel including viewing monitoring screens.

10. SNMP

a. The UPS shall come equipped with an internal SNMP adapter, which will connect the UPS directly to any I.P. based network using Ethernet communications. The UPS will become a managed device on the network. From a network management station the system administrator shall be capable of monitoring important system measurements, alarm status and alarm history data. In the event of a utility failure the SNMP shall continue with live communication without the requirement of additional or separate UPS equipment until such time as the UPS shuts down for Low battery. On resumption of Utility power the SNMP shall resume full SNMP communication automatically.

11. IBM* AS/400* UPS Signal

a. The following isolated normally open contacts shall be provided for user connection to an IBM AS/400 UPS signal interface:

(1) UPS on (UPS is supplying power)
(2) Bypass active (bypass is supplying power)
(3) Utility failure (battery is discharging)
(4) Battery low (limited battery time remaining)

b. A 50-foot shielded cable, compliant with NEMA Class 2 for plenum applications, with sub-miniature 9-pin D-type connector, shall be provided for connection to the signal interface.

12. IBM* AS/400* Multi-Interface System

a. An AS/400 Multi-Interface System shall be provided where a single UPS is powering multiple AS/400 units (up to 8). The MultiInterface Unit (MIU) shall provide the required UPS status information to each AS/400 so it can perform an automatic unattended orderly shutdown when necessary. Each AS/400 includes the software required to interface with the UPS. The following status messages are activated in the IBM system:

(1) UPS on (UPS is supplying power)
(2) Bypass active (bypass is supplying power)
(3) Utility failure (battery is discharging)
(4) Battery low (limited battery time remaining)

b. Each AS/400 individually monitors the UPS status to determine when to initiate a quick power down to preserve data and protect hardware during a utility power outage. This system requires the optional remote contact board to provide isolated contacts. This system shall include a shielded primary cable with a 9-pin subminiature D-shell connector, the AS/400 Multi-Interface Unit (MIU), and shielded secondary cables with RJ11 and 9-pin subminiature D-shell connectors. Cables shall be available in selected lengths from 25 to 300 feet.

c. IBM and AS/400 are trademarks of International Business Machines Corporation.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Factory-trained field service personnel shall perform the following inspections and test procedures during the UPS startup.

1. Visual Inspection

a. Inspect equipment for signs of damage
b. Verify installation is correct

c. Inspect cabinets for foreign objects
d. Verify neutral and ground conductors are properly sized and configured
e. Inspect battery cases
f. Inspect battery for proper polarity
g. Verify all printed circuit boards are configured properly

2. Mechanical Inspection

a. Check all control wiring connections for tightness
b. Check all power wiring connections for tightness
c. Check all terminal screws, nuts, and/or spade lugs for tightness

3. Electrical Inspection

a. Check all fuses for continuity
b. Confirm input voltage and phase rotation is correct
c. Verify control transformer connections are correct for voltages being used
d. Assure connection and voltage of the battery string(s)

3.2 MANUFACTURER'S FIELD SERVICE

A. Service Personnel

1. The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory trained field service personnel dedicated to the start-up, maintenance, and repair of UPS and power equipment. The organization shall consist of regional and local offices.
2. The manufacturer shall provide a fully automated national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, and 365 days/year. If emergency service is required, response time shall be 20 minutes or less.
3. An automated procedure shall be in place to insure that the manufacturer is dedicating the appropriate technical support resources to match escalating customer needs.

B. Replacement Parts Stocking

1. Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.
2. Recommended spare parts shall be fully stocked by local field service personnel with back-up available from national parts center and the manufacturing location. The national parts center Customer Support Parts Coordinators shall be on-call 24 hours/day, 7 days/week, and 365 days/year for immediate parts availability. Parts from the national parts center shall be shipped within 4 hours on the next available flight out and delivered to the customer's site within 24 hours.

C. UPS Operator Training

1. Operator training courses for customer employees shall be available by the UPS manufacturer. The training course shall cover UPS theory, safety, battery considerations and UPS operational procedures.
2. Training and materials shall be provided for LAWA personnel.

D. Maintenance Contracts

1. A complete offering of preventive and full service maintenance contracts for both the UPS system and battery system shall be available. An extended warranty and preventive maintenance package shall be available. Factory-trained service personnel shall perform warranty and preventive maintenance service.

END OF SECTION 26 33 53

SECTION 26 43 13 - TRANSIENT-VOLTAGE SUPPRESSION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes transient voltage surge suppressors for low-voltage power, control, and communication equipment

1.2 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor(s), both singular and plural; also, transient voltage surge suppression.

1.3 SUBMITTALS

A. Product Data: For each type of product. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Product Certificates: For TVSS devices, from manufacturer.

C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

D. Maintenance Data: For transient voltage suppression devices.

E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

C. Comply with IEEE C62.41.2 and test devices according to IEEE C62.45.

1. Comply with NEMA LS 1.
2. Comply with UL 1283 and UL 1449.
3. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Manufacturers of a Broad Line of Suppressors:

1. Cutler-Hammer, Inc.
2. Square D Co.
3. General Electric

C. Manufacturers of Category A and Telephone/Data Line Suppressors:

1. MCG Electronics, Inc.
2. NTE Electronics, Inc.
3. Telebyte Technology, Inc.

2.2 SERVICE ENTRANCE SUPPRESSORS

A. Surge Protective Device Description: Non-modular type with the following features and accessories:

1. LED indicator lights for power and protection status Copper lugs.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 a, 250-V ac, for remote monitoring of protection status.

B. Surge Protective Device Description: Modular design with field-replaceable modules and the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring Copper lugs.
3. Integral disconnect switch.
4. Arrangement with copper busbars and for bolted connections to phase buses, neutral bus, and ground bus.
5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
6. Red and green LED indicator lights for power and protection status.
7. Audible alarm, with silencing switch, to indicate when protection has failed.
8. One set of dry contacts rated at 5 a and 250-V ac, for remote monitoring of protection status.
9. Surge-event operations counter.

C. Peak Single-Impulse Surge Current Rating: 240kA per phase.

D. Connection Means: Permanently wired.

E. Protection modes and UL 1449 clamping voltage for grounded wye circuits with voltages of 480Y/277 and 208Y/120; 3-phase, 4-wire circuits, shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120 .
2. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.
3. Neutral to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

F. Protection modes and UL 1449 clamping voltage for 240/120 V, single-phase, 3-wire circuits, shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

G. Protection modes and UL 1449 clamping voltage for 240/120 V, 3-phase, 4-wire circuits, with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

H. Protection modes and UL 1449 clamping voltage for voltages of 240, 480, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V and 1000 V for 240 V.
2. Line to Ground: 2000 V for 480 V and 1000 V for 240 V.

2.3 PROJECT CONDITIONS

A. Service Conditions: Rate TVSS devices for continuous operation under the following conditions unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.

2. Operating Temperature: 30 to 120 deg F

3. Humidity: 0 to 85 percent, noncondensing.

4. Altitude: Less than 20,000 feet above sea level.

2.4 PANELBOARD SUPPRESSORS

A. Surge Protective Device Description: Non-modular type with the following features and accessories:

1. LED indicator lights for power and protection status Copper lugs.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 a, 250-V ac, for remote monitoring of protection status.
4. Fuses, rated at 200-kA interrupting capacity.
5. Fabrication using bolted compression lugs for internal wiring.
6. Integral disconnect switch.
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
8. Red and green LED indicator lights for power and protection status.
9. Audible alarm, with silencing switch, to indicate when protection has failed.
10. One set of dry contacts rated at 5 A, 250-V, ac, for remote monitoring of protection status.
11. Surge-event operations counter.

B. Peak Single-Impulse Surge Current Rating: 120 kA per phase.

C. Protection modes and UL 1449 clamping voltage for grounded wye circuits with voltages of 480Y/277 and 208Y/120; 3-phase, 4-wire circuits, shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 and400 V for 208Y/120.
2. Line to Ground: 800 V for 480Y/277 and400 V for 208Y/120.
3. Neutral to Ground: 800 V for 480Y/277 and400 V for 208Y/120.

D. Protection modes and UL 1449 clamping voltage for 240/120 V, single-phase, 3-wire circuits, shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

E. Protection modes and UL 1449 clamping voltage for 240/120 V, 3-phase, 4-wire circuits, with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.

3. Neutral to Ground: 400 V.

F. Protection modes and UL 1449 clamping voltage for voltages of 240, 480, 3-phase, 3-wire, delta circuits shall be as follows:

1. Line to Line: 2000 V for 480 V and1000 V for 240 V.
2. Line to Ground: 1500 V for 480 V and800 V for 240 V.

2.5 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.

B. Install devices for panelboard with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

C. Provide multipole, 15-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated, or direct bus mounted, internal to electrical equipment.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field assembled components and equipment installation, including piping and electrical connections. Report results in writing.

B. Verify that electrical wiring installation complies with manufacturer's installation requirements.

3.4 TRAINING

A. Engage a factory-authorized service representative to train LAWA maintenance ersonnel to adjust, operate, and maintain surge protective devices.

B. Train LAWA maintenance personnel on procedures and schedules for maintaining suppressors.

C. Review data in maintenance manuals.

D. Schedule training with LAWA with at least seven days' advance notice.

E. Training to include minimum of 15 personnel for 40 hours training, 16 hours shall be classroom training and 24 hours shall be hands-on training.

END OF SECTION 26 43 13

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories.

> **NOTE:** Consider the use of pendant lighting that may make the fixture more accessible for routine maintenance. Linear lighting is preferred over typical "can" down lights.
>
> General illumination lighting in passenger terminal public restrooms may be provided by energy-saving compact fluorescent downlights (center of room). Supplemental lighting in passenger terminal public restrooms may be provided by wall washers or cove lights at the back of the toilet compartments, above the urinals and above wash basins. The emergency light fixture is to located above the wash basins.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

B. Illuminating Engineering Society of North America

C. UL Underwriters Laboratories

D. ETL Intertek Testing Services

E. NEC National Electric Code

F. NEMA National Electrical Manufacturers Association

G. CBM Certified Ballast Manufacturers

1.3 DEFINITIONS

A. BF: Ballast Factor

B. CCT: Correlated Color Temperature

C. HID: High Intensity Discharge

D. LED: Light Emitting Diode

E. LER: Luminaire Efficiency Rating

F. Lumen: Measured output of luminaire, lamp, or both.

G. Luminaire: Complete lighting fixture, including driver or ballast if included

1.4 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.

B. Product Data: Submit dimensions, ratings, and performance data.

C. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum two years documented experience.

B. Photometric Data: For qualified agencies providing photometric data for lighting fixtures.

1.6 QUALITY ASSURANCE

A. Provide Luminaire Data Photometric Testing performed by an independent agency complying with IESNA Lighting Measurement Testing and Calculation Guides.

B. Comply with NFPA 70.

1.7 MOCK-UP

A. Quality Requirements: Mock-up requirements.

1.8 FIELD MEASUREMENTS

A. Verify all critical measurements in the field prior to fabrication.

1.9 COORDINATION

A. Coordinate layout and installation of light fixtures with other construction.

1.10 MAINTENANCE MATERIALS

A. Execution and Closeout Requirements: Spare parts and maintenance products.

1.11 WARRANTIES

A. All fixtures and workmanship shall be guaranteed free of defects and fully operational for the duration of the warranty period. Defective fixtures or workmanship will be replaced by the Contractor at no cost to the Owner.

B. Ballasts for fluorescent fixtures, transformers for low voltage fixtures, and drivers for LED fixtures shall be warranted against defects in workmanship or material. Warranty to provide for replacement of fluorescent ballasts, transformers for low voltage fixtures, and LED drivers at no cost to the Owner.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

> **NOTE:** Highly efficient LED fixtures with consistent color temperature (tight binning), high Color Rendering Index (85+ CRI), and rated life greater than 50,000 hours are preferred.
>
> All lighting fixtures shall be recessed, surface mounted if the existing condition dictates.

A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

2.2 LED LIGHTING FIXTURES AND COMPONENTS

A. Manufacturers:

1. Lighting Science Group.
2. Con-Tech Lighting.
3. Bega Lighting.
4. Lunera Lighting.

B. Product Testing: Comply with U.L. 1598 and 8750. Test according to IES LM-79 and LM-80.

C. Drivers: Operation to be at standard rated voltage of driver, and not "over-driven.".

> **NOTE:** T8 and compact fluorescent lamps/ballasts are recommended for use on the project. Minimize the lamp types for stocking and purchasing purposes.

FLUORESCENT BALLASTS

D. Manufacturers:

1. Philips.
2. Osram.
3. General Electric.

2.3 FLUORESCENT DIMMING BALLASTS AND CONTROLS

A. Manufacturers:

1. Philips.
2. General Electric.
3. Lutron.

B. Product Description: Electrical assembly of control unit and ballast to furnish smooth dimming of fluorescent lamps.

C. Control Unit: Selected for energy efficiency and daylight harvesting capability.

D. Ballast: Selected by dimming system manufacturer as suitable for operation with control unit and suitable for lamp type and quantity specified for luminaire.

2.4 LED LAMPS

A. Manufacturers:

1. Lighting Science Group.
2. OptiLED.
3. Con-Tech Lighting.

> **NOTE:** Incandescent or halogen lamps **not** recommended for use on the project unless the lamp life exceeds 10,000 hours.For fluorescent lamps, a color rendering of 80+ CRI, and color temperatures of 2800-3500 Kelvin are preferred.

2.5 INCANDESCENT LAMPS

A. Manufacturers:

1. Tivoli.
2. Ushio.

2.6 FLUORESCENT LAMPS

A. Manufacturers:

1. Philips.
2. Osram.
3. General Electric.

2.7 LIGHTING CONTROL SYSTEM

A. Product Description: Complete programmable system allowing for daylight harvesting, DMX-512 fixture control, and interfacing with existing Building Automation Control system in accordance with LEED guidelines.

B. System Commissioning: Provide labor and temporary equipment as required to commission lighting control system in accordance with LEED guidelines.

C. Level Setting: Provide labor and temporary equipment necessary to set and program dimmed and DMX-controlled lighting levels under the Lighting Consultant's supervision.

D. Owner Training: Schedule and provide user training sessions for designated LAWA personnel.

2.8 LIGHTING FIXTURES

A. Downlights
   1. Lightolier, 1002F1
   2. Lightolier 1045, Lytecaster Recessed Downlight
   3. LSI Lightron, Inc., Trim Series, 206CFLH

B. Perimeter Lights
   1. LSI Lightron, Inc., Series 99W
   2. LSI Lightron, Inc., Series 900
   3. Prudential Lighting, P-60-2T8-04-NS-TMW-D2
   4. Prudential Lighting, IT8-04' (08")-BLA-SC-X4B-B

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned luminaires, lamps, and accessories.

B. Extend existing interior luminaire installations using materials and methods compatible with existing installations, or as specified.

C. Clean and repair existing interior luminaires to remain or to be reinstalled.

3.2 INSTALLATION

A. Provide labor and materials to install and structurally support fixtures in accordance with all applicable codes and safety practices.

> **NOTE:** Provide additional labor and materials necessary to install color and/or diffusion media in light fixtures as determined by a professional lighting designer. Locate lamps so that they are accessible utilizing standard ladders and lifts.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

A. Provide labor and materials for aiming and adjustment of all fixtures, color and/or diffusion media, and accessories under the Lighting Consultant’s supervision.

3.5 CLEANING

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

A. Re-lamp all luminaires that have failed lamps at Substantial Completion.

> **NOTE:** The recommended illumination levels (in footcandles) for the public areas of the Terminals are as follows:
>
> - Arrival (Exterior) = 5-10FC
> - Artwork and Displays = 40-50FC
> - Back of House Areas
>   - General illumination for working areas = 25-35FC
>   - Corridors and stairways = 5-10FC
> - Baggage Handling = 35-45FC
> - Concessions and Food Courts
>   - General illumination = 15-20FC
>   - Work surfaces = 35-45FC
> - Concourse = 10-15FC
> - Departure (Exterior) = 5-10FC
> - Information Desks = 30-40FC
> - Restrooms = 10-15FC
> - Retail
>   - General illumination = 20-25FC
>   - Accenting = 40-50FC
> - TSA / Security
>   - General illumination = Per current TSA guideline
> - Ticketing
>   - General illumination = 15-20FC

END OF SECTION 26 51 00

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories.

> **NOTE:** Consider the use of pendant lighting that may make the fixture more accessible for routine maintenance. Linear lighting is preferred over typical "can" down lights.
>
> General illumination lighting in passenger terminal public restrooms may be provided by energy-saving compact fluorescent downlights (center of room). Supplemental lighting in passenger terminal public restrooms may be provided by wall washers or cove lights at the back of the toilet compartments, above the urinals and above wash basins. The emergency light fixture is to located above the wash basins.

1.2 REFERENCES

A. American National Standards Institute:

1. ANSI C82.1 - American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
2. ANSI C82.4 - American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

B. Illuminating Engineering Society of North America

C. UL Underwriters Laboratories

D. ETL Intertek Testing Services

E. NEC National Electric Code

F. NEMA National Electrical Manufacturers Association

G. CBM Certified Ballast Manufacturers

1.3 DEFINITIONS

A. BF: Ballast Factor

B. CCT: Correlated Color Temperature

C. HID: High Intensity Discharge

D. LED: Light Emitting Diode

E. LER: Luminaire Efficiency Rating

F. Lumen: Measured output of luminaire, lamp, or both.

G. Luminaire: Complete lighting fixture, including driver or ballast if included

1.4 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.

B. Product Data: Submit dimensions, ratings, and performance data.

C. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum two years documented experience.

B. Photometric Data: For qualified agencies providing photometric data for lighting fixtures.

1.6 QUALITY ASSURANCE

A. Provide Luminaire Data Photometric Testing performed by an independent agency complying with IESNA Lighting Measurement Testing and Calculation Guides.

B. Comply with NFPA 70.

1.7 MOCK-UP

A. Quality Requirements: Mock-up requirements.

1.8 FIELD MEASUREMENTS

A. Verify all critical measurements in the field prior to fabrication.

1.9 COORDINATION

A. Coordinate layout and installation of light fixtures with other construction.

1.10 MAINTENANCE MATERIALS

A. Execution and Closeout Requirements: Spare parts and maintenance products.

1.11 WARRANTIES

A. All fixtures and workmanship shall be guaranteed free of defects and fully operational for the duration of the warranty period. Defective fixtures or workmanship will be replaced by the Contractor at no cost to the Owner.

B. Ballasts for fluorescent fixtures, transformers for low voltage fixtures, and drivers for LED fixtures shall be warranted against defects in workmanship or material. Warranty to provide for replacement of fluorescent ballasts, transformers for low voltage fixtures, and LED drivers at no cost to the Owner.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

> **NOTE:** Highly efficient LED fixtures with consistent color temperature (tight binning), high Color Rendering Index (85+ CRI), and rated life greater than 50,000 hours are preferred.
>
> All lighting fixtures shall be recessed, surface mounted if the existing condition dictates.

A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

2.2 LED LIGHTING FIXTURES AND COMPONENTS

A. Manufacturers:

1. Lighting Science Group.
2. Con-Tech Lighting.
3. Bega Lighting.
4. Lunera Lighting.

B. Product Testing: Comply with U.L. 1598 and 8750. Test according to IES LM-79 and LM-80.

C. Drivers: Operation to be at standard rated voltage of driver, and not “over-driven.”.

> **NOTE:** T8 and compact fluorescent lamps/ballasts are recommended for use on the project. Minimize the lamp types for stocking and purchasing purposes.

2.3 FLUORESCENT BALLASTS

A. Manufacturers:

1. Philips.
2. Osram.
3. General Electric.

B. Product Description: Electronic ballasts shall be instant start and designed for the type and quantity of lamps served. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated. Comply with ANSI C82.11.

2.4 FLUORESCENT DIMMING BALLASTS AND CONTROLS

A. Manufacturers:

1. Philips.
2. General Electric.
3. Lutron.

B. Product Description: Electrical assembly of control unit and ballast to furnish smooth dimming of fluorescent lamps.

C. Control Unit: Selected for energy efficiency and daylight harvesting capability.

D. Ballast: Selected by dimming system manufacturer as suitable for operation with control unit and suitable for lamp type and quantity specified for luminaire.

2.5 LED LAMPS

A. Manufacturers:

1. General Electric.
2. Osram.
3. Philips.

> **NOTE:** Incandescent or halogen lamps **not** recommended for use on the project unless the lamp life exceeds 10,000 hours.For fluorescent lamps, a color rendering of 80+ CRI, and color temperatures of 2800-3500 Kelvin are preferred.

~~2.6 INCANDESCENT LAMPS~~

~~A. Manufacturers:~~

~~1. Tivoli.~~
~~2. Ushio.~~

~~2.7~~2.6 FLUORESCENT LAMPS

A. Manufacturers:

1. Philips.
2. Osram.
3. General Electric.

~~2.8~~2.7 LIGHTING CONTROL SYSTEM

A. Product Description: Complete programmable system allowing for daylight harvesting, DMX-512 fixture control, and interfacing with existing Building Automation Control system in accordance with LEED guidelines.

B. System Commissioning: Provide labor and temporary equipment as required to commission lighting control system in accordance with LEED guidelines.

C. Level Setting: Provide labor and temporary equipment necessary to set and program dimmed and DMX-controlled lighting levels under the Lighting Consultant’s supervision.

D. Owner Training: Schedule and provide user training sessions for designated LAWA personnel.

~~2.9 LIGHTING FIXTURES~~

~~A. Downlights~~
1. ~~Lightolier, 1002F1~~
2. ~~Lightolier 1045, Lytecaster Recessed Downlight~~
3. ~~LSI Lightron, Inc., Trim Series, 206CFLH~~

~~B. Perimeter Lights~~
1. ~~LSI Lightron, Inc., Series 99W~~
2. ~~LSI Lightron, Inc., Series 900~~
3. ~~Prudential Lighting, P-60-2T8-04-NS-TMW-D2~~
4. ~~Prudential Lighting, IT8-04’ (08”)-BLA-SC-X4B-B~~

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned luminaires, lamps, and accessories.

B. Extend existing interior luminaire installations using materials and methods compatible with existing installations, or as specified.

C. Clean and repair existing interior luminaires to remain or to be reinstalled.

3.2 INSTALLATION

A. Provide labor and materials to install and structurally support fixtures in accordance with all applicable codes and safety practices.

> **NOTE:** Provide additional labor and materials necessary to install color and/or diffusion media in light fixtures as determined by a professional lighting designer. Locate lamps so that they are accessible utilizing standard ladders and lifts.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

A. Provide labor and materials for aiming and adjustment of all fixtures, color and/or diffusion media, and accessories under the Lighting Consultant's supervision.

3.5 CLEANING

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

A. Re-lamp all luminaires that have failed lamps at Substantial Completion.

NOTE: The recommended illumination levels (in footcandles) for the public areas of the Terminals are as follows:

- Arrival (Exterior) = 5-10FC
- Artwork and Displays = 40-50FC
- Back of House Areas
  - General illumination for working areas = 25-35FC
  - Corridors and stairways = 5-10FC
- Baggage Handling = 35-45FC
- Concessions and Food Courts
  - General illumination = 15-20FC
  - Work surfaces = 35-45FC
- Concourse = 10-15FC
- Departure (Exterior) = 5-10FC
- Information Desks = 30-40FC
- Restrooms = 10-15FC
- Retail
  - General illumination = 20-25FC
  - Accenting = 40-50FC
- TSA / Security
  - General illumination = Per current TSA guideline
- Ticketing
  - General illumination = 15-20FC
  - Work Surfaces = 35-45FC

END OF SECTION 26 51 00

SECTION 27 05 00 – BASIC TELECOMMUNICATION REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational systems shown and described in the Specifications.

B. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

C. The Contractor shall coordinate interfaces to existing systems that are being extended in the Project in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA (refer to Section 27 05 05 – Selective Demolition Telecommunication Systems).

D. The Contractor shall coordinate specialty electronic, ACAMS, Information Technology (IT) data networks, common use and flight information systems and displays, CCTV, public address and any other IT infrastructure systems.

E. Related documents included in the specification requirements:

1. LAWA Information Management and Technology Group Infrastructure Standards of Practice, dated 04/01/11.
2. LAWA IT Requirements for New Concessions Model.
3. Section 01 11 00 – Summary of Work
4. Section 01 25 00 – Substitution Procedure
5. Section 01 31 00 – Administrative Requirements
6. Section 01 33 00 – Submittal
7. Section 01 40 00 – Quality Requirements
8. Section 01 43 00 – Quality Assurance
9. Section 01 64 00 – Owner Furnished Products
10. Section 01 77 13 – Preliminary Closeout Reviews
11. Section 01 77 16 – Final Closeout Review
12. Section 01 78 00 – Close Out Submittals
13. Section 27 11 00 – IT Communication Rooms (Telecom & MPOE) Requirements

F. Products furnished (but not installed) under this section:

G. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Abbreviations and Acronyms

1.	ANSI	American National Standards Institute
2.	ASTM	American Society for Testing Materials
3.	BFU	Board of Fire Underwriters
4.	BICSI	Building Industry Consulting Services International
5.	CSA	Canadian Standards Association
6.	DEC	Department of Environmental Conservation
7.	EIA	Electronics Industry Association
8.	ER	Equipment Room
9.	FCC	Federal Communications Commission
10.	FM	Factory Mutual
11.	IEEE	Institute of Electrical and Electronics Engineers
12.	ISO	International Standards Organization
13.	NEC	National Electrical Code
14.	NEMA	National Electrical Manufacturers' Association
15.	NESC	National Electrical Safety Code
16.	NFPA	National Fire Protection Association
17.	OSHA	Occupational Safety and Health Administration
18.	TIA	Telecommunications Industry Association
19.	TR	Telecommunications Room
20.	TWC	Tenant Wiring Closet
21.	UFBC	Uniform Fire Prevention and Building Code
22.	UL	Underwriter's Laboratories, Inc.

B. Codes, Standards, and References

1. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

   a. ANSI C80.1 Rigid Steel Conduit, Zinc-Coated

   b. ANSI C80-3 Electrical Metallic Tubing, Zinc-Coated

   c. ICEA S-83-596 Optical Fiber Premises Distribution Cable

   d. TIA-455-107 FOTP-107 Determination Of Component Reflectance Or Link/System Return Loss Using A Loss Test Set

   e. ANSI/TIA/EIA-455 Test Procedures For Fiber Optic Fibers, Cables, TR

   f. ANSI/TIA/EIA 455-57 Optical Fiber End Preparation and Examination

   g. ANSI/TIA/EIA 455-59 Optical Time Domain Reflectometry

   h. ANSI/TIA/EIA 455-60 OTDR Measurement Of Fiber Optic Cable Length

   i. ANSI/TIA/EIA -526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

   j. ANSI/TIA/EIA 526-14 OFSTP-14 Optical Power Loss Measurements Of Installed Multimode Fiber Cable Plant

   k. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09

   l. ANSI/TIA/EIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling Components and Standards, April, 2010

   m. ANSI/TIA/EIA-568-C.3 Optical Fiber Cabling Components Standard, June, 2008

   n. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009

   o. ANSI/TIA/EIA 598-C Optical Fiber Cable Color Coding, 2005

   p. ANSI/TIA/EIA -604-1 Fiber Optic Connector Intermateability Standard, 2002

   q. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08

   r. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994

   s. ANSI/TIA/EIA –758-A Customer-Owned Outside Plant Telecommunications Infrastructure Standard 2004

   t. ANSI/TIA/EIA – 854 A Full Duplex Ethernet Specification for 1000Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001

   u. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

v. ANSI/TIA/EIA-4750000B Generic Specifications for Fiber Optic Connectors

w. ASTM E814 Standard Test Method For Fire Tests Of Penetration Firestop Systems

x. BICSI Telecommunications Distribution Methods Manual (Tenth Edition)

y. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications

z. IEEE National Electrical Safety Code (NESC); 2007

aa. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises

bb. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code

cc. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)

dd. NFPA-70 National Electric Code; 2008

ee. TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems

ff. TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines

gg. TIA/EIA TSB 75 Additional Horizontal Cabling Practices for Open Offices

hh. TIA/EIA TSB 95 Additional Transmission Performance Guidelines For 4-Pair 100 Ohm Category 5 Cabling

ii. UL 1459 Underwriters Laboratories Standard for Safety – Telephone Equipment

jj. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

2. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a letter of approval or other certification from the manufacturer indicating that the Bidder is a manufacturer certified installer of the proposed cabling system(s) (submit with Bid).

C. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project. Submit a two-foot length sample of each fiber cable type/count to be installed.

D. Submit manufacturers' data sheets for proposed racks and cabinets, termination equipment, cable management or support hardware, power and grounding equipment, and labeling material.

E. Submit manufacturers' instructions for storage, handling, protection, examination, preparation, operation, and installation of all products. Include any application conditions or limitations of use stipulated by any product testing agency.

F. Submit all applicable Material Safety Data Sheets.

G. Submit all factory test information of cables prior to installation of the product.

H. Submit a complete test plan (and subsequent test data) per ANSI/TIA/EIA-568-C and ANSI/TIA/EIA TSB-67 for all cabling.

I. Submit (5) hardbound copies of all cable test results and one electronic compact disc

J. Submit calibration reports for all test equipment, the calibration shall be performed by a manufacturer certified calibration facility and be dated no more than sixty (60) days prior to the start of testing.

K. Submit all proposed labeling materials and nomenclature for approval.

L. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.
2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.
3. Layout of Telecommunication Rooms: Within thirty (30) days before beginning installation, the Contractor shall furnish a telecommunications room drawing showing the initial layout design and plans for the proposed equipment, cable routings, and termination locations for all cable and equipment.

M. Project Record Documents required include:

1. Marked-up copies of Contract Drawings
2. Marked-up copies of Shop Drawings
3. Newly prepared Drawings
4. Marked-up copies of Specifications, Addenda and Change Orders
5. Marked-up Project Data submittals
6. Record Samples
7. Field records for variable and concealed conditions
8. Record information on Work that is recorded only schematically
9. As-built drawings
10. Record drawings
11. Electronic as-built and LAWA LUSAD requirements

N. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

O. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.

2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

P. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Manuals: Manuals including maintenance instructions and other descriptive material as received from the manufacturers shall be provided that will enable LAWA personnel to maintain equipment and test equipment. The Contractor shall make reasonable effort to obtain specified maintenance documentation for all third party equipment. This documentation shall include descriptions, specifications, theory of operation (where applicable), layout drawings (showing component types and positions), and back-panel and assembly wiring diagrams. In addition to hardcopies, electronic copies, in a Design Consultant approved format, shall be provided.

B. Preventative Maintenance: Instructions shall be provided for preventive maintenance procedures that include examinations, tests, adjustments, and periodic cleaning. The manuals shall provide guidelines for isolating the causes of hardware malfunctions and for localizing faults. The manuals shall provide thorough instructions on the use of any specialized test equipment needed for hardware maintenance. In addition to hardcopies, electronic copies, in a Design Consultant approved format, shall be provided.

C. Maintenance Schedule: A recommended schedule for preventative, routine, and emergency maintenance indicating frequency and response time. Preventative maintenance services during peak activity periods shall be avoided. The Contractor shall coordinate with LAWA to define peak activity periods. The Contractor shall submit a finalized preventative maintenance schedule for Design Consultant approval.

1.07 QUALITY ASSURANCE

A. Contractor Experience: The Contractor or approved sub-contractor shall be a Certified Cable Installer, with the capability of providing a manufacturer's certification of not less than fifteen (15) years for the horizontal and backbone cabling and associated termination equipment. The Contractor shall offer proof of certification by submitting a copy of certification with the Bid.

B. The Contractor shall have at least one (1) Registered Communications Distribution Designer (RCDD) on staff. The Contractor shall offer proof of RCDD certification by submitting a copy of the certification with the Bid. The Contractors RCDD shall be part of the Contractors team throughout the duration of the project to assist on shop drawings and other related technical issues.

C. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant/LAWA may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.13).

1.08 DELIVERY, STORAGE AND HANDLING

1.09 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.10 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
2. Equipment shall meet all applicable FCC Regulations.
3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.
5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.
6. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.
7. All components of an assembled unit need not be products of the same manufacturer.
8. Constituent parts, which are alike, shall be from a single manufacturer.
9. Components shall be compatible with each other and with the total assembly for intended service.
10. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

B. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

C. Major items of equipment that serve the same function must be the same make and model.

D. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

E. Maximum standardization of components shall be provided to reduce spare part requirements.

1.11 FIELD CONDITIONS

A. Installation and testing crews shall have completed all appropriate training in copper and fiber cabling installation as required by the manufacturer.

B. The Contractor shall employ the maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection or configuration of ACAMS or other existing systems that might be affected by this Work.

C. The Contractor shall provide all new UTP cable, optical fiber cable, innerduct, racks, cabinets, patch panels, cover plates, outlet boxes, related hardware, distribution, termination equipment, and any other appurtenances and equipment associated with this project.

D. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

E. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation.

F. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

G. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

H. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

I. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

J. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

K. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the LAWA so the area can be appropriately noted.

L. Following each day’s work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

1.12 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of fifteen (15) years from Final Acceptance. Cable integrity and associated termination’s shall be thoroughly inspected, fully tested and guaranteed as free from defects, transpositions, opens-shorts, tight kinks, damaged jacket insulation, etc.

B. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

C. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

D. The Bidder shall submit a copy of all manufacturer warranty information.

E. The structured cabling system manufacturer of the cable products to be submitted shall provide a minimum fifteen (15) year extended product warranty and application assurance (system performance warranty). The warranty shall provide the following:

1. Ensure against all product defects.
2. Ensure that all copper and fiber approved cabling and components meet or exceed the specifications of ANSI/TIA/EIA-568-C and ISO/IEC IS 11801, meet or exceed the NEXT requirements of ANSI/TIA/EIA TSB-67, TSB-95 and ISO/IEC IS 11801 for cabling links/channels.
3. Ensure that the installation of copper and fiber components will meet or exceed the loss and bandwidth requirements of ANSI/TIA/EIA TSB-67, TSB-95 and ISO/IEC IS 11801 for a fifteen year period.
4. Cover the repair or replacement of defective products, and the labor for repair or replacement of such defective products.
5. Application assurance which shall cover the failure of the cabling system to support the application which it was designed to support, as well as additional applications introduced in the future by recognized standards or user forums that use the ANSI/TIA/EIA-568-C or ISO/IEC IS 11801 component and link/channel specifications.

F. The Bidder shall submit a letter of approval or other certification from the manufacturer indicating that the Bidder is a manufacturer certified installer of the proposed cabling system (submit with bid).

PART 2 - PRODUCTS

2.01 EQUIPMENT CABINETS

A. LAWA standard telecommunications room equipment cabinet is 28”W x 36”D x 84”H DAMAC MODEL CSN1284Z23077-3 (part number includes cooling fans, enclosure light, power strips, cable managers).

1. For raised floor applications provide DAMAC raised floor seismic support kit
2. Some applications (blade servers or data switches) require deep (42”) cabinets (DAMAC MODEL CSN1284Z23079-3. Refer to Drawings.
3. Equipment mounting rails shall be 45U, EIA standard, with RMU markings, fully adjustable.
4. Provide (2) 4” cutouts and (2) 6” long 4” conduit sleeves in top for cable routing.
5. Provide waterproofing seals for each conduit sleeve (STI products #FP400 4” fire stop plug or equal).

B. Relay Racks (DAMAC MODEL RSE19084-3 or for extra heavy rack loading DAMAC MODEL R4A19084B-3MU

1. 19-inch rack mounting space.
2. 84 inches high.
3. Lightweight aluminum construction.
4. Black polyurethane finish.
5. 15-inch deep base with four (4) ¾-inch bolt down holes.

C. Each rack shall have double-sided tapped holes with standard EIA hole pattern.

D. Each rack shall be equipped with a 12-position power strip. Power strip:

1. Shall be 20 amp, 120V.
2. Shall be rack mounted.
3. Shall be non-switched.
4. Shall be surge suppressed.
5. Shall have a minimum of twelve (12) outlets – transformer spaced.
6. Power shall be hardwired.

E. Relay racks shall meet UL 1363 and 1449 requirements.

F. Vertical Cable Channel:

1. Each rack will have an integral vertical cable channel with a minimum of 6 inches by 4 inches of channel space to facilitate the management of the cables entering the rack from the cable tray.

G. There shall be horizontal and vertical cable management associated with all cabinets and racks.

H. The cable management products shall meet the following requirements:

1. Cable management panels shall be metal or plastic with integral wire retaining fingers.
2. Cable management panels shall have removable covers.

2.02 CABLE TRAY

A. Cable Trays installed other than in Telecommunication Rooms will be Legrand Cablofil Cable Tray CF 54 and CF105 (or equivalent) as indicated on Drawings, installed per Manufacturer's recommendations and instruction. Cable tray shall be UL Classified as an equipment grounding conductor and shall meet NEC Article 318.

1. Cable tray shall be supported as follows:
   a. Where tray is adjacent to TR wall it will be supported by Unistrut mounting brackets as indicated in construction Drawings.
   b. Where tray is suspended above equipment cabinets it shall be supported by a single center support consisting of ½-inch threaded rod suspended from structure above as indicated in construction Drawings.
      1) Thread rod shall be fitted with a 6-inch PVC tube where it resides in cable tray to protect cables.

B. Cable management and routing in all Telecommunications Rooms will be via 6 inch deep cable tray (Chalfant Series 6 or equivalent) in widths as indicated on Drawings.

2. Cable tray shall be UL Classified as an equipment grounding conductor and shall meet NEC Article 318-5.
3. Cable tray shall be louvered ventilated construction with louvered openings minimum 3 inches wide. Cable bearing surface shall be 3 inches wide. Openings shall be on 6-inch centers with metal drawn downward so cables can drop out at any location along tray without cutting or gasketing the openings.
4. All cable tray 90 degree elbows, cross fittings and tees shall have 3-inch diameter holes punched out in them at a minimum spacing of 6 inches on center to allow for dropping cables down at corners and tees to equipment below. Holes shall have rubber or hard plastic gaskets installed inside the punched hole to protect cables from sharp edges.
5. Cable tray material shall be 304 stainless steel.
6. Cable tray hardware shall be 3/8 inch by 3/4 inch 302 stainless steel round head shoulder bolts with serrated neck, SS hex nuts shall have an integral lock washer.
7. Cable tray shall be supported as follows:

a. Where tray is adjacent to TR wall it will be supported by Unistrut mounting brackets as indicated in construction Drawings.

b. Where tray is suspended above equipment cabinets it shall be supported by a single center support consisting of ½-inch threaded rod suspended from structure above as indicated in construction Drawings.

1) Thread rod shall be fitted with a 6-inch PVC tube where it resides in cable tray to protect cables.

2.03 UNSHIELDED TWISTED PAIR CABLE

A. Provide CMP rated 4-pair Category 6 UTP cable (orange in color) GENERAL GS6000E or equivalent.

B. Provide 4-port wall mount face plates (almond in color) AMP 1479446-1 or equivalent.

C. Provide Category 6 SL 110 modular jacks (with orange inserts) AMP 1375055-5 or equivalent.

D. Patch cables shall be Belkin A3L980-XX-BLK-S or equivalent.

E. Transmission Characteristics:

1. The UTP connector module shall meet the transmission technical specifications performance when measured at 100 MHz:

a. Parameters Value (dB)

1)	NEXT	55.1
2)	PSNEXT	52.0
3)	FEXT	49.8
4)	PSFEXT	46.9
5)	Attenuation	0.10
6)	Return Loss	27.0

2.04 UTP PATCH PANELS

A. Category 6 patch panels shall meet or exceed the following specifications:

1. Category 6 standard.
2. T568A wired.
3. Have sufficient ports to provide at least 25% growth, per patch panel.
4. Have a paired punch down sequence to allow pair-twist within ½-inch of the termination.
5. Rack mounted.
6. UL listed File # E129878.
7. Made of rolled edge black anodized aluminum construction.

8. Provide orange inserts
9. AMP 1375015-2 plus 1479450-1 or equivalent

B. From the same manufacturer as the other connectivity products (jacks, faceplates, etc.) used for this project.

C. Acceptable Manufacturers:

1. ADC
2. Tyco/AMP
3. Nordx/CDT
4. Ortronics
5. Panduit
6. Systimax

2.05 OPTICAL FIBER CABLE

A. Singlemode Fiber

1. Shall be class IVa Dispersion-Unshifted single mode optical fibers complying with ANSI/EIA/TIA-492BA00 with fiber counts as indicated on drawings.
2. The zero dispersion wavelength shall be between 1300 nm and 1324 nm. The ANSI/EIA/TIA-455-168 maximum value of the dispersion slope shall be no greater than 0.093 ps/km-nm2. Dispersion measurements shall be made in accordance with ANSI/EIA/TIA-455-169 or ANSI/EIA/TIA-455-175.
3. The nominal core diameter shall be 8.7 µm to 10.0 µm with a tolerance of +/- 0.5 um at 1300 nm when measured in accordance with ANSI/EIA/TIA-455-164 or ANSI/EIA/TIA-455-167.

B. Physical Characteristics:

1. Optical fiber riser cable shall have an Underwriters Laboratory rating that meets or exceeds the requirements of UL-1666.
2. The designation “UL®” and either “OFNP” or “OFNR” shall be printed every two (2) feet on the cable jacket.
3. Strength members shall be FGE/Aramid yarn with extruded PVC sub-cable jacket.
4. The cable shall have individual fiber tube colors per TIA/EIA-606 and overall black jacket.
5. The cable shall contain a stiff central member with cables stranded around center.
6. The cable shall contain a ripcord for the outside jacket.
7. The cable shall be suitable for temperatures of -40o to +75o C.

C. Outdoor backbone cables to indoor within fifty feet of the building entrance shall be Corning Altos Cable or approved equal.

D. Outdoor to indoor beyond fifty feet of the building entrance shall be Corning Freedm Cable or approved equal.

E. Indoor backbone cable shall be Corning MIC® Cable (OS2):

1. For 72 minimum use E88-T3131-29 for Plenum and E81-T3131-24 for Riser or approved equal.
2. For 48 fiber use E88-61131-29 for Plenum and E81-61131-24 for Riser or approved equal.
3. For 24 fiber use E88-33131-29 for Plenum and E81-33131-24 for Riser or approved equal.

F. For small conduit or where fiber may be stressed during installation use Corning SMF28e+ glass with clearCurve bend insensitive properties.

G. Fibers connectors shall be SCAPC.

H. Pigtails shall be fusion spliced onto all fiber cables. All pigtails shall have connectors installed and polished by the manufacturer or local cable assembly house. No connectors shall be installed or terminated either in the field or in the contractor's shop. Provide Corning cable six foot length SC/APC polish.

I. Acceptable Manufacturers:

1. Berk-Tek
2. Nordx/CDT
3. CommScope
4. Corning
5. General
6. Systimax

2.06 OPTICAL FIBER PATCH PANELS

A. Patch panels shall be BEJED MODEL BJ-1940A-001 with:

1. BJ-1742C-011 Splice Pads
2. BJ-1646-047 Coupler Plates
3. MIC Cable Furcation Fan-out cable assemblies with SC angled PC Connectors

2.07 INNERDUCT

A. Innerduct shall be installed in all conduits in which fiber cabling is to be installed.

B. All optical fiber cables shall be placed within the innerduct.

C. The innerduct shall be Maxcell fabric innerduct in sizes as indicated on drawings.

2.08 OPTICAL FIBER CABLE TESTER

A. The Contractor shall test all strands of optical fiber cable with an approved Power Meter and Light Source.

B. The tester shall have been calibrated by a manufacturer certified calibration facility. The calibration shall be dated no more than sixty (60) days prior to the start of testing.

C. Acceptable Manufacturers:

1. Corning
2. Fluke
3. Noyes
4. Other approved equal

2.09 HORIZONTAL UNSHIELDED TWISTED PAIR CABLE TESTER

A. Shall perform all tests necessary to certify the horizontal UTP cabling to the requirements of Category 6.

B. Shall be a UL certified Level IV test set calibrated by a manufacturer certified calibration facility. The calibration shall be dated no more than sixty (60) days prior to the start of testing.

C. Acceptable Manufacturers:

1. Fluke
2. WaveTek
3. MicroTest
4. Other approved equal

2.10 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18” above all direct buried services, underground conduits and duct-banks.

F. Acceptable Manufacturers:

1. W.H. Brady

2. Ideal
3. Panduit
4. Other equal

2.11 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

C. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

D. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways. Contractor shall notify Design Engineer if any proposed horizontal pathways may exceed the maximum distance for the purpose it is intended.

E. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways.

F. The maximum allowable Category 6 UTP cable distance (as measured by electronic UTP Test Equipment) between the wall outlet and the serving "Port" on the Ethernet switch in the serving Telecommunications Room is 90 meters. Planned horizontal cable conduit runs that will result in a cable run that exceeds 90 meters shall be pointed out to Engineer before they are installed for appropriate redesign or waiver.

G. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas, such as equipment racks and telecommunications devices.

H. The Contractor shall use existing conduit and surface raceway where possible and practicable. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

I. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed that may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of Engineer and approval received before such alterations are made.

J. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. All TR cabinets and racks shall be mounted a minimum of 36-inches from the wall, any wall mounted equipment, other cabinets, equipment or power panels (or per NEC for voltages exceeding 120VAC).

K. Where required, the Contractor shall be responsible for cutting, patching, coring and associated work for the complete cabling system at no additional cost to the Owner. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

L. All conduit and sleeve openings used by the Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

M. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

N. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

O. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:

1. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.
2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire stop seal between sleeve and wall for drywall construction.
3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.
4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:
   a. Floors – three (3) hours
   b. Corridor walls – two (2) hours
   c. Offices – three-quarters (0.75) hour
   d. Smoke partitions – three-quarters (0.75) – one (1) hour
   e. Provide fire stop pillows for existing cable tray penetrations through firewalls

P. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

Q. The Contractor shall seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits designated for telecommunications use.

R. Spare conduits shall be plugged with expandable plugs.

S. All service entrance conduits through building shall be sealed or resealed upon cable placement.

T. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant.

U. Fiber and Copper Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.
2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.
3. Bundles shall be secured with hook-and-loop cable strap material.
4. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.
5. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.
6. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.02 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.03 INSPECTIONS AND VERIFICATIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.04 FLOOR MOUNTED CABINETS AND RACKS

A. All racks shall be securely anchored to the floor (slab, not floor tile) with a minimum of 1/2-inch drop in anchors and shall be seismically braced to structure to prevent toppling. Mounting shall comply with Seismic Zone 4 requirements. Contractor shall submit proposed mounting method for approval prior to beginning installation. Proposed mounting method submitted shall be stamped by Contractor's Structural Engineer that it meets local codes and Seismic Zone 4 mounting requirements.

B. Provide vertical and horizontal cable management for all cabling installed by this Contractor.

C. Mount with a minimum of 36 inches of clear access behind and in front of cabinets unless otherwise noted on Construction Drawings. Submit all proposed Telecommunications Rooms layouts with dimensions for approval prior to beginning installation.

D. Ground the cabinets and racks to the equipment ground busbar with an insulated #6 copper wire, green in color. Refer to Construction Drawing grounding details for specific requirements.

3.05 CABLE TRAY

A. Cable tray shall be appropriately secured as indicated in Construction Drawings. Mounting shall comply with Seismic Zone 4 requirements. Contractor shall submit proposed mounting method for approval prior to beginning installation. Proposed mounting method submitted shall be stamped by Contractor's Structural Engineer that it meets local codes and Seismic Zone 4 mounting requirements.

3.06 GROUNDING

A. Grounding systems and ground busbars are to be installed in each Telecommunications Room. All equipment cabinets, racks, termination frames, conduits, sleeves, cable tray and other conductive materials shall be bonded to the grounding busbar with #6 AWG insulated conductor. Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.

B. Braided Type Bonding Jumpers: Use for flexible bonding and grounding connections.

C. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Bond all adjacent sections of overhead cable tray with # 6 AWG conductors.

E. Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot tin coated materials to assure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.

3. Aluminum-to-steel connections shall be with stainless steel separators and mechanical clamps.
4. Aluminum-to-galvanized steel connections shall be with tin plated copper jumpers and mechanical clamps.
5. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture to contact surfaces.

F. Exothermic Welded Connections: Use for connections to structural steel or grounding busbar. Comply with manufacturer's written recommendations. Welds that are puffed up or show convex surfaces indicating improper cleaning are not acceptable and will be re-done at Contractor’s expense.

G. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

H. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torque tightening requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.

3.07 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.
2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
3. System wiring has been tested and verified as correctly connected as indicated.
4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.08 OPTICAL FIBER TESTING

A. Factory Test: Prior to shipment of the optical fiber cable, 100 percent of the fibers shall be tested with an optical time domain reflectometer.

1. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum.
2. Copies of the traces shall be furnished as part of the submittals.

B. Pre-installation Test: An optical time domain reflectometer test of every fiber of each cable on the reel prior to installation.

1. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum.
2. Copies of the traces shall be furnished to Architect/Engineer.

C. Contractor's Field Test: The Contractor shall verify the integrity of the installed fiber ring by testing the installed fiber with an optical time domain reflectometer.

1. Tests shall be performed on 100 percent of the fibers and repeated from the opposite end of each fiber.
2. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum.
3. Copies of the traces shall be furnished as part of the submittals.
4. Installed cable optical time domain reflectometer test:
   a. Prior to installation Contractor shall perform onsite, on reel testing under the supervision of Engineer or Design Consultant.
   b. An optical time domain reflectometer test of all fibers shall be performed on the fiber optic cable after it is installed.
   c. The optical time domain reflectometer shall be calibrated to show anomalies of 0.2 dB as a minimum.
   d. If the optical time domain reflectometer test results are unsatisfactory, the cable segment is unacceptable.
   e. The unsatisfactory segments of cable shall be replaced with a new segment of cable at Contractor’s expense.
   f. The new segment of cable shall then be tested to demonstrate acceptability.
   g. Copies of the traces for each circuit shall be furnished as part of the submittals.

D. The Contractor shall provide end-to-end attenuation testing using an approved Power Meter and Light Source per ANSI/EIA/TIA 455-53A.

E. Backbone singlemode fiber shall be tested in both directions at both 1310 nm and 1550 nm in accordance with ANSI/EIA/TIA-526-14A method B.

F. Perform optical attenuation measurements for each optical fiber after both ends of an optical cable have been connectorized, dressed, and mounted into outlets, panels, or frames to show losses of the optical cable, connectors, and couplers. Acceptable link attenuation for backbone cabling shall be as follows:

Optical Fiber cable type Wavelength (nm) - Maximum allowed attenuation (dB/km) and Minimum information transmission capacity for overfilled launch (MHz/km) are shown in the following table:

Optical Fiber Cable Type	**Wavelength (nm)**	**Maximum attenuation (dB/km)**	**Minimum information transmission capacity for overfilled launch (MHz/km)**
62.5/125 µm multimode	850	3.5	200
	1300	1.5	500
Singlemode ISP cable	1310	1.0	N/A*
	1550	1.0	N/A*
Singlemode 8.0 OSP cable	1310	0.5	N/A*
	1550	0.5	N/A*
*Note – The information capacity of the fiber, as measured by the fiber manufacturer, can be used the contractor to demonstrate compliance with this requirement.			

G. General: Cables and components that fail performance tests shall be replaced and retested until they meet the required performance standards.

H. Fiber Optic Cable:

1. Record cable length from either length markings on cable or through OTDR test.
2. After installing connectors perform OTDR on all fibers to evaluate connector loss and validate connector.
3. Loss shall not exceed manufacturer's listed maximum loss for connector type installed.
4. Connector shall be replaced at Contractors expense if it fails test.

3.09 HORIZONTAL UNSHIELDED CABLE TESTING

A. Test all new UTP cables.

B. Testing shall conform to ANSI/TIA/EIA TSB-67 Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems and ANSI/TIA/EIA-568-C.2, Propagation Delay and Delay Skew Specification for 100 Ohm 4-Pair Cable.

C. Testing shall be accomplished using a UL certified Level III tester.

D. Notify Owner of any cable failing the prescribed certification testing.

E. The Contractor shall provide Category 6, 100 MHz channel test results on all pairs of cable, including but not limited to cable length, wire map, NEXT, Power Sum NEXT, ACR, Power Sum ACR, ELFEXT, Power Sum ELFEXT, Return Loss, Propagation Delay and Delay Skew. Results shall be provided in an electronic format.

3.10 BACKBONE CABLE TESTING

A. Testing shall be according to device manufacturer’s specification. Testing for cable integrity after installation shall be performed to include as a minimum, DC resistance, opens or shorts.

3.11 TEST RESULTS

A. Fiber Optic Cables:

1. The Contractor shall test all fiber optic cables and submit all fiber test result data in an electronic format and provide five (5) hard copies of the test results showing graphically, the entire length of the fiber.
2. Reports shall show circuit ID, cursor marks, total attenuation, date of installation and test used.
3. The Contractor shall submit one (1) copy of software capable of viewing the electronic test result files.
4. Contractor shall create and provide a spreadsheet or database summary report of all fiber links to include origin, destination, patch panel, designations, OTDR distances, OTDR and return loss results.

B. Horizontal Copper Cabling:

1. The Contractor shall test all cables and submit all horizontal copper cable test result data in electronic format, with the resulting file formatted with one test result per 8.5-inch x 11-inch page.
2. Files exported and saved as *.txt files shall NOT be acceptable.
3. The Contractor shall submit (1) copy of software capable of viewing the electronic test result files and (1) hardcopy.

3.12 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. All outdoor cables shall be labeled with ACP FT-LAWAATAG-2.5X4 plastic tags and pre-printed with permanent ink, outdoor cables shall be labeled (and secured with heavy duty straps) in every manhole and handhole within 12 inches of where the cable enters and exits the manhole or handhole and on the slack coil.

E. Backbone cables shall be marked at each endpoint and at all intermediate pull/ access points or junction boxes. Label shall indicate origination and destination TR ID's, sheath ID and strand or pair range.

F. Copper and Optical Patch Panels:

1. Patch panels shall be marked using adhesive labels indicating the range of circuits installed to it.

2. Each port shall be labeled with the origination, destination and the individual strand ID.

3.13 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is in the process of procuring and implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.14 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 27 05 00

SECTION 27 05 05 SELECTIVE DEMOLITION TELECOMMUNICATION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

2. Demolition and removal of selected site elements and/or Information Technology (IT), Security or other Special Systems or infrastructure.

3. Salvage of existing items to be reused or recycled.

B. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete demolition and cutover of existing telecommunication systems shown and described in the Specifications.

C. The Contractor is responsible for providing and coordinating phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

D. The Contractor shall coordinate interfaces to existing systems that are being demolished in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA.

E. The Contractor shall coordinate specialty electronic, ACAMS, IT data networks, common use and flight information systems and displays, CCTV, public address and any other IT infrastructure systems.

F. Related documents included in the scope of this work:

Section 01 11 00 – Summary of Work

Section 01 25 00 – Substitution Procedure

Section 01 31 00 – Administrative Requirements

Section 01 33 00 – Submittal

Section 01 40 00 – Quality Requirements and all sub-sections

Section 01 43 00 – Quality Assurance

Section 01 64 00 – Owner-Furnished Products

Section 01 77 13 – Preliminary Closeout Reviews

Section 01 77 16 – Final Closeout Review

G. Products furnished (but not installed) under this section:

H. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Definitions

1. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
2. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner [ready for reuse].
3. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
4. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Demolition Meeting

1. Conduct a pre-demolition meeting at Project Site with LAWA and all affected stakeholders.
   a. Inspect and discuss condition of construction to be selectively demolished.
   b. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   c. Existing telecommunications rooms that have demolition work may involve electrical, mechanical and architectural demolition. Review and coordinate requirements of work performed by other trades.
   d. Review areas where existing construction is to remain and requires protection.
   e. Review procedures to be followed when critical systems are inadvertently interrupted.

1.05 SUBMITTALS

A. Action Submittals

1. Comply with all LAWA submittal procedures given in other Sections.
2. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, dust control and for noise control. Indicate proposed locations and construction of barriers.
3. Submit a Schedule of selective demolition and cutover activities which indicates the following as a minimum:
    a. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and tenants' on-site operations are uninterrupted.
    b. How long IT and security services will be interrupted and when systems cannot be disabled and temporary parallel service is required submit how this is proposed to be accomplished.
    c. The contractor's plan for coordination of shutoff, capping, and continuation of IT and all other utility services.
    d. Use of elevator and stairs.
    e. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
    f. Phone tree and procedures to be followed when critical systems are inadvertently interrupted (for each shift).
4. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
5. Pre-demolition Photographs or Video: Submit before Work begins.
6. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

B. Closeout Submittals

1. Submit a list of items that have been removed and salvaged
2. Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
3. Submit as-built documentation of all remaining IT and security systems conduit and cabling that remains

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE AND HANDLING

1.08 MATERIAL OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.09 FIELD/SITE CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

a. <Insert items to be removed by Owner> .

C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. **<Insert warranted system>.**

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL – SELECTIVE DEMOLITION

A. Demolition and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level. Remove all abandoned cable from origin to destination.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and/or portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

C. Work in Historic Areas: Selective demolition may be performed only in areas of the Project that are not designated as historic. In historic spaces, areas, and rooms or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling".

D. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's designated storage area.

5. Protect items from damage during transport and storage.

E. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
5. Perform testing on reinstalled active systems and get sign-off by a LAWA approved inspector that systems are re-connected and working properly.

F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.02 EXAMINATION

A. Verify that utilities have been disconnected and capped per LAWA approved procedures before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing condition of all IT related conduits and cables from origin to destination and correlate with requirements indicated to determine extent of selective demolition required.

D. Label all conduits and cables with origin, destination and what system they serve.

E. Consult with LAWA to determine whether systems can be disabled or whether a new parallel system needs to be installed.

F. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

G. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

H. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.03 UTILITY SERVICES AND MECHANICAL / ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions.
2. When temporary bypass systems are installed, test and get approval from Engineer before proceeding with demolition of existing systems.
3. For existing equipment cabinets with active components in them, provide an air tight dust seal around the cabinet and circulate cooling air with a portable air conditioning unit or other means to ensure equipment does not overheat.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.04 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.05 QUALITY CONTROL

A. Site Inspections

B. Non-Conforming Work

3.06 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.07 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.08 CLOSEOUT ACTIVITIES

END OF SECTION 27 05 05

SECTION 27 11 00 IT COMMUNICATION ROOMS (Telecom & MPOE) REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Requirements in this Section pertains to building new, or expanding Telecom and Minimum Point of Entry Rooms (MPOE)

B. Related Sections included in the specification requirements:

Section 01 11 00 – Summary of Work

Section 01 25 00 – Substitution Procedure

Section 01 31 00 – Administrative Requirements

Section 01 33 00 – Submittal

Section 01 40 00 – Quality Requirements

Section 01 43 00 – Quality Assurance

Section 01 64 00 – Owner Furnished Products

Section 01 77 13 – Preliminary Closeout Reviews

Section 01 77 16 – Final Closeout Review

Section 01 78 00 – Close Out Submittals

Section 07 84 00 – Firestopping

Section 03 82 00 – Concrete Boring

Section 27 05 00 – Basic Telecommunication Requirements

Section 23 81 23.13 - HVAC for Telecom Rooms

Section 23 81 23.16 - HVAC for MPOE Rooms

Section 27 11 26.13 - UPS for Telecom Rooms

Section 27 11 26.16 - UPS for MPOE Rooms

C. Products furnished (but not installed) under this section:

D. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Abbreviations and Acronyms

1. ANSI American National Standards Institute
2. ASTM American Society for Testing Materials
3. BFU Board of Fire Underwriters
4. BICSI Building Industry Consulting Services International
5. CSA Canadian Standards Association
6. DEC Department of Environmental Conservation
7. EIA Electronics Industry Association
8. ER Equipment Room
9. FCC Federal Communications Commission
10. FM Factory Mutual
11. IEEE Institute of Electrical and Electronics Engineers
12. ISO International Standards Organization
13. NEC National Electrical Code
14. NEMA National Electrical Manufacturers' Association
15. NESC National Electrical Safety Code
16. NFPA National Fire Protection Association
17. OSHA Occupational Safety and Health Administration
18. TIA Telecommunications Industry Association
19. TR Telecommunications Room
20. TWC Tenant Wiring Closet
21. UFBC Uniform Fire Prevention and Building Code
22. UL Underwriter's Laboratories, Inc.

B. Codes, Standards, and References

1. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

   a. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08

b. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994

c. ANSI/TIA/EIA –758-A Customer-Owned Outside Plant Telecommunications Infrastructure Standard 2004

d. ANSI/TIA/EIA – 854 A Full Duplex Ethernet Specification for 1000Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling, 2001

e. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

f. ASTM E814 Standard Test Method For Fire Tests Of Penetration Firestop Systems

g. BICSI Telecommunications Distribution Methods Manual (Tenth Edition)

h. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications

i. IEEE National Electrical Safety Code (NESC); 2007

j. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises

k. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code

l. NFPA-70 National Electric Code; 2008

2. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. Action Submittals

1. The contractor shall submit cut-sheets (submittals) for each component to be used before the installation begins. The cut-sheets must be organized in a binder with an index identifying each component. All components must be compatible with and meet the performance specifications outlined in this document. Index the material cut-sheets by manufacturer and type of component.

2. The following project work activities should be documented and recorded:

a. Statement of work to be performed

b. Project schedules

c. Minutes of meetings

d. Cell phone numbers of all Contractors’ project supervisory staff

e. Emergency contact lists

f. Miscellaneous notes and photos

B. Close-out Submittals

1. The contractor will also submit final cut-sheets at the end of the project that include any changes or additional components. Three (3) hardcopies of these submittals must be provided in a binder.

C. Maintenance Submittals

1.06 QUALITY ASSURANCE

A. Equipment Certification - Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as “acceptable” does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

6. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

7. All components of an assembled unit need not be products of the same manufacturer.

8. Constituent parts, which are alike, shall be from a single manufacturer.

9. Components shall be compatible with each other and with the total assembly for intended service.

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to LAWA all evidence to support the contention that the item proposed for substitution is equal to the specified item. LAWA's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Submit manufacturers' instructions for storage, handling, protection, examination, preparation, operation, and installation of all products. Include any application conditions or limitations of use stipulated by any product testing agency.

1.09 FIELD/SITE CONDITIONS

A. Material And Work

1. The Installer shall protect all finished and unfinished work against loss or damage until the final acceptance of the completion of the entire project.

2. In the event of a loss or damage, the Installer shall promptly notify the LAWA ITG Project Manager.

3. Protection Of Person(s) And Property

4. The Installer shall not interfere with the airlines and/or passenger circulation or tenants in front of or within the terminals, in the parking structures, or on the airfield during the course of the installation without obtaining prior permission from both LAWA ITG and the airline or tenant.

5. The Installer shall protect all persons and all private and public property from hazardous conditions, damage, injury, and death during the course of the installation. These precautions shall include, but shall not be limited to cordoning off the Installer's construction area with lights, barricades, enclosures and sufficient guards at and about the construction site.

6. The Installer shall promptly notify the LAWA ITG Project Manager after the occurrence of such damage, loss or injury and shall prepare a full and complete written report to the LAWA ITG Project Manager within 24-hours**.**

7. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast

integral with, stamped or otherwise permanently marked upon the components of the equipment.

8. Major items of equipment that serve the same function must be the same make and model.

9. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

10. Maximum standardization of components shall be provided to reduce spare part requirements.

11. The Contractor shall obtain the approval the Design Consultant and LAWA for the final layout of telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation.

1.10 WARRANTY

PART 2 – PRODUCTS

2.01 DESIGN REQUIREMENTS

A. Environment

1. Critical requirement. The environment surrounding the location of the IT room must be free from sources of electromagnetic interference.
2. Critical requirement. The immediate environment surrounding an IT room cannot contain equipment such as steam boilers, compressors, chilled/hot water pipes, elevator equipment, electrical co-generation equipment, or waste processing.
3. The location must be above any potential flood zones, including being located below rest rooms and restaurants.
4. Critical requirement. IT rooms need be located away from flying dirt and debris (i.e. airline equipment ramps). If that is not feasible, then the IT rooms shall have positive ventilation and magnetic gasketing.
5. IT rooms need to be accessible from a corridor, stairwell, and/or a service elevator large enough for cabinet and equipment loading and servicing.

B. Location

1. Critical requirement. The location and quantity of telecommunications rooms shall be designed so that the maximum distance from the IT room to any field device that the room supports shall not exceed 250 feet via the longest possible route (i.e. right angles) traveled by the cable from the room to the field device. This includes all work area outlets, ACAMS card readers, cameras, access points, displays, antennas, etc.
2. Critical requirement. If the distance from the IT room to the furthest field device exceeds 250‟ via the longest possible route, then another IT room shall be installed to accommodate the distant field devices.
3. Where feasible, to maximize coverage of an IT room, IT rooms should be located near the center of the floors that they serve, and there shall be a minimum of at least one IT room per floor.
4. All field devices shall be fed from an IT room on the same floor where that field device is installed. That is, where feasible, field devices should not be fed from IT rooms on levels above or below.
5. Critical requirement. Within a building, if there are two or more IT rooms per floor, then the distance from one IT room to an adjacent IT room shall not exceed 500 feet via the longest possible pathway route (i.e. right angles).
6. If more than one IT room is installed within a building, then a Main IT room shall be identified that shall be larger than the other IT rooms.
7. LAWA IT rooms, closets, or equipment rooms shall not be used by tenants for their equipment. Tenants shall install all communications equipment within their leasehold.

8. In a multi-level building, IT rooms on different floors should stack on top of each other. Straight vertical cable risers should be established for the purpose of cable routing.
9. Buildings with special shapes and sizes shall be considered on an individual basis.

C. Size

1. Design standards shall address two room types/sizes:

   a. IT Telecom Rooms that contain six to seven equipment cabinets plus one or two UPS cabinets – 11’ x 24’ or approximately 264 sq. ft. It is preferable to have the UPS in one cabinet footprint – leaving seven equipment cabinets.

   b. Minimum Point of Entry (MPOE) Rooms that contain eight to nine equipment cabinets plus one to two UPS cabinets 12’ x 30’ or approximately 360 sq. ft. It is preferable to have the UPS in one cabinet footprint – leaving nine equipment cabinets.

2. All room sizes, orientation, and layout shall be reviewed with LAWA for approval before final design / bid.

D. Construction

1. General IT rooms within buildings may be constructed with materials similar to the surround architecture.
2. IT equipment rooms shall be constructed with concrete block walls and lined with an electromagnetic interference prevention material.

E. Ceiling

1. Drop or false ceilings are not permitted
2. Minimum Ceiling height is eight feet, six inches (8’6”)
3. Requested ceiling height is ten feet

F. Flooring

1. Raised access floors shall not be permitted
2. Shall be covered with an anti-static vinyl
3. Floor loading for general IT rooms shall be a minimum of 100 lbf/ft^2
4. Floor loading for large IT equipment rooms shall be a minimum of 200 lbf/ft^2

G. Seismic Bracing

1. Contractors shall provide seismic restraint of all infrastructure and equipment installed in Telecom and MPOE rooms. All infrastructure supports and anchoring shall meet seismic zone 4 requirements with importance factor 1.5 for essential facility rating.

H. Walls

1. Walls without plywood shall be painted while in a semi-gloss finish.
2. Walls with plywood shall be covered with ¾ inch x 4ft x 8 ft, AC –grade, fire-retardant treated plywood with the FR-S stamp on it.
3. The “C” side shall face the studs so that the “Fire retardant” stamp is visible on the “A” side.
4. Cutouts for electrical switches and outlets shall be provided.
5. Important: Plywood shall be painted with two coats of white, fire=retardant, low gloss, paint leaving the FR-S stamps(s) exposed for inspectors.
6. Plywood shall not be fastened with a nail gun or explosive-charge device.

I. Doors

1. Minimum door size is 36 inches x 80 inches.
2. Door should swing outward if local building codes allow.
3. All doors shall have entry and exit ACAMS card reader access.
4. All IT room doors shall be keyed to (TBD) locks to allow opening from the outside, and shall have a mechanism to manually enable and disable the key lock.
5. Important: Plywood shall be painted with two coats of white, fire-retardant, low gloss, paint leaving the FR-S stamps(s) exposed for inspectors.
6. Plywood shall not be fastened with a nail gun or explosive-charge device.

J. Window**s**

1. Windows are not permitted without approval from LAWA prior to final design.

K. Powe**r**

1. Design standards for IT Telecom rooms shall use a maximum 20kVA/16kW for conditioned user equipment loads as the basis for design. Refer to Section 27 11 26.16 for UPS equipment specification.

2. Design standards for IT MPOE rooms shall use a maximum 30kVA/16kW for conditioned user equipment loads as the basis for design. Refer to Sections 27 11 26.13 and 27 11 26.13 for UPS equipment specification.

3. Contractor shall design for the major electrical components including but not limited to:

   a. Electrical Distribution in Room (non-conditioned)
   b. Uninterruptible Power Supply w/power distribution

c. Electrical Panel (conditioned from UPS output)
d. Electrical Distribution to cabinets (conditioned from UPS)
e. Maintenance Bypass Circuit (if required due to input voltage)
f. Batteries (VRLA type)

4. Electrical panels serving the UPS shall be separate from those serving lighting and mechanical equipment.

5. A dedicated 200 amp electrical panel shall be installed within IT Telecom rooms sized between 150 and 230 square feet.

6. Power requirements for larger rooms shall be calculated on an individual basis.

7. Excepting for special circuits, all panels shall be fully populated with 20 amp circuit breakers.

8. Excepting special power requirements, each individual equipment cabinet or equipment rack shall have two separate 120 VAC 20 amp circuits feeding them.

9. Walls with backboards shall have 120 VAC, 20 amp, non-switched, quad-plex wall outlets installed every six (6) feet.

L. Lighting

1. Lighting shall provide a minimum of 50 foot candles measured at three foot, three inches (3’3”) above the floor.

2. Fluorescent fixtures shall use “cool white” lamps.

3. Dimmer switches shall not be used.

4. Light fixtures shall be centered in the aisles between the low=voltage cable tray segments mounted at a minimum of 8’ 6” above the finished floor. Lights shall not be mounted directly above cable tray.

5. A minimum of fifty percent of all fixtures shall be on emergency power.

M. Grounding/Bonding

1. Within the main telecommunications room there shall be installed a telecommunications main grounding busbar (TMGB).

2. The TMGB shall be grounded to both the electrical grounding entrance facility and the building’s steel exterior wall, or according to the local Authority Having Jurisdiction. The TMGB shall also connect to a telecommunications grounding busbar (TGB) within each IT room via a telecommunications bonding backbone (TBB). Grounding conductors shall be installed to building steel with clamps designed for the purpose.

3. The TMGB shall be copper busbar of a minimum 4 inches x 10 inches x ¼ inch with a minimum of eight (8) wire connection lugs attached to it. Busbar shall be insulated from its support.
4. The TGB shall be provided for each IT room, and shall be connected to both the closest grounding point in the building's electrical service panel or according to the local Authority Having Jurisdiction, and the building's steel exterior wall.
5. The TBB shall be installed to connect the TMGB to each TGB. Separate conductors shall run from the TMGB to every level within a building. TBB's can be extended from the TGBs in IT rooms on the same level.
6. TBBs shall be sized according to the distance that they need to run, as follows:
   a. # 6 AWG for distances less than 13 feet
   b. #4 AWG for distances between 13 and 20 feet
   c. #3 AWG for distances between 20 and 26 feet
   d. #2 AWG for distances between 26 and 33 feet
   e. #1 AWG for distances between 33 and 44 feet
   f. #1/0 AWG for distances between 44 and 52 feet
   g. #2/0 AWG for distances between 52 and 66 feet
   h. #3/0 AWG for distances between 66 feet
7. For TGBs, a minimum, #6 AWG, stranded, copper, green insulated conductor shall be provided to connect equipment racks and cabinets and cable tray intersystem bonding. All equipment racks and cabinets shall be bonded to each other and to the telecommunications grounding busbar.
8. All grounding conductors shall be protected by installing within ½" conduit.).
9. Isolated grounding receptacles shall be colored orange or marked with an orange triangle.
10. Codes/Standards: Installations are to be performed in accordance with; (1) NEC article 250, (2) NEC article 800, and (3) ANSI J-STD 607-A.
11. Acceptable Product(s): B-Line #SB-477-K Busbar

N. Mechanical

1. Provide and install a dedicated ceiling-mounted air conditioning unit w/reheat and humidification function. Unit shall be installed immediately outside of the IT space to provide for 24 hour service. For Telecom and MPOE rooms, see HVAC requirements; Sections 23 81 23.13 and 23 81 23.16.
2. Air conditioning unit shall be chilled water type. If a suitable chilled water source does not exist, contractor shall coordinate with LAWA to specify a DX system based on existing conditions and using the same capacities as outlined.

3. Air units shall be sized according to max user equipment loads in the space as calculated by the UPS size in kW for both the Telecom room and MPOE room.
4. Inside temperature shall be maintained between 64°F to 75°F, at between 30% and 55% relative humidity.
5. A thermostat shall be provided within the room.
6. All Telecom and MPOE room doors shall be sealed for dust-proofing, have positive ventilation, and all ventilation ducts into the room shall be filtered for dust abatement purposes.
7. Supply ducting and supply diffuser from air unit shall be located above cold aisle in Telecom and MPOE rooms. Return ducting to air unit shall be located above hot aisle in Telecom and MPOE rooms.

O. Fire Systems

1. Provide self-contained double-interlocking pre-action riser system to support Telecom and MPOE Room spaces as required by LAWA. Location of pre-action cabinet shall be outside of Telecom and MPOE spaces and shall be coordinated with LAWA for approval prior to design and installation.
   a. Double interlocked pre-action system shall have an electric / pneumatic valve requiring both low-air signal and detection signal to open the valve.
   b. Double interlocked pre-action system shall have pressure gauges to indicate water supply pressure, priming water pressure, and air pressure, and shall contain an automatic air compressor to fill the system in prescribed time.
   c. Double interlocked pre-action system shall be provided with integral FM approved UL listed butterfly valve installed on the system riser outside of cabinet with test and drain assembly for full-flow testing.
   d. Pre-action valve shall have sight glass to visually confirm water flow upon system activation.
   e. Pre-action system shall be type Reliable Prepak or Viking TotalPac
2. Sprinkler heads shall have wire cages installed to prevent damage and accidental activation.
3. Specialty spaces may require a clean agent fire suppression system. Any clean agent system requirements shall be coordinated with the LAWA prior to design and installation

P. Monitoring Systems

1. Provide monitoring equipment to support both the UPS and mechanical unit. Monitoring equipment shall be compatible with the existing Sitelink system and Sitescan software used to monitor other IT spaces and critical infrastructure. Monitoring equipment shall have interface for future connectivity to Building Management System (BMS).

2. Provide and install SSW-2E Sitelink interface module (or equiv.) allowing for communication with UPS and Mechanical system for integration with Sitescan Web software via BACnet. Module shall be mounted in NEMA-1 wall-mount enclosure within room. Include one external power supply 120VAC/24VAC and startup services. One pair of EIA-422 cable required for both UPS and Air critical.

Q. Plumbing

1. Excepting fire sprinklers required by code, no pipes intended to carry water or any other fluid shall be installed in or above the IT room ceiling. See Fire Section for plumbing requirements related to any pre-action sprinkler systems.

R. Security

1. Entry and exit ACAMS card readers shall be provided for all IT Room doors.
2. All IT room doors shall also be keyed to LAWA A-2 locks to allow opening from the outside, and shall have a mechanism to manually enable and disable the key lock.
3. All IT rooms shall have cameras within the room that connect to the CCTV Management System.
4. Some rooms shall have cameras mounted on the outside of the room watching the entry door. Obtain LAWA direction prior to final design.
5. Some rooms may have intercoms that connect back to the network operations cents. Obtain LAWA direction prior to final design.

S. Conduit Sleeves

1. Conduit sleeves for backbone cabling are not permitted in new construction.
2. All backbone conduits shall terminate either within equipment cabinets or lockable junction boxes with hinged covers, sized as follows:
   a. One 36” x 12” deep junction box for 2 to 4 inch conduits
   b. Two 36” x 12” deep junction box for 5 to 8 inch conduits

T. Clearances

1. Clearances around all electrical and mechanical equipment shall satisfy all local, NEC, and manufacturer’s required clearances.
2. IT Equipment cabinets require a 36” aisle space in front of and behind each cabinet.
3. Applicable Codes/Standards Reference: (1) NEC article 110.26, NEC article 800, and (3) ANSI J-STD 607-A.

U. Cross-Connect Facilities

1. All VOICE backbone and horizontal cables shall be terminated on CAT6 rated, 110 style punch-blocks. All DATA backbone and horizontal cables shall be terminated in jack-fields that are rack-mounted.

V. Cross-Connect Color Coding

1. LAWA ITG does not follow Industry Standards for color-coding backboards and cross-connects.
2. Backboards shall be painted white until further notice.

2.02 PATHWAYS

A. Conduits

1. General

a. Critical Requirements. All IT rooms shall connect to the main telecommunication rom (MPOE) with a minimum of two 4-inch conduits.

b. Critical Requirement. Adjacent IT rooms shall connect to each other with a minimum of two 4-in conduits.

c. Critical Requirement. Within passenger terminals there shall be a minimum of two sets of two 4-inch, individual, physically separate, redundant, conduit riser pathways feeding each level of the building from the MPOE.

d. Every IT room on the level immediately below the rooftop shall provide for connectivity to the rooftop.

e. Power lines shall not run in communications conduits.

f. EMT and Rigid metallic conduit shall be reamed and have bushings installed.

g. Conduit shall be sized for forty percent (40%) perfect fill.

h. The maximum number of cables that can be installed with two 90-degree bends is 40 percent of perfect fill.

i. Conduit fill shall be reduced by fifteen percent (15%) for each additional 90-degree bend, not to exceed 360 degrees of bend.

j. Conduits shall not run more than 150 feet or have more than two 90degree bends without pull-boxes.

k. Each conduit shall have a pull-string inserted and tied off at each end.

l. One 4-inch conduit entering the IT room and one 4-inch conduit leaving the IT room shall have three (3) 1-¼”, orange-colored, innerducts or four 1-inch orange-colored innerducts installed with pull-strings in each.

m. All conduit bends shall be long sweeping bends.

n. The inside bend radius for conduits sized 2-inches or less shall be a minimum of 6x the internal diameter of the conduit.

o. The inside bend radius of conduits sized greater than 2 inches shall be a minimum of 10x the internal diameter of the conduit.

p. All conduits shall be labeled on both origin and destination ends.

B. Pull Boxes

1. Sized according to the NEC, unless specific sizes are specified.

2. The minimum size pull box for ¾ inch conduit is 12 inches long x 4 inches wide x 3 inches deep (12" x 4" x 3").

3. The minimum size pull box for 4-inch conduit is 60 inches x 15 inches wide x 8 inches deep. (60" x 15" x 8").

4. Conduits shall not run more than 150 feet or have more than two 90 degree bends without pull boxes.

5. Conduit entry points shall be placed at opposite ends of the pull box, if possible.

C. Innerduct

1. Innerduct shall be installed in all conduit systems where fiber optic cable is placed.

2. For new multiple conduit installations, three 1-1/4" innerducts or four 1" innerducts shall be pulled and shall include pull strings (See LAWA ITG for details)

3. LAWA ITG only uses orange-colored innerduct so as not to be confused with other agencies.

4. Acceptable Products:

a. For Plenum installations: Any plenum-rated innerduct that has the plenum rating visibly stamped on the outside innerduct.
b. For Riser Installation: Any plenum-rated or riser-rated innerduct that has the rating visibly stamped on the outside of the innerduct. If the riser transitions to a plenum, then the innerduct shall be plenum-rated.

c. For EMT or rigid conduit installations: Any ribbed PVC innerduct in straight underground installations where the bending radius allows or any corrugated PVC innerduct.

D. Ductbanks

1. Refer to Section 27 05 43 Requirements for Ductbanks, Maintenance Holes, Direct Burial.

E. Cable Tray & Vertical Ladder Runway

1. Overhead Cable tray shall be a standard twelve inches wide and five inches deep and mounted at approximately 8' above finished floor. Ideally, cable trays should be mounted at 12" above cabinets being served.

2. Overhead cable trays installed with Telecom and MPOE rooms shall be installed around the perimeter of the room and over the center-line of the cabinets from wall to wall and tee off at intervals not to exceed six feet.

3. Cable tray shall be aluminum ladder-type flange-in cable tray type PW/Legrand Industries model 4E02 w/ 5 inch rung spacing and NEMA Class B rating.

4. Provide and install with the required radius bends and pre-fabricated corner and Tee fittings of the same type as linear sections to match layout as outlined in shop plans to be approved by LAWA ITG.

5. Coordinate exact cable tray placement over cabinets to facilitate low-voltage cable plant installation via knockouts located on top of cabinets.

6. Cable tray installation shall be supported by a threaded rod trapeze sized and unistrut. All overhead cable tray installation and anchoring shall meet essential facility rating with seismic importance factor 1.5 for Seismic Zone 4.

7. Cable trays parts shall be bonded to a number 6 AWG copper conductor and connected to the grounding busbar.

8. Vertical ladder runway shall be installed on the wall to facilitate cable routing from floor or O/H conduit sleeves to cable tray. In IT rooms, install 24 inch black CPI cable runway mounted to wall for all vertical pathways from floor/ceiling conduits to overhead runway. CPI part number 10250-724 or equal.

9. Cabletrays parts shall be bonded to a number 6 AWG copper conductor and connected to the grounding busbar.

F. Raised Access Floors – Telecom and MPOE rooms shall not have raised floors unless specifically noted by LAWA ITG.

G. Surface Mount – Surface mount raceways shall be used only if there is no other alternative pathway for cables (Consult LAWA ITG).

H. Fire Stopping (also refer to Section 07 84 00)

1. All penetrations made through fire-rated structures by conduits, cables, innerducts, cable trays, and duct banks shall be sealed with approved fire stopping material.

2. Fire stopping materials shall be sufficient to restore the fire-rating of the penetrated structure.

3. Putty-type fire stopping material is preferred for ease of fire stop reentry.

4. Acceptable Product: STI Firestop E-Z Path (or equal)

I. Core Drilling – (Also refer to Section 03 81 00 and 03 82 00)

1. Core drilling concrete floors may be permitted with approval from LAWA Project Management Division provided that structural integrity is not compromised.

2. Ground Penetrating Radar Systems shall not be used.

3. The concrete shall be X-rayed prior to drilling, and that x-ray given to the EPMD along with a request for core drilling.

4. The concrete slurry from the drilling operation shall not be allowed to stain anything either above or below it. Provisions shall be made to protect the environment and contain the slurry.

5. All spillage shall be cleaned up.

6. The core-drilled opening shall be properly firestopped.

2.03 CABINETS AND RACKS

A. Cabinets – Refer to Section 27 05 00 Basic Telecommunications

B. Racks

1. Any use of two-post open frame 19” racks shall be reviewed and approved by LAWA ITG beforehand. Approved part numbers shall be determined at that time.

C. Wall Mounting

1. In special circumstances, if cabinets and racks are not provided, wall mounting is acceptable provided that the equipment is small and the installation can be done securely to the plywood backboard. Any wall-mount equipment plans shall be reviewed and approved by LAWA ITG beforehand.

D. Hardware

1. All fastening hardware used outdoors shall be stainless steel grade 19-8 or better.

2.04 CABLE REQUIREMENTS FOR TELECOM AND MPOE ROOMS

A. Cable General Requirements – Refer to Section 27 05 00 Basic Telecommunications

B. Backbone: For new Telecom and MPOE Rooms install sufficient Backbone UTP / CAT-6 GS6000 cable from the Main IT room to new or expanded IT Room to cover current and future needs for the area served by that particular new or expanded IT Room. CAT-6 cables shall be used as a universal cable for all IT needs, including telephone, data, fax, video, audio, etc. Refer to Section 27-05-00 for cable, termination and testing requirements.

C. Horizontal: Install Single Mode, 4-pair / CAT-6 cable, as required from the new or expanded IT Room shall follow requirements shown I Section 27 05 00 for cable, termination and testing requirements.

2.05 RACKS

A. Any use of two-post open frame 19" racks shall be reviewed and approved by LAWA ITG beforehand. Approved part numbers shall be determined at that time.

2.06 LABELING

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18" above all direct buried services, underground conduits and duct-banks.

F. Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

PART 3 – EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

C. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

D. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways.

E. The maximum allowable Category 6 UTP cable distance (as measured by electronic UTP Test Equipment) between the wall outlet and the serving "Port" on the Ethernet switch in the serving Telecommunications Room is 90 meters. Planned horizontal cable conduit runs that will result in a cable run that exceeds 90 meters shall be pointed out to LAWA before they are installed for appropriate redesign or waiver.

F. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant / LAWA the exact location and mounting height of all equipment in finished areas, such as equipment racks and telecommunications devices.

G. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed that may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of LAWA and approval received before such alterations are made.

H. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. All TR cabinets and racks shall be mounted a minimum of 36-inches from the wall, any wall mounted equipment, other cabinets, equipment or power panels (or per NEC for voltages exceeding 120VAC).

I. Where required, the Contractor shall be responsible for cutting, patching, coring and associated work for the complete cabling system at no additional cost to LAWA. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

J. All conduit and sleeve openings used by the Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

K. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

L. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

M. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:

1. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.

2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:

   a. Floors – three (3) hours

   b. Corridor walls – two (2) hours

   c. Offices – three-quarters (0.75) hour

   d. Smoke partitions – three-quarters (0.75) – one (1) hour

   e. Provide fire stop pillows for existing cable tray penetrations through firewalls

N. Manufacturer's recommended installation standards must be closely followed.

O. The Contractor shall seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits designated for telecommunications use.

P. Spare conduits shall be plugged with expandable plugs.

Q. All service entrance conduits through building shall be sealed or resealed upon cable placement.

R. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of the Design Consultant/LAWA.

S. Fiber and Copper Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.
2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.
3. Bundles shall be secured with hook-and-loop cable strap material.
4. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.
5. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.
6. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.02 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit Installation drawing for LAWA review and approval prior to any construction.

3.03 PREPARATION

3.04 INSTALLATION

3.05 FIELD QUALITY CONTROL - TESTING

3.06 CLEANING

3.07 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all cables, equipment and systems provided by this Contract into this database.

3.08 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.09 CLOSEOUT ACTIVITIES - ACCEPTANCE

END OF SECTION

SECTION 27 11 26.13 Communications Rack Mounted Uninterruptible Power Protection System for Minimum Point of Entry (MPOE) Rooms (30 kVA UPS)

PART 1 – GENERAL

1.01 SUMMARY

A. This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty three-phase, solid-state, uninterruptible power system (UPS). The UPS shall provide high-quality AC power for sensitive electronic equipment loads. This specification provides requirements for the following options:

1. Option #1: MPOE Room UPS Requirement: 30 kVA, Electrical 280V
2. Option #2: MPOE Room UPS Requirement: 30 kVA, Electrical 480V

B. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

C. Related documents included in the specification requirements:

1. Section 01 11 00 – Summary of Work
2. Section 01 25 00 – Substitution Procedure
3. Section 01 31 00 – Administrative Requirements
4. Section 01 33 00 – Submittal
5. Section 01 40 00 – Quality Requirements
6. Section 01 43 00 – Quality Assurance
7. Section 01 64 00 – Owner Furnished Products
8. Section 01 77 13 – Preliminary Closeout Reviews
9. Section 01 77 16 – Final Closeout Review
10. Section 01 78 00 – Close Out Submittals
11. Section 27 05 00 – Basic Telecommunication Requirements

D. Products furnished (but not installed) under this section:

E. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Standards

1. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

   a. ASME

   b. CSA 22.2, No. 107.1

   c. FCC Part 15, Class A

   d. IEC 1000-4-5

   e. ISO 9001

   f. National Electrical Code (NFPA-70)

   g. NEMA PE-1

   h. OSHA

   i. UL Standard 1778

2. The UPS shall be UL listed per UL Standard 1778, and shall be CSA certified.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. Proposal Submittals with the proposal shall include:

1. System configuration with single-line diagrams.
2. Functional relationship of equipment including weights, dimensions, and heat dissipation.
3. Descriptions of equipment to be furnished, including deviations from these specifications.
4. Size and weight of shipping units to be handled by installing contractor.
5. Detailed layouts of customer power and control connections.
6. Detailed installation drawings including all terminal locations.

B. Action Submittals

1. Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) set of instruction manuals that shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

1.06 QUALITY ASSURANCE

A. A minimum of twenty years' experience in the design, manufacture, and testing of solid-state UPS systems is required. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

B. Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.08 DELIVERY, STORAGE AND HANDLING

A. Submit manufacturers' instructions for storage, handling, protection, examination, preparation, operation, and installation of all products. Include any application conditions or limitations of use stipulated by any product testing agency.

1.09 FIELD/SITE – ENVIRONMENT CONDITIONS

A. The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

1. Operating Ambient Temperature
   a. UPS Module: 32°F to 104°F (0°C to 40°C).
   b. Battery: 77°F ±9°F (25°C ±5°C).

2. Storage/Transport Ambient Temperature
   a. UPS Module: -4°F to 158°F (-20°C to 70°C).
   b. Battery: -4°F to 92°F (-20°C to 33°C)

3. Relative Humidity - 0 to 95%, non-condensing.

4. Altitude
   a. Operating: to 3300 ft. (1000 meters) above Mean Sea Level. Derated for higher altitude applications.
   b. Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.

5. Audible Noise – Noise generated by the UPS under any condition of normal operation shall not exceed 54 dBA measured 1 meter from surface of the UPS.

1.10 WARRANTY

A. The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after initial start-up or 18 months after ship date, whichever period expires first.

B. The battery manufacturer's standard warranty shall be passed through to the end user.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Voltage: Input/output voltage specifications of the 30 kVA UPS shall be:
   1. Rectifier Input: 120/208 volts, three-phase, 4-wire-plus-ground.
   2. Output: 120/208 volts, three-phase, 4-wire-plus-ground.

B. Output Load Capacity: Specified output load capacity of the UPS shall be 30kVA/16kW at 0.8 lagging power factor.

2.02 DESIGN REQUIREMENTS

A. Battery Design Requirements for 30 kVA UPS:

   1. Battery Cells: Sealed, lead-acid, valve-regulated.
   2. Reserve Time: 10 minutes at 16kW full load, with ambient temperature of 25°C
   3. Recharge Time: to 95% capacity within ten (10) times discharge time

B. Modes of Operation – The UPS shall be designed to operate as on on-line, double-conversion, reverse-transfer system in the following modes:

   1. Normal – The Critical AC load is continuously supplied by the UPS inverter. The rectifier/charger derives power from a utility AC source and supplies DC power to the inverter while simultaneously float-charging the reserve battery.

   2. Emergency – Upon failure of utility AC power, the critical AC load is supplied by the inverter, which, without any switching, obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.

   3. Recharge – Upon restoration of utility AC power, after a utility AC power outage, the rectifier/charger shall automatically restart, walk-in, and gradually assume the inverter and battery recharge loads.

   4. Bypass – If the UPS must be taken out of service for maintenance or repair, or should the inverter overload capacity be exceeded, the static transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.

2.03 PERFORMANCE REQUIREMENTS

A. AC Input to UPS

   1. Voltage Configuration for Standard Units: three-phase, 4-wire plus ground.
   2. Voltage Range: +10%, -20% of nominal.
   3. Frequency: Nominal frequency 5%.

4. Power Factor: Up to 0.99 lagging at nominal input voltage and full rated UPS output load.
5. Inrush Current: 800% of full load current maximum.
6. Current Limit: 125% of nominal AC input current maximum.
7. Input Current Walk-In: 20 seconds to full rated input current maximum. Field selectable 5 through 20 seconds.
8. Current Distortion: 4% reflected THD maximum at full load.
9. Surge Protection: Sustains input surges without damage per criteria listed in IEC 1000-4-5.

B. AC Output, UPS Inverter
1. Voltage Configuration: three-phase, 4-wire plus ground

2. Voltage Regulation:

    a. ±1% three-phase RMS average for a balanced three-phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

    b. ±2% three-phase RMS average for a 100% unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

3. Frequency: Nominal frequency ±0.1%.

4. Frequency Slew Rate: 1.0 Hertz per second maximum. Field selectable from 0.1 to 1.0 Hz per second.

5. Phase Displacement:
    a. ±0.5 degree for balanced load,
    b. ±1.0 degrees for 100% unbalanced load.

6. Bypass Line Sync Range:
    a. ±0.5 Hertz,
    b. Field selectable ±0.5 to 5.0 Hz.
7. Voltage Distortion:

    a. 1% total harmonic distortion (THD) for linear loads.
    b. <4% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.

8. Load Power Factor Range: 0.7 lagging to 0.95 leading without derating.

9. Output Power Rating: Rated kVA at 0.8 lagging power factor.

10. Overload Capability:

    a. 125% for ten minutes (without bypass source).
    b. 150% for one minute (without bypass source).

11. Inverter Output Voltage Adjustment: ±5% manual adjustment.

12. Voltage Transient Response:

a.	100% load step	±4.0%.
b.	Loss or return of AC input power	±1.0%.
c.	Manual transfer of 100% load	±3.0%.

13. Transient Recovery Time: to within 1% of output voltage within one cycle.

14. Voltage Unbalance: 100% unbalanced load ±1%.

Note: All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

2.04 APPROVED MANUFACTURER FOR MPOE ROOM UPS

A. MPOE Room: UPS, 208Volt Input (4 wire plus ground)

1. Provide (1) 30kVA/16kW 120/208V-input, 3-phase UPS, model Liebert NX 38SB030C0CHX. Include internal VRLA battery capacity rated to 10 minutes at full load w/ disconnect facility for maintenance.
2. UPS shall be packaged in a single 24” wide cabinet with automatic continuous static transfer switch and internal manual bypass.
3. Include seismic anchoring
4. Include (1) OC-485 Webcard to interface w/ Sitelink system.
5. Connect 120/208V output to single wall-mounted panelboard.
6. Options for MPOE are:
    a. <u>Option #1</u>
        1) Provide (1) external VRLA battery cabinet providing for a total of (26) minutes at 16kW load, model Liebert 38BP030RHX1BNR.
        2) Include DC cables so that 27” battery cabinet can be directly bolted to right side of UPS cabinet.

3) Include seismic anchoring.

b. Option #2

1) Provide (1) external maintenance bypass cabinet, model Liebert 38MB0300CC6AL.

2) Include interconnecting cables for bolting to left side of UPS.

3) Cabinet shall be 27” wide with single rotary switch interlocked for make-before-break manual transfers.

4) Include seismic anchoring.

B. MPOE Room UPS, 480Volt Input (3 wire plus ground)

1. Provide (1) 30kVA/16kW 480V-input, 120/208v output, 3-phase UPS. Model Liebert NX 38SB030C0CHX.

2. Include internal VRLA battery capacity rated to 18 minutes at full load w/ disconnect facility for maintenance.

3. UPS shall be packaged in a single 24” wide cabinet with automatic continuous static transfer switch and internal manual bypass.

4. Include (1) OC-485 Webcard to interface w/ Sitelink system.

5. Include (1) external maintenance bypass/transformer cabinet, model Liebert 38MB0200AC6DL.

6. Include interconnecting cables for bolting to left side of UPS.

7. Cabinet shall be 27” wide with 480V input isolation transformer and single rotary switch interlocked for making before-break manual transfers.

8. Include seismic anchoring for both cabinets.

9. Connect 120/208V UPS output to single wall mounted panelboard.

10. Option for MPOE Room:

a. Option 1:

1) Provide (1) external VRLA battery cabinet providing for a total of (26) minutes at 16kW load, model Liebert 38BP030RHX1BNR.

2) Include DC cables so that 27” battery cabinet can be directly bolted to right side of UPS cabinet.

3) Include seismic anchoring.

2.05 FABRICATION

A. Materials

1. All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing.

2. The maximum working voltage, current, and di/dt of all solid-state power components and electronic devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature of solid-state component sub-assembly shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the maximum rectifier charging voltage.

B. Wiring

1. Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code (NFPA 70). All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the National Electrical Code and other applicable standards. All electrical power connections are to be torqued to the required value and marked with a visual indicator.

2. Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

C. Construction and Mounting

1. The UPS unit, comprised of an input circuit breaker, rectifier/charger, inverter, static transfer switch and maintenance bypass switch, shall be housed in a single free-standing NEMA type 1 enclosure. Cabinet doors/covers shall require a tool for gaining access. Casters and stops shall be provided for ease of installation. Front access only shall be required for expedient servicing and adjustments. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.

2. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer’s standard color. The UPS shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug connections. Like assemblies and like components shall be interchangeable.

D. Cooling

1. Cooling of the UPS shall be by forced air. Low-velocity fans shall be used to minimize audible noise output. Fan power shall be provided by the UPS output. There shall be redundant fans.

2. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded.

E. Grounding

1. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for local bonding shall be provided.

2.06 COMPONENTS

A. Rectifier/Charger

1. General

   a. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT type with constant voltage/current limiting control circuitry.

2. AC Input Current Limiting

   a. The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 125% of the full input current rating. The rectifier/charger shall operate at a reduced current limit mode whenever the critical load is powered from the UPS static bypass circuit such that the maximum UPS input current will not exceed 125% of full load input current. In addition, the rectifier/charger shall have a battery current limit, adjustable from 0 to 25% of the full load input current.

3. Input Current Walk-In

   a. The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 20-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 through 20 seconds.

4. DC Filter

   a. The rectifier/charger shall have a filter to minimize ripple voltage into the battery. Under no conditions shall ripple voltage into the battery exceed 1% RMS. The filter shall be adequate to ensure that the DC output of the rectifier/charger will meet the input requirements of the inverter. The inverter shall be able to operate from the rectifier/charger with the battery disconnected.

5. Automatic Rectifier Restart

   a. Upon restoration of utility AC power, after a utility AC power outage and prior to a UPS automatic end-of-discharge shutdown, the rectifier/charger shall automatically restart, walk-in, and gradually assume the inverter and battery recharge loads.

6. Battery Recharge

   a. In addition to supplying power for the inverter load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

7. Overvoltage Protection

a. There shall be DC over-voltage protection so that if the DC voltage rises to the pre-set limit, the UPS is to shut down automatically and initiate an uninterrupted load transfer to the static bypass line.

B. Inverter

1. General

a. The term inverter shall denote the solid-state equipment and controls to convert DC power from the rectifier/charger or battery to regulated AC power for supporting the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. Overload Capability

a. The inverter shall be capable of supplying current and voltage for overloads exceeding 100%. The inverter is to provide 150% of full load for 1 minute and 125% of full load for 10 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

3. Fault Clearing and Current Limit

a. The inverter shall be capable of supplying an overload current of 150% of its full-load rating for one minute. For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The critical load will be transferred to the static bypass automatically and uninterrupted. The inverter shall be self-protecting against any magnitude of connected output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses.

4. Step Load Response

a. The output voltage shall be maintained to within ±4% with a 0-to-100% step load change or a 100%-to-0 step load change. The output voltage shall recover to within 1% of nominal voltage within 1 cycle.

5. Voltage Distortion

a. For linear loads, the output voltage total harmonic distortion (THD) shall not be greater than 1%. For 100% rated load of 3:1 crest factor nonlinear loads, the output voltage total harmonic distortion shall not be greater than 4%. The output rating is not to be derated in kVA nor kW due to the 100% nonlinear load with 3:1 crest factor.

6. Phase Balance

a. Electronic controls shall be provided to regulate each phase so that an unbalanced loading will not cause the output voltage to go outside the specified voltage unbalance or phase displacement. With 100% load on one phase and 0% load on the other 2 phases or 100% load on 2 phases and 0% load on the other phase, the voltage balance is to be within 2% and the phase displacement is to be 120 degrees within ±1 degree.

7. Fuse Failure Protection

   a. Power semiconductors in the inverter unit shall be fused with fast-acting fuses, so that loss of any one power semiconductor will not cause cascading failures.

8. Inverter Shutdown

   a. For rapid removal of the inverter from the critical load, the inverter control electronics shall instantaneously turn off the inverter transistors. Simultaneously, the static transfer switch shall be turned on to maintain continuous power to the critical load.

9. Inverter DC Protection

   a. The inverter shall be protected by the following disconnect levels:

      1) DC Overvoltage Shutdown
      2) DC Undervoltage Warning (Low Battery Reserve), adjustable
      3) DC Undervoltage Shutdown (End of Discharge)

10. Inverter Output Voltage Adjustment

    a. The inverter shall use a software control to adjust the output voltage from ±5% of the nominal value.

11. Output Frequency

    a. The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and hold the inverter output frequency to ±0.1% for steady state and transient conditions. Drift shall not exceed 0.1% during a 24-hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.

C. Display and Controls

1. Monitoring and Control

   a. The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. A graphical display shall be used to show a single-line diagram of the UPS, and shall be provided as part of the monitoring and controls sections of the UPS. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, status and alarms shall be displayed on the graphical LCD display. Additional features of the monitoring system shall include:

      1) Alarm history with time and date stamp
      2) Battery backed-up memory
      3) Menu-driven display with pushbutton navigation

4) Real time clock (time and date)

2. Metering

   a. The following parameters shall be displayed:

      1) Active power
      2) Apparent power
      3) Battery charge/discharge current
      4) Battery time left during battery operation
      5) Battery voltage
      6) Input AC current for each phase
      7) Input AC voltage line-to-line
      8) Input frequency
      9) Output AC current for each phase
      10) Output AC voltage line-to-line and line-to-neutral for each phase
      11) Output frequency

3. Alarm Messages

   a. The following alarm messages shall be displayed:

      1) Battery charger problem
      2) Battery failed test
      3) Bypass frequency out of range
      4) Control error
      5) Critical power supply failure
      6) DC bus overvoltage
      7) Excessive retransfers attempted
      8) External shutdown (remote EPO activated)
      9) Fan failure
      10) Input power out of tolerance
      11) Load transferred due to internal protection
      12) Load transferred to bypass
      13) Load transferred to bypass due to overload
      14) Low battery shutdown
      15) Low battery warning
      16) Output overcurrent

17) Output overvoltage

18) Output undervoltage

19) Overload shutdown

20) Overtemperature shutdown

21) Overtemperature shutdown impending

22) Static switch failure

23) System output overloaded

24) UPS output not synchronized to bypass power

b. An audible alarm shall be provided and activated by any of the above alarm conditions.

4. Status Messages

a. The following UPS status messages shall be displayed:

1) Load on maintenance bypass

2) Load on static bypass

3) Load on UPS

4) Normal operation

5) System shutdown

6) UPS on battery

5. Controls

a. UPS start-up, shutdown, and maintenance bypass operations shall be accomplished through the front-panel pushbutton controls. Menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. Pushbuttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms. A mimic screen shall be available on the LCD screen to depict a single-line diagram of the UPS, with switch positions and power flow.

6. On-Line Battery Test

a. The UPS shall be provided with a menu-driven On-Line Battery Test feature. The test shall ensure the capability of the battery to supply power to the inverter while the load is supplied power in the normal mode.

D. Static Transfer Switch

1. General

a. A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be a naturally commutated high-speed static (SCR-type) device rated to conduct full load current continuously. The switch shall have an overload rating to clear a 20-ampere load branch circuit breaker.

b. The static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

2. Uninterrupted Transfer

a. The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:

1) Battery protection period expired

2) Critical AC load overvoltage or undervoltage

3) Inverter overload capacity exceeded

4) UPS fault condition

b. The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

1) Inverter/bypass voltage difference exceeding preset limits

2) Bypass frequency out-of-limits

3) Bypass out-of-synchronization range with inverter output

3. Uninterrupted Retransfer

a. Retransfer of the critical AC load from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

1) Bypass out of synchronization range with inverter output

2) Inverter/bypass voltage difference exceeding preset limits

3) Overload conditions exist in excess of inverter full load rating

4) UPS fault condition present

E. Maintenance Bypass Switch

1. General

a. A manually operated maintenance bypass switch shall be incorporated into the UPS cabinet to directly connect the critical load to the bypass AC input power source, bypassing the rectifier/charger, inverter, and static transfer switch.

2. Isolation

   a. All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come in contact with energized parts or terminals. A means to de-energize the static switch shall be provided when the UPS is in the maintenance bypass mode of operation.

3. Maintenance Capability

   a. With the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery, and static transfer switch. When the application calls for the Maintenance Bypass Switch to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

4. Battery Power Pack

   a. The battery power pack shall include sealed, lead-acid valve regulated battery cells housed in a separate cabinet that matches the UPS cabinet styling to form an integral system line-up. Battery cells shall be mounted on slide-out trays for ease of maintenance. A battery disconnect circuit breaker shall be included for isolation of the battery pack from the UPS module. The UPS shall automatically be disconnected from the battery when the battery reaches the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery power pack cabinet for ease of installation. When the application calls for the battery cabinet to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

F. Accessories (Optional Equipment)

1. Optional External Maintenance Bypass Cabinet

   a. A matching external maintenance bypass cabinet shall be provided to enable the UPS module to be completely isolated from the electrical system while the critical load is powered through the external maintenance bypass line. This optional cabinet shall provide make-before-break operation for transfers to and from the external maintenance bypass line with a single rotary switch.

   b. The following components shall be standard: (1) input and output circuit breakers, (2) single rotary switch with auxiliary contacts, (3) inter-cabinet wiring, (4) casters, and leveling feet.

   c. Optional voltage matching transformers and isolation transformers are to be offered.

   d. This matching cabinet shall bolt to the side of the UPS module with a barrier shield to separate the two cabinets. Only front access shall be required for installation and service.

2. Intellislot ™ Relay Board

   a. Five sets of isolated contacts shall be provided to indicate a change of status of the UPS. Contacts are provided for:

1) On UPS
2) On Battery
3) Low Battery
4) On Bypass
5) Summary

3. Intellislot ™ OC-485

   a. Inteliislot 485 card. The IntelliSlot® 485 card family delivers Modbus and proprietary protocol for monitoring and control of the UPS through a custom interface and monitoring system or your Building Management System.

PART 3 - EXECUTION

3.01 GENERAL

3.02 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit Installation drawing for LAWA review and approval prior to any construction.

3.03 PREPARATION

3.04 INSTALLATION

3.05 FIELD QUALITY CONTROL - TESTING

A. Site Test and inspections

1. Field Inspection – The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

a. Visual Inspection

1) Inspect equipment for signs of damage

2) Verify installation per drawings

3) Inspect cabinet for foreign objects

4) Verify neutral and ground conductors are properly sized and configured

5) Inspect battery cases

6) Inspect battery for proper polarity

7) Verify all printed circuit boards are configured properly

b. Mechanical Inspection:

1) Check all control wiring connections for tightness

2) Check all power wiring connections for tightness

3) Check all terminals screws, nuts and/or spade lungs for tightness

c. Electrical Inspection:

1) Check all fuses for continuity
2) Confirm input voltage and phase rotation is correct
3) Verify control transformer connections are correct for voltages being used.
4) Assure connection and voltage of the battery string(s)

B. Non-Conforming Work

3.06 CLEANING

3.07 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all cables, equipment and systems provided by this Contract into this database.

3.08 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.09 CLOSEOUT ACTIVITIES - ACCEPTANCE

A. Acceptance

1. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the UPS and cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

B. Maintenance

1. The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory trained field service personnel dedicated to the start-up,

maintenance, and repair of UPS and power equipment. The organization shall consist of regional and local offices.

2. The manufacturer shall provide a fully automated national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, and 365 days/year. If emergency service is required, response time shall be 20 minutes or less.

3. An automated procedure shall be in place to ensure that the manufacturer is dedicating the appropriate technical support resources to match escalating customer needs.

C. Replacement Parts Stocking

1. Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.

2. Recommended spare parts shall be fully stocked by local field service personnel with back-up available from national parts center and the manufacturing location. The national parts center Customer Support Parts Coordinators shall be on-call 24 hours/day, 7 days/week, and 365 days/year for immediate parts availability. Parts from the national parts center shall be shipped within 4 hours on the next available flight out and delivered to the customer's site within 24 hours.

D. UPS Maintenance Training

1. Maintenance training courses for customer employees shall be available by the UPS manufacturer. The training is in addition to the basic operator training conducted as a part of the system start-up.

2. The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC to DC conversion and DC to AC inversion techniques as well as control, metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics should be stressed.

E. Maintenance Contracts

1. A complete offering of preventive and full service maintenance contracts for both the UPS system and battery system shall be available. An extended warranty and preventive maintenance package shall be available. Warranty and preventive maintenance service shall be performed by factory-trained service personnel.

END OF SECTION

SECTION 27 11 26.16 Communications Rack Mounted Uninterruptible Power Protection System (20 kVA UPS) for Telecommunication Rooms

PART 1 - GENERAL

1.01 SUMMARY

A. This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty three-phase, solid-state, uninterruptible power system (UPS). The UPS shall provide high-quality AC power for sensitive electronic equipment loads. This specification provides requirements for the following options:

1. Option #1: Telecom Room UPS Requirement: 20 kVA, Electrical 280V
2. Option #2: Telecom Room UPS Requirement: 20 kVA, Electrical 480V

B. All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

C. Related documents included in the specification requirements:

1. Section 01 11 00 – Summary of Work
2. Section 01 25 00 – Substitution Procedure
3. Section 01 31 00 – Administrative Requirements
4. Section 01 33 00 – Submittal
5. Section 01 40 00 – Quality Requirements
6. Section 01 43 00 – Quality Assurance
7. Section 01 64 00 – Owner Furnished Products
8. Section 01 77 13 – Preliminary Closeout Reviews
9. Section 01 77 16 – Final Closeout Review
10. Section 01 78 00 – Close Out Submittals
11. Section 27 05 00 – Basic Telecommunication Requirements

D. Products furnished (but not installed) under this section:

E. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Standards

1. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

    a. ASME

    b. CSA 22.2, No. 107.1

    c. FCC Part 15, Class A

    d. IEC 1000-4-5

    e. ISO 9001

    f. National Electrical Code (NFPA-70)

    g. NEMA PE-1

    h. OSHA

    i. UL Standard 1778

2. The UPS shall be UL listed per UL Standard 1778, and shall be CSA certified.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. Proposal Submittals with the proposal shall include:

1. System configuration with single-line diagrams.
2. Functional relationship of equipment including weights, dimensions, and heat dissipation.
3. Descriptions of equipment to be furnished, including deviations from these specifications.
4. Size and weight of shipping units to be handled by installing contractor.
5. Detailed layouts of customer power and control connections.
6. Detailed installation drawings including all terminal locations.

B. Action Submittals

1. Submittals upon UPS delivery shall include a complete set of submittal drawings and one (1) set of instruction manuals that shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

1.06 QUALITY ASSURANCE

A. A minimum of twenty years' experience in the design, manufacture, and testing of solid-state UPS systems is required. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

B. Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.08 DELIVERY, STORAGE AND HANDLING

A. Submit manufacturers' instructions for storage, handling, protection, examination, preparation, operation, and installation of all products. Include any application conditions or limitations of use stipulated by any product testing agency.

1.09 FIELD/SITE AND ENVIRONMENT CONDITIONS

A. The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:

1. Operating Ambient Temperature
   a. UPS Module: 32°F to 104°F (0°C to 40°C).
   b. Battery: 77°F±9°F (25°C ±5°C).

2. Storage/Transport Ambient Temperature
   a. UPS Module: -4°F to 158°F (-20°C to 70°C).
   b. Battery: -4°F to 92°F (-20°C to 33°C)

3. Relative Humidity - 0 to 95%, non-condensing

4. Altitude

a. Operating: to 3300 ft. (1000 meters) above Mean Sea Level. Derated for higher altitude applications.
b. Storage/Transport: to 40,000 ft. (12,200 meters) above Mean Sea Level.

1. Audible Noise – Noise generated by the UPS under any condition of normal operation shall not exceed 54 dBA measured 1 meter from surface of the UPS.

1.10 WARRANTY

A. The UPS manufacturer shall warrant the UPS module against defects in materials and workmanship for 12 months after initial start-up or 18 months after ship date, whichever period expires first.

B. The battery manufacturer's standard warranty shall be passed through to the end user.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Voltage: Input/output voltage specifications of the 20 kVA UPS shall be:
   1. Rectifier Input: 120/208 volts, three-phase, 4-wire-plus-ground.
   2. Output: 120/208 volts, three-phase, 4-wire-plus-ground.

B. Output Load Capacity: Specified output load capacity of the UPS shall be 20kVA/16kW at 0.8 lagging power factor.

2.02 DESIGN REQUIREMENTS

A. Battery Design Requirements for 20 kVA UPS:

   1. Battery Cells: Sealed, lead-acid, valve-regulated.
   2. Reserve Time: 18 minutes at 16kW full load, with ambient temperature of 25°C.
   3. Recharge Time: to 95% capacity within ten (10) times discharge time

B. Modes of Operation – The UPS shall be designed to operate as on on-line, double-conversion, reverse-transfer system in the following modes:

   1. Normal – The Critical AC load is continuously supplied by the UPS inverter. The rectifier/charger derives power from a utility AC source and supplies DC power to the inverter while simultaneously float-charging the reserve battery.

   2. Emergency – Upon failure of utility AC power, the critical AC load is supplied by the inverter, which, without any switching, obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.

   3. Recharge – Upon restoration of utility AC power, after a utility AC power outage, the rectifier/charger shall automatically restart, walk-in, and gradually assume the inverter and battery recharge loads.

   4. Bypass – If the UPS must be taken out of service for maintenance or repair, or should the inverter overload capacity be exceeded, the static transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.

2.03 PERFORMANCE REQUIREMENTS

A. AC Input to UPS

1. Voltage Configuration for Standard Units: three-phase, 4-wire plus ground.
2. Voltage Range: +10%, -20% of nominal.
3. Frequency: Nominal frequency 5%.
4. Power Factor: Up to 0.99 lagging at nominal input voltage and full rated UPS output load.
5. Inrush Current: 800% of full load current maximum.
6. Current Limit: 125% of nominal AC input current maximum.
7. Input Current Walk-In: 20 seconds to full rated input current maximum. Field selectable 5 through 20 seconds.
8. Current Distortion: 4% reflected THD maximum at full load.
9. Surge Protection: Sustains input surges without damage per criteria listed in IEC 1000-4-5.

B. AC Output, UPS Inverter

1. Voltage Configuration: three-phase, 4-wire plus ground.

2. Voltage Regulation:

   a. ±1% three-phase RMS average for a balanced three-phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

   b. ±2% three-phase RMS average for a 100% unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.

3. Frequency: Nominal frequency ±0.1%.

4. Frequency Slew Rate: 1.0 Hertz per second maximum. Field selectable from 0.1 to 1.0 Hz per second.

5. Phase Displacement:
   a. ±0.5 degree for balanced load.
   b. ±1.0 degrees for 100% unbalanced load.

6. Bypass Line Sync Range:
   a. ±0.5 Hertz,
   b. Field selectable ±0.5 to 5.0 Hz.
7. Voltage Distortion:

   a. 1% total harmonic distortion (THD) for linear loads.
   b. <4% THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.

8. Load Power Factor Range: 0.7 lagging to 0.95 leading without derating.

9. Output Power Rating: Rated kVA at 0.8 lagging power factor.

10. Overload Capability:

    a. 125% for ten minutes (without bypass source).
    b. 150% for one minute (without bypass source).

11. Inverter Output Voltage Adjustment: ±5% manual adjustment.

12. Voltage Transient Response:

    a. 100% load step ±4.0%.
    b. Loss or return of AC input power ±1.0%.
    c. Manual transfer of 100% load ±3.0%.

13. Transient Recovery Time: to within 1% of output voltage within one cycle.

14. Voltage Unbalance: 100% unbalanced load ±1%.

2.04 Approved Manufacturer for Telecom Room UPS

A. Telecom Room: UPS, 208Volt Input (4 wire plus ground)

1. Provide (1) 20kVA/16kW 120/208V-input, 3-phase UPS, model Liebert NX 38SB020C0CHX. Include internal VRLA battery capacity rated to 18 minutes at full load w/ disconnect facility for maintenance.
2. UPS shall be packaged in a single 24” wide cabinet with automatic continuous static transfer switch and internal manual bypass.
3. Include seismic anchoring.
4. Include (1) OC-485 Webcard to interface w/ Sitelink system.
5. Connect 120/208V output to single wall-mounted panelboard.

6. Options for Telecom Rooms are:
    a. <u>OPTION #1</u>
        1) Provide (1) external VRLA battery cabinet providing for a total of (41) minutes at 16kW load, model Liebert 38BP020RHX1BNR.
        2) Include DC cables so that 27” battery cabinet can be directly bolted to right side of UPS cabinet.

3) Include seismic anchoring.

b. OPTION #2

1) Provide (1) external maintenance bypass cabinet, model Liebert 38MB0200CC6AL.

2) Include interconnecting cables for bolting to left side of UPS.

3) Cabinet shall be 27” wide with single rotary switch interlocked for make-before-break manual transfers.

4) Include seismic anchoring.

B. Telecom Room UPS, 480Volt Input (3 wire plus ground)

1. Provide (1) 20kVA/16kW 480V-input, 120/208v output, 3-phase UPS. Model Liebert NX 38SB020C0CHX.

2. Include internal VRLA battery capacity rated to 18 minutes at full load w/ disconnect facility for maintenance.

3. UPS shall be packaged in a single 24” wide cabinet with automatic continuous static transfer switch and internal manual bypass.

4. Include (1) OC-485 Webcard to interface w/ Sitelink system.

5. Include (1) external maintenance bypass/transformer cabinet, model Liebert 38MB0200AC6DL.

6. Include interconnecting cables for bolting to left side of UPS.

7. Cabinet shall be 27” wide with 480V input isolation transformer and single rotary switch interlocked for making before-break manual transfers.

8. Include seismic anchoring for both cabinets.

9. Connect 120/208V UPS output to single wall mounted panelboard.

10. Option for Telecom Room:

a. Option 1:

1) Provide (1) external VRLA battery cabinet providing for a total of (41) minutes at 16kW load, model Liebert 38BP020RHX1BNR.

2) Include DC cables so that 27” battery cabinet can be directly bolted to right side of UPS cabinet.

3) Include seismic anchoring.

Note: All references to model numbers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment manufactured by Liebert. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

2.05 FABRICATION

A. Materials

1. All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing.

2. The maximum working voltage, current, and di/dt of all solid-state power components and electronic devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature of solid-state component sub-assembly shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the maximum rectifier charging voltage.

B. Wiring

1. Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code (NFPA 70). All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the National Electrical Code and other applicable standards. All electrical power connections are to be torqued to the required value and marked with a visual indicator.

2. Provision shall be made for power cables to enter or leave from the top or bottom of the UPS cabinet.

C. Construction and Mounting

1. The UPS unit, comprised of an input circuit breaker, rectifier/charger, inverter, static transfer switch and maintenance bypass switch, shall be housed in a single free-standing NEMA type 1 enclosure. Cabinet doors/covers shall require a tool for gaining access. Casters and stops shall be provided for ease of installation. Front access only shall be required for expedient servicing and adjustments. The UPS cabinet shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling.

2. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer’s standard color. The UPS shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug connections. Like assemblies and like components shall be interchangeable.

D. Cooling

1. Cooling of the UPS shall be by forced air. Low-velocity fans shall be used to minimize audible noise output. Fan power shall be provided by the UPS output. There shall be redundant fans.

2. The thermal design, along with all thermal and ambient sensors, shall be coordinated with the protective devices before excessive component or internal cabinet temperatures are exceeded.

E. Grounding

1. The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal. Provisions for local bonding shall be provided.

2.06 COMPONENTS

A. Rectifier/Charger

1. General

a. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging. The rectifier/charger shall be a solid-state SCR/IGBT type with constant voltage/current limiting control circuitry.

2. AC Input Current Limiting

a. The rectifier/charger unit shall be provided with AC input current limiting whereby the maximum input current shall be limited to 125% of the full input current rating. The rectifier/charger shall operate at a reduced current limit mode whenever the critical load is powered from the UPS static bypass circuit such that the maximum UPS input current will not exceed 125% of full load input current. In addition, the rectifier/charger shall have a battery current limit, adjustable from 0 to 25% of the full load input current.

3. Input Current Walk-In

a. The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 20-second time interval after input voltage is applied. Walk-in time shall be field selectable for 5 through 20 seconds.

4. DC Filter

a. The rectifier/charger shall have a filter to minimize ripple voltage into the battery. Under no conditions shall ripple voltage into the battery exceed 1% RMS. The filter shall be adequate to ensure that the DC output of the rectifier/charger will meet the input requirements of the inverter. The inverter shall be able to operate from the rectifier/charger with the battery disconnected.

5. Automatic Rectifier Restart

a. Upon restoration of utility AC power, after a utility AC power outage and prior to a UPS automatic end-of-discharge shutdown, the rectifier/charger shall automatically restart, walk-in, and gradually assume the inverter and battery recharge loads.

6. Battery Recharge

a. In addition to supplying power for the inverter load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

7. Overvoltage Protection

a. There shall be DC over-voltage protection so that if the DC voltage rises to the pre-set limit, the UPS is to shut down automatically and initiate an uninterrupted load transfer to the static bypass line.

B. Inverter

1. General

a. The term inverter shall denote the solid-state equipment and controls to convert DC power from the rectifier/charger or battery to regulated AC power for supporting the critical load. The inverter shall use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. Overload Capability

a. The inverter shall be capable of supplying current and voltage for overloads exceeding 100%. The inverter is to provide 150% of full load for 1 minute and 125% of full load for 10 minutes. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

3. Fault Clearing and Current Limit

a. The inverter shall be capable of supplying an overload current of 150% of its full-load rating for one minute. For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The critical load will be transferred to the static bypass automatically and uninterrupted. The inverter shall be self-protecting against any magnitude of connected output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses.

4. Step Load Response

a. The output voltage shall be maintained to within ±4% with a 0-to-100% step load change or a 100%-to-0 step load change. The output voltage shall recover to within 1% of nominal voltage within 1 cycle.

5. Voltage Distortion

   a. For linear loads, the output voltage total harmonic distortion (THD) shall not be greater than 1%. For 100% rated load of 3:1 crest factor nonlinear loads, the output voltage total harmonic distortion shall not be greater than 4%. The output rating is not to be derated in kVA nor kW due to the 100% nonlinear load with 3:1 crest factor.

6. Phase Balance

   a. Electronic controls shall be provided to regulate each phase so that an unbalanced loading will not cause the output voltage to go outside the specified voltage unbalance or phase displacement. With 100% load on one phase and 0% load on the other 2 phases or 100% load on 2 phases and 0% load on the other phase, the voltage balance is to be within 2% and the phase displacement is to be 120 degrees within ±1 degree.

7. Fuse Failure Protection

   a. Power semiconductors in the inverter unit shall be fused with fast-acting fuses, so that loss of any one power semiconductor will not cause cascading failures.

8. Inverter Shutdown

   a. For rapid removal of the inverter from the critical load, the inverter control electronics shall instantaneously turn off the inverter transistors. Simultaneously, the static transfer switch shall be turned on to maintain continuous power to the critical load.

9. Inverter DC Protection

   a. The inverter shall be protected by the following disconnect levels:
      1) DC Overvoltage Shutdown
      2) DC Undervoltage Warning (Low Battery Reserve), adjustable
      3) DC Undervoltage Shutdown (End of Discharge)

10. Inverter Output Voltage Adjustment

    a. The inverter shall use a software control to adjust the output voltage from ±5% of the nominal value.

11. Output Frequency

    a. The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and hold the inverter output frequency to ±0.1% for steady state and transient conditions. Drift shall not exceed 0.1% during a

24-hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.

C. Display and Controls

1. Monitoring and Control

a. The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. A graphical display shall be used to show a single-line diagram of the UPS, and shall be provided as part of the monitoring and controls sections of the UPS. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, status and alarms shall be displayed on the graphical LCD display. Additional features of the monitoring system shall include:

1) Alarm history with time and date stamp
2) Battery backed-up memory
3) Menu-driven display with pushbutton navigation
4) Real time clock (time and date)

2. Metering

a. The following parameters shall be displayed:

1) Active power
2) Apparent power
3) Battery charge/discharge current
4) Battery time left during battery operation
5) Battery voltage
6) Input AC current for each phase
7) Input AC voltage line-to-line
8) Input frequency
9) Output AC current for each phase
10) Output AC voltage line-to-line and line-to-neutral for each phase
11) Output frequency

3. Alarm Messages

a. The following alarm messages shall be displayed:

1) Battery charger problem
2) Battery failed test
3) Bypass frequency out of range

4) Control error
5) Critical power supply failure
6) DC bus overvoltage
7) Excessive retransfers attempted
8) External shutdown (remote EPO activated)
9) Fan failure
10) Input power out of tolerance
11) Load transferred due to internal protection
12) Load transferred to bypass
13) Load transferred to bypass due to overload
14) Low battery shutdown
15) Low battery warning
16) Output overcurrent
17) Output overvoltage
18) Output undervoltage
19) Overload shutdown
20) Overtemperature shutdown
21) Overtemperature shutdown impending
22) Static switch failure
23) System output overloaded
24) UPS output not synchronized to bypass power

b. An audible alarm shall be provided and activated by any of the above alarm conditions.

4. Status Messages

a. The following UPS status messages shall be displayed:

1) Load on maintenance bypass
2) Load on static bypass
3) Load on UPS
4) Normal operation
5) System shutdown
6) UPS on battery

5. Controls

   a. UPS start-up, shutdown, and maintenance bypass operations shall be accomplished through the front-panel pushbutton controls. Menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. Pushbuttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms. A mimic screen shall be available on the LCD screen to depict a single-line diagram of the UPS, with switch positions and power flow.

6. On-Line Battery Test

   a. The UPS shall be provided with a menu-driven On-Line Battery Test feature. The test shall ensure the capability of the battery to supply power to the inverter while the load is supplied power in the normal mode.

D. Static Transfer Switch

1. General

   a. A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be a naturally commutated high-speed static (SCR-type) device rated to conduct full load current continuously. The switch shall have an overload rating to clear a 20-ampere load branch circuit breaker.

   b. The static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

2. Uninterrupted Transfer

   a. The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:

      1) Battery protection period expired

      2) Critical AC load overvoltage or undervoltage

      3) Inverter overload capacity exceeded

      4) UPS fault condition

   b. The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

      1) Inverter/bypass voltage difference exceeding preset limits

      2) Bypass frequency out-of-limits

3) Bypass out-of-synchronization range with inverter output

3. Uninterrupted Retransfer

a. Retransfer of the critical AC load from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

1) Bypass out of synchronization range with inverter output

2) Inverter/bypass voltage difference exceeding preset limits

3) Overload conditions exist in excess of inverter full load rating

4) UPS fault condition present

E. Maintenance Bypass Switch

1. General

a. A manually operated maintenance bypass switch shall be incorporated into the UPS cabinet to directly connect the critical load to the bypass AC input power source, bypassing the rectifier/charger, inverter, and static transfer switch.

2. Isolation

a. All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come in contact with energized parts or terminals. A means to de-energize the static switch shall be provided when the UPS is in the maintenance bypass mode of operation.

3. Maintenance Capability

a. With the critical load powered from the maintenance bypass circuit, it shall be possible to check out the operation of the rectifier/charger, inverter, battery, and static transfer switch. When the application calls for the Maintenance Bypass Switch to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

4. Battery Power Pack

a. The battery power pack shall include sealed, lead-acid valve regulated battery cells housed in a separate cabinet that matches the UPS cabinet styling to form an integral system line-up. Battery cells shall be mounted on slide-out trays for ease of maintenance. A battery disconnect circuit breaker shall be included for isolation of the battery pack from the UPS module. The UPS shall automatically be disconnected from the battery when the battery reaches the minimum discharge voltage level. Casters and leveling feet shall also be provided with the battery power pack cabinet for ease of installation. When the application calls for the battery cabinet to be bolted to the UPS cabinet, the interconnecting cables are to be provided, precut and prelugged.

F. Accessories (Optional Equipment)

1. Optional External Maintenance Bypass Cabinet

a. A matching external maintenance bypass cabinet shall be provided to enable the UPS module to be completely isolated from the electrical system while the critical load is powered through the external maintenance bypass line. This optional cabinet shall provide make-before-break operation for transfers to and from the external maintenance bypass line with a single rotary switch.

b. The following components shall be standard: (1) input and output circuit breakers, (2) single rotary switch with auxiliary contacts, (3) inter-cabinet wiring, (4) casters, and leveling feet.

c. Optional voltage matching transformers and isolation transformers are to be offered.

d. This matching cabinet shall bolt to the side of the UPS module with a barrier shield to separate the two cabinets. Only front access shall be required for installation and service.

2. Intellislot ™ Relay Board

a. Five sets of isolated contacts shall be provided to indicate a change of status of the UPS. Contacts are provided for:

1) On UPS

2) On Battery

3) Low Battery

4) On Bypass

5) Summary

3. Intellislot ™ OC-485

a. Inteliislot 485 card. The IntelliSlot® 485 card family delivers Modbus and proprietary protocol for monitoring and control of the UPS through a custom interface and monitoring system or your Building Management System.

PART 3 - EXECUTION

3.01 GENERAL

3.02 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit Installation drawing for LAWA review and approval prior to any construction.

3.03 PREPARATION

3.04 INSTALLATION

3.05 FIELD QUALITY CONTROL - TESTING

A. Site Test and inspections

1. Field Inspection – The following inspections and test procedures shall be performed by factory-trained field service personnel during the UPS startup.

a. Visual Inspection

1) Inspect equipment for signs of damage

2) Verify installation per drawings

3) Inspect cabinet for foreign objects

4) Verify neutral and ground conductors are properly sized and configured

5) Inspect battery cases

6) Inspect battery for proper polarity

7) Verify all printed circuit boards are configured properly

b. Mechanical Inspection:

1) Check all control wiring connections for tightness

2) Check all power wiring connections for tightness

3) Check all terminals screws, nuts and/or spade lungs for tightness

c. Electrical Inspection:

1) Check all fuses for continuity
2) Confirm input voltage and phase rotation is correct
3) Verify control transformer connections are correct for voltages being used.
4) Assure connection and voltage of the battery string(s)

B. Non-Conforming Work

3.06 CLEANING

3.07 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all cables, equipment and systems provided by this Contract into this database.

3.08 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.09 CLOSEOUT ACTIVITIES

A. Acceptance

1. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the UPS and cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

B. Maintenance

1. The UPS manufacturer shall directly employ a nationwide service organization, consisting of factory trained field service personnel dedicated to the start-up,

maintenance, and repair of UPS and power equipment. The organization shall consist of regional and local offices.

2. The manufacturer shall provide a fully automated national dispatch center to coordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, and 365 days/year. If emergency service is required, response time shall be 20 minutes or less.

3. An automated procedure shall be in place to ensure that the manufacturer is dedicating the appropriate technical support resources to match escalating customer needs.

C. Replacement Parts Stocking

1. Parts shall be available through an extensive network to ensure around-the-clock parts availability throughout the country.

2. Recommended spare parts shall be fully stocked by local field service personnel with back-up available from national parts center and the manufacturing location. The national parts center Customer Support Parts Coordinators shall be on-call 24 hours/day, 7 days/week, and 365 days/year for immediate parts availability. Parts from the national parts center shall be shipped within 4 hours on the next available flight out and delivered to the customer’s site within 24 hours.

D. UPS Maintenance Training

1. Maintenance training courses for customer employees shall be available by the UPS manufacturer. The training is in addition to the basic operator training conducted as a part of the system start-up.

2. The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC to DC conversion and DC to AC inversion techniques as well as control, metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics should be stressed.

E. Maintenance Contracts

1. A complete offering of preventive and full service maintenance contracts for both the UPS system and battery system shall be available. An extended warranty and preventive maintenance package shall be available. Warranty and preventive maintenance service shall be performed by factory-trained service personnel.

END OF SECTION

SECTION 27 17 00 – BROADBAND TELEVISION DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. General

1. Scope of Work: The Contractor shall provide a new broadband television distribution system to support the distribution of entertainment and informational television throughout the North and South Concourses. The signal source for this system may originate from a satellite television provider or cable television company and is not considered part of this work.

   a. The forward bandpass for this system shall be 50 MHz to 860MHz. Reverse bandpass, shall be from 5 MHz to 45 MHz. The system shall deliver a level of +20dBmV flat +/- 1dB to all distribution outputs with a flat Radio Frequency (RF) signal applied to the system input.

   b. Coordination with LAWA

2. Related Work Specified Elsewhere

B. Related documents included in the specification requirements:

Section 01 11 00 – Summary of Work

Section 01 25 00 – Substitution Procedure

Section 01 31 00 – Administrative Requirements

Section 01 33 00 – Submittal

Section 01 40 00 – Quality Requirements

Section 01 43 00 – Quality Assurance

Section 01 64 00 – Owner Furnished Products

Section 01 77 13 – Preliminary Closeout Reviews

Section 01 77 16 – Final Closeout Review

Section 01 78 00 – Closeout Submittals

Section 27 05 00 - Basic Telecommunications Requirements

C. Products furnished (but not installed) under this section:

D. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Codes Standards and References are specified in Section 27 05 00 – Basic Telecommunications Requirements.

B. Applicable Codes

C. Industry Standards

1. Telecommunications Industries Association / Electronics Industries Alliance (EIA/TIA)

2. American National Standards Institute - ANSI

3. Building Industry Consulting Services International - BISCI

4. Institute of Electrical and Electronic Engineers – IEEE

5. National Electrical Code (NEC)

6. Underwriters Laboratories (UL)

7. Code of Federal Regulations (CFR)

a. CFR 29 Part 1910.146; Permit-Required Confined Spaces Standard

b. CFR 47 Part 76; Cable Television Service

8. Electronic Industries Association (EIA)

a. EIA 403-A-90; Precision Coaxial Connectors for CATV Applications

9. National Cable Television Association (NCTA)

a. NCTA-02; NCTA Recommended Practices for Measurements on Cable Television Systems.

10. State and Local Codes

11. Seismic Codes

12. Others

D. Aviation Specific Related References

E. Materials and workmanship shall conform to the latest issue of all industry standards, publications, codes, regulations or requirements of regulatory agencies referenced in this section.

1.04 ADMINISTRATIVE REQUIREMENTS

A. As specified in Section 27 05 00 – Basic Telecommunication Requirements.

B. Coordinate the work of this Section with that of other Divisions as required to ensure that the entire work of this project will be carried out in an orderly, complete and coordinated fashion.

C. The Contractor is required to supply all necessary supervision and coordination to any contractor or subcontractor who is performing work to accommodate the work of this section and minimize interferences.

1.05 SUBMITTALS

A. Comply with the requirements of Section 01 33 00 – Submittal Procedures and with Section 27 05 00 – Basic Telecommunications Requirements. In addition to the requirements found in the Sections cited, provide the following:

   1 Coordinate with the Systems Manager.

   2. System Description and Analysis: Complete system descriptions, analysis and calculations used in sizing the equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance requirements of this specification. The submittal shall include the following:

      a. A complete system headend and distribution system diagram shall be submitted indicating calculated forward levels delivered at each directional tap port at 50 and 860 MHz and required reverse path input at each directional tap for full output to the headend prior to system installation.

      b. Calculations of cable loss between in-line amplifiers and each of the cable taps and/or splitters at the lowest frequency and highest frequency.

      c. Calculations of cable loss between taps and/or splitters at the lowest frequency and highest frequency.

      d. Calculated values for each of the taps or splitters – forward direction:

         1) Show calculated line level at the tap or splitter in dBmV.

         2) Show each of the tap or splitter port values in dBmV.

         3) Show the input level to each television receiver/equipment input in dBmV.

   3. Calculated values for each of the taps and splitters – reverse direction:

a. Headend reverse path output at 5 mHz and 45 mHz for highest and lowest loss paths to outlets in the system.

4. Submittal quantities: The Contractor shall submit 10 copies of all required submittals.

5. Product Data Submittals:

   a. Indicate the UL listing and NEC insulation type for each type of cable installed as part of the system.

   b. Amplification equipment.

   c. Power supplies.

   d. Cable, connectors, taps, splitters, pads and filters.

   e. Any other equipment installed as part of the system.

6. Shop Drawings:

   a. Prepare and submit coordination drawings detailing raceways and system components and materials in relationship with other building systems and components.

   b. System Block Diagram; The Contractor shall provide a red-lined block diagram for the installed system indicating areas where the actual installed configuration differs from the design drawings.

   c. Interconnection with the electrical system, block diagrams and wiring diagrams shall be indicated.

7. Running As-Built documents: The Contractor shall maintain real-time running as-built documentation for the as installed system. Electronic as-Built information shall be submitted quarterly to LAWA and the Engineer for review.

8. Detail Drawings: submit detailed drawings for:

   a. Wall-mounted facilities on terminal backboards.

   b. Equipment rack and cabinet elevations for all termination locations.

9. Cable and equipment labeling schemes and sample labels as coordinated with LAWA.

B. Contractor shall submit Contractor qualifications.

C. Review of product data shall not relieve the Contractor from responsibility for deviations from the drawings or specifications, unless the Contractor has, in writing, called attention to such deviations at the time of submission and secured written approval.

D. Product Data Manuals: upon completion of the project, submit final Product Data Manuals that include:

1. A complete as-installed equipment list of all components installed with manufacturers' names and model numbers.

2. A complete set of product data sheets for all products installed. Product data sheets shall be clearly marked, identifying the specific items installed.

3. This submittal shall be provided in both hard copy and in electronic format.

4. Submit ten (10) identical sets of Product Data Manuals with electronic copies of circuit schedule spreadsheets in MS Excel format.

E. Record Drawings

1. As-Built documents are to include updating and revising contract documents to record actual locations (as-installed) of all equipment, pull boxes, devices, raceways, cabling, outlets, communications rooms and all Premise Distribution cable infrastructure components.

2. Coordinate As-Build documents with the Systems Manager

3. As-Built drawings shall include:

a. Complete floor plans indicating placement and routing of as-installed raceways, outlet locations and types with labels and cabling facilities installed under this scope of work.

b. A complete riser diagram, showing as-installed originations, destinations, and equipment. Include circuit numbers, equipment identification and layouts, and other designations.

c. Equipment rack/cabinet and wallboard as-installed elevation drawings shall be provided for each communication room and equipment location.

d. Wiring terminal point-to-point color-coded wiring diagrams. Drawings shall show each item of equipment, locations, all wiring, and all connections. Wiring color code shall be as described by the specifications. If no color code is specifically mentioned, the color code shall be as recommended by the equipment manufacturer.

F. Test Reports: The Contractor as coordinated with and in conjunction with the Systems manager shall be responsible for recording all test data. Copies of all test results are to be submitted to LAWA for review as part of final acceptance and subsequently submitted to LAWA for their records.

1. Submit ten (10) printed copies of a final test reports and communication circuit schedules (typed and bound) and ten (10) electronic copies (CD media), which confirms that the cabling infrastructure has been tested, labeled and documented.

2. Submit test reports in both printed format and an electronic format to assist the Engineer and LAWA in the final review process. Printed test reports shall be provided in 8-1/2 x 11-inch three ring binders. Electronic copies of the test reports shall be either in a file format that can be imported or viewed using standard office software or in a file format used by the testing software, provided the testing software program is also submitted with the raw testing files.

3. Refer to the testing section of the Specifications for details on the data that shall be included in the test reports.

4. Submit ten (10) printed copies of the test reports and ten (10) electronic copies of the test reports with the testing software program on CD-ROM.

G. The Contractor shall provide an as-built list of the connections that with the schedule of outlets will enable LAWA to trace the circuit continuity of each outlet.

1.06 QUALITY ASSURANCE

A. Contractor Qualifications

1. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and metallic premise distribution systems and have personnel who are adequately trained in the use of such tools and equipment.

2. A resume of qualification shall be submitted with the Contractor's bid. In addition to those requirements, the Contractor shall submit the following information.

   a. A list of (3) three completed projects over the past 5 years of similar type and size with contact names and telephone numbers for each.
   b. A list of test equipment proposed for use in verifying the installed integrity of fiber and metallic cable systems on this project.
   c. A technical resume of experience for the Contractor's Engineer and on-site installation foreman who will be assigned to this project.
   d. Refer to specification section 27 13 33 Communications Systems Interfaces – Legacy Systems for additional requirements for the coordination requirements between the contractor and the System Manager.
   e. Similar documentation for any subcontractor who will assist the Contractor in performance of this Work.
   f. Reference Section 27 0500 – Basic Telecommunication Requirements for additional Contractor qualification requirements.

3. Standards of workmanship shall meet or exceed accepted telecommunications systems industry installation practices.

B. Refer to specifications 27 0500 – Basic Telecommunication Requirements, for quality assurance requirements.

C. Test Equipment: The Contractor executing this work shall utilize the necessary equipment and tooling to properly install the system in accordance with recommendations set forth by the manufacturers of each item of system equipment. Calibration reports for test equipment shall be available to the Owner for review.

   1. A signal level meter capable of measuring levels between 5 and 860 megahertz.

   2. A flat noise generator or sweep/marker generator capable of providing a calibrated output between 5 and 860 megahertz.

   3. An oscilloscope with a suitable RF detector for use in sweep testing system response.

   4. A return loss bridge and variable termination for on-site cable sweep testing prior to installation.

   5. Composite test sets, simul-sweep equipment and other test systems capable of providing the required functions shall be considered equivalent to the equipment specified.

D. Materials and Equipment: Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, and vibration conditions encountered at the installed location. The equipment shall meet the following environmental requirements.
   1. Exterior Environments:
      a. Minus 30 degrees to 130 degrees F dry bulb and 10 to 100 percent relative humidity, condensing.
      b. Conditions specified in UL 294 for outdoor use equipment.

E. Standard products: Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of CATV products and shall be the manufacturer's latest standard design in satisfactory use for at least 1 year prior to bid opening.

F. Equipment shall be new and shall be UL approved.

G. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

1.07 DELIVERY, STORAGE AND HANDLING

1.08 FIELD - SITE CONDITIONS

A. The locations of telecommunications devices, equipment and raceways are shown diagrammatically on the drawings. Exact locations of items of work shall be field coordinated prior to installation.

B. Provide site inspection to verify areas of work, conditions, products to match existing and conflicts between contract documentation and site conditions. Bring conflicts to LAWA's attention for resolution.

C. Verify locations of pull and junction boxes prior to rough in.

1.09 WARRANTY

A. Contractor shall provide a warranty for products and work provided under this Section as specified in Section 27 05 00 – Basic Telecommunications Requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. All equipment shall be new and unused.

B. The System shall include all equipment, materials, accessories, devices and other facilities necessary for a fully functional system.

C. The Contractor shall provide all components, equipment, cabling, connectors, adaptors, terminators, parts, accessories and associated quantities required for complete installations and according to the manufacturer's installation specifications. All components may not be specified herein.

D. The Contractor shall supply all cabling, connectors, adapters, terminators, and appurtenances necessary to interconnect all broadband equipment including equipment located in the equipment rooms.

E. Equipment List:

1. Optical Transmitter: Harmonic HLT-7806R-F7-AS-AC-7L

2. Optical Amplifier: Harmonic HOA-8230-8-AS-A-C-EDFA

3. Dividing Network: Harmonic HLS-8016 1 x 16

4. Optical Fiber Node: ATX Networks Model QFMN Bi-Directional Optical Node 26VAC Transformer - 50VA

5. Optical PAD: SC/APC male to SC/APC female

6. PAD: 8dB

7. SC/APC jumpers

8. Passive Devices: 16-Way Splitter 5-1000 Mhz:

9. Tamper proof terminators with tool: Regal RLT75WT

10. Coaxial cables shall be extended between broadband outlets located as indicated on the drawings and passive taps in each telecommunications room (TR). Design Selection: Belden 9116P or Approved equal

F. Spares:

1. Provide quantities as listed:

a. Optical Transmitter: Harmonic HLT-7806R-F7-AS-AC-7L, quantity. one (1)

b. Optical Amplifier: Harmonic HOA-8230-8-AS-A-C-EDFA, quantity. one (1)

c. Optical Fiber Node: ATX Networks Model QFMN Bi-Directional Optical Node 26VAC Transformer - 50VA, quantity two (2)

d. 4 and 16 way splitters, quantity four (4) each

e. Tamper proof terminator, quantity one (1) bag

f. Connectors of each type, quantity five (5) of each

g. Crimping tool, quantity one (1) of each cable type

G. Equipment Specified Elsewhere

1. General: Refer to 27-05 00 – Basic Telecommunications and 27 11 00 Equipment Room Build-Out for requirements pertaining to:
   a. Fiber Optic and Copper Backbone Cables
   b. Fiber Optic Connectors
   c. Fiber Optic and Copper Backbone Termination Equipment
   d. Fiber Optic Patchcords
   e. Fiber Optic and Copper Horizontal Cables
   f. Fiber Optic Patch Panels
   g. Copper Station Outlets
   h. Copper Termination Facilities
   i. Cable Trays
   j. Cable Ladder Racks
   k. Equipment Enclosures and Relay Racks
   l. Innerduct
   m. Communications Room Accessories
   n. Communications Pathways
   o. Communications Grounding

PART 3 – EXECUTION

3.01 GENERAL

A. Installations shall meet or exceed industry standards and installation practices listed in the Specification.

B. System installation and construction methods shall conform to the requirements of applicable State and Local codes.

C. System installation and construction methods shall conform to the requirements of the Federal Communications Commission.

D. The Contractor shall install all system components including furnished equipment, and appurtenances in accordance with the manufacturer's instructions, NFPA 70, ANSI-C2 and as shown, and shall furnish all cables, connectors, terminators, interconnections, services, and adjustments required for a complete and operable system.

E. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

F. Rack mounted equipment: as a general practice, Contractor shall run power cables, control cables, and high level cables on the left side of an equipment rack as viewed from the rear.

1. Contractor shall run other cables on the right side of an equipment rack, as viewed from the rear.

2. For equipment mounted in drawers or on slides, provide the interconnecting cables with a service loop of not less than three feet and ensure that the cable is long enough to allow full extension of drawer or slide.

G. Product installations failing to meet standards and practices shall be removed and replaced at no additional cost to the Owner.

H. The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces including painting shall be included as necessary.

I. Contractor shall supply all tools and test equipment necessary for successful completion of the Project.

J. If deviations from the drawings are required, they shall require approval by LAWA prior to placement of the affected work.

K. The locations of raceways, stub ups, outlets, panels, equipment racks and cabinets and other related products as indicated on the drawings are diagrammatic in location.

Contractor should have precise and definite locations accepted by LAWA before proceeding with the installation.

3.02 EXAMINATION

3.03 CABLE INSTALLATION PRACTICES

A. Cable installation: Contractor shall install all cables required for fully functional system.

B. Contractor shall submit shop drawings indicating the intended layout prior to beginning the cable pulling.

C. If deviations from the drawings are required they shall be approved by the Project Manager prior to placement of the affected cables.

D. Contractor shall not install any cable with a bend radius less than that recommended by the cable manufacturer.

E. Contractor shall monitor pull tension continuously during installation and shall not exceed manufacturers recommended maximum pull tension.

   1. A cable lubricant specifically manufactured for cable pulling lubrication purposes and compatible with the cable sheathing material may be used on cables pulled in conduits or ducts to meet pull tension requirements.

      a. Petroleum grease shall not be used as a cable lubricant.

F. Contractor shall mark cables at each end, regardless of length, with permanent, non-handwritten number or letter cable markers within six inches of both ends.

   1. There shall be no unmarked cables in the system.

G. Contractor shall test cable with Time Domain Reflectometer (TDR) as required under Article “Testing.”

H. Contractor shall then install active and passive line equipment including wall outlets.

I. Contractor shall perform forward and reverse alignment of the system.

J. A portion of the BTDS wiring installed within the building will be installed above ceilings within cable tray in areas used for circulation of environmental air. Cables installed within these areas shall be rated for use in such plenum locations and shall bear the CMP marking

K. Contractor shall not install more cables in a conduit than shown unless approved in writing by LAWA.

1. Conduit systems shall not exceed 40 percent cable fill. The Contractor shall provide larger conduit or additional conduit should planned cable fill exceed 40 percent.

L. Contractor shall plan cable pulls so that the maximum number of cables required in the conduit is pulled simultaneously.

M. Restraints shall be provided on each backboard associated with cable terminations that meet industry standards for cable restraint hardware. Provide sufficient quantities to assure cables routed on backboards are restrained at periodic intervals.

N. All fiber optic cables shall include a thirty (30) foot service loop located on both ends, unless otherwise noted. Service loops entering from the cable tray or above grade conduits shall be neatly organized and secured in the cable ladder in the originating and destination Equipment Rooms. Service loops for cables entering a Equipment Room from the depressed slab shall be neatly coiled and secured in the depressed slab area in each Equipment Room. Shop drawings shall indicate all locations where services loops will be provided.

O. All optical fiber terminations are to be made by personnel trained and certified by the fiber manufacturer. All connectors shall be installed utilizing the appropriate certified tool kit and equipment as recommended by the manufacturer.

P. Fiber optic splices are not allowed except where specifically noted on the drawings and where pre-terminated pigtails are used for fiber terminations. If field conditions are discovered that require additional splices, submit a request in writing to LAWA and obtain approval prior to performing the splicing.

Q. All fiber optic splices shall be made by fusing splicing and shall be performed in the field by a qualified splicer. Provide heat shrink protection for all fiber optic splices and store within splice trays. Mechanical splices are not allowed.

R. The maximum optical attenuation for fusion splicing shall not exceed 0.15 dB per the TIA/EIA-568C Standards.

S. Contractor shall ensure that all cable reel tests have been performed and that the cable has passed all pre-installation tests.

3.04 BUILDING RACEWAY SYSTEM

A. Provide conduits and raceways as shown on the drawings. Ensure that adequate conduit facilities are installed to support the intended systems. Primary raceways and conduits are shown on the drawings; however, the Contractor shall also be responsible for additional raceways as required to provide a complete conduit system.

B. Refer to specification section 27 05 00 – Basic Telecommunications for specific requirements.

3.05 GROUNDING

A. Provide grounding installation as specified in Section 27 05 00 – Basic Telecommunications for specific requirements.

B. The Contractor shall furnish and install grounding busbars and ground wire to provide a single common grounding point in each telecommunication space for connection of telecommunication equipment and components to the Building Ground Reference.

C. Grounding shall meet the requirements and practices of applicable authorities or codes. In addition, telecommunications grounding shall conform with the ANSI: J-STD-607-A

D. Contractor shall ground and bond all telecommunications conduits, cable ladder, equipment racks and cabinets and other telecommunications components requiring grounding to the Telecommunication Ground Bars (TGBs) within the Telecommunications Spaces.

E. Coordinate with power trades to extend insulated ground cable from the TGB to the Main Building Ground Reference.

3.06 LABELING

A. Coordinate all labeling with the Systems Manager

B. Specific labeling conventions for all cabling systems, equipment and termination facilities shall as directed by and coordinated with LAWA IT. All communication conduits, cable jacket ends, voice/data outlets, termination punch down blocks, ports and patch panels, shall be labeled and identified.

D. Label each face plate and outlet and with permanent self-adhesive label with minimum 3/16-inch high characters.

E. Label each Horizontal cable with permanent self-adhesive label with minimum, 1/8-inch high characters, in the following locations:

1. Inside receptacle box at the work area.

2. Behind the communication room patch panel and splitters.

F. Use labels on face of patch panels, dividing panels and splitters.

G. Labels shall be machine-printed, Brady or equal. Hand-lettered labels shall not be acceptable.

H. All racks, cabinets, enclosures and boxes installed as part of this Section's scope of work shall be permanently labeled with engraved black on white laminate matching identification scheme depicted in the Project drawings and defined in this section.

I. BTDS components to be labeled shall include:

1. BTDS conduit labeling: Each BTDS conduit entering a communication facility shall be permanently labeled with adhesive labels or tie on tags.

2. Cabling shall be labeled with adhesive cable labels on each cable end, within 12-inches of jacket terminations at each termination point.

3. Copper termination systems shall include color coded designator strips providing indication of building floor and communications room serviced by remote cable ends.

4. Fiber optic termination systems shall include port assignments and color coded designator strips providing indication of building floor and TR serviced by remote cable ends

5. Termination system identification shall be used. All cable identification shall be in numerical sequence.

6. Grounding bus bars shall be labeled.

J. Provide facility assignment records and a copy of the as-built Horizontal cable plant floor plan drawing for each Communications Room coverage area, posted on the wall of each Communications Room. These drawings and schedules shall be covered by protective sheet of polycarbonate or PMMA material. All facility references, equipment enclosure, equipment and cabling designations shall be coordinated with LAWA IT staff.

K. Contractor shall supply and attach permanent labels to both ends of all cables and conductors. For proper administration, additional cable labeling may be required on the cable at intermediate locations such as conduit ends and along cable tray runs.

L. Contractor shall supply and attach permanent labels to cables, wiring, and equipment.

1. All cables shall be labeled at both ends of all cables and conductors.

2. All outlets shall be labeled.

3. All termination blocks, patch panels and splitters shall be labeled.

4. All terminations shall be labeled.

5. All equipment frames and cabinets shall be labeled.

6. Each system shall be labeled.

7. Grounding system shall be labeled.

8. Other items as directed by LAWA shall be labeled.

M. Identification information shall be typed or printed on labels.

1. Identification information on labels shall be indelible.

2. Handwritten labels will not be accepted.

N. Labels for equipment, racks, backboards, patch panels, enclosures of all types, and other equipment shall be by engraved label.

1. Labels on same type of equipment shall be attached in same place on each piece of equipment.

O. Identify empty outlet boxes, junction boxes, and cabinets installed for future use by means of indelible markings on the inside of the box or cabinet noting system use.

P. Enclosures and junction boxes located above unfinished spaces, such as lay-in ceilings, shall be clearly identified on the outside as “BTDS.”

Q. Provide conduits and raceways as shown on the drawings. Ensure that adequate conduit facilities are installed to support the intended systems. Primary raceways and conduits are shown on the drawings; however, the Contractor shall also be responsible for additional raceways as required to provide a complete conduit system.

R. Refer to specification Section 27 05 28 – Pathways for Communications Systems for specific requirements.

3.07 FIELD / SITE QUALITY CONTROL

A. Written notification of planned testing shall be given to the Project Manager at least 14 days prior to the test, and in no case shall notice be given until after the Contractor has received written approval of the specific test procedures.

B. The Contractor shall provide all testing procedures, personnel, equipment, instrumentation, and supplies necessary to perform all testing.

C. Test Procedures and Reports: Test procedures shall explain, in detail, step-by-step actions and expected results demonstrating compliance with the requirements of the specification.

1. Test reports shall be used to document results of the tests.

2. Reports shall be delivered to the Project Manager within 7 days after completion of each test.

3. Cable testing: after installation of the cable and before splicing in the system components, each cable section shall be tested using a time domain reflectometer (TDR) to determine shorts, open, kinks, and other impedance discontinuities and their locations.

   a. Contractor shall submit TDR traces as a hard copy printout for each length of cable as part of the test report. Cable sections showing adverse impedance discontinuities shall be replaced at the Contractor's expense.

4. Contractor shall perform leakage tests, sweep tests and signal level tests at end points.

   a. Contractor shall demonstrate that system meets FCC requirements for signal leakage as required by CFR 47 Part 76. Contractor shall demonstrate that system meets requirements of NCTA and EIA 250 for video signals.

   b Contractor shall balance signal levels from each of the sources indicated above to provide a uniform output from the headend amplifier.

   c. Contractor shall measure and record visual carrier levels on the highest and lowest channels at each of the following locations.

      1) Input and output of each amplifier.

      2) Contractor shall verify that visual carrier levels are not less than +6dBmv and not greater than +9dBmv at any television receiver on any channel.

5. Test reports shall include:

   a. An installer - signed statement of compliance with specifications herein.

   b. All certificates of test equipment calibration/certification.

   c. All certificates of training for test personnel.

6. Cable reel serial number and cable product number shall be recorded and included in the test results for each reel.

D. Fiber Optic Test Procedures

1. Contractor to measure optical power level at 1550 nm and insert the appropriate value of optical PAD's.

2. Refer to Specification Section

3.08 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

C. Contractor shall insert unmodulated +10dBmv signal at 50mhz and 860 mhz into system at forward input to headend amplifier and balance and align amplifiers at high and low frequencies.

3.09 CLOSE OUT ACTIVITIES

A. Training:

1. Coordinate training schedule with Owner three weeks prior to training date.

2. Include training for two sessions of people to allow for shift differential. Include session handouts of information with instructions and information for training.

3. Videotape the sessions and turn 2 copies of the tapes over to the Owner. Keep one copy at the Contractor’s facility for future copies of the tape to be made.

4. Training shall include:

a. Maintenance and installation of active system components.

b. System signal balancing and alignment in the forward and reverse direction.

3.10 MAINTENANCE

END OF SECTION

SECTION 27 21 00 – LOCAL AREA NETWORK

PART 1 - GENERAL

1.01 SUMMARY

A. General: Los Angeles World Airports (LAWA) has deployed a large scale campus-wide Cisco Multi-Protocol Label Switching (MPLS) layer three network with Cisco 6500 series core switches at two physically separate locations on the Airport. Individual Terminals and various other locations around the airport have Cisco 6513 switches that serve as distribution layer switches as well as the campus MPLS provider edge switches. Telecommunication Rooms deploy Cisco 6509 distribution/provider edge switches. These switches contain 10GBASE-LR blades and modules that accept uplinks from Cisco 3750 switch stacks. All assignments of distribution / PE switch ports are coordinated with LAWA.

B. Furnish and install new Access Layer PoE stackable switches with redundant power supplies and voice gateways as shown on the contract drawings. Include all cabling between redundant power supplies and stackable switches. Include all stack-wise cabling for both switch-to-switch connections and for a wrap-around stackwise link from top to bottom switch in stack. Furnish and install X2 10GB adapters as shown on the contract drawings, both at the switch stack and at the blades at the distribution switches.

C. Furnish and install new industrial switches, expansion modules and power supplies as shown on the contract drawings. Include DIN rail mounting for each switch, expansion module and power supply. Provide UL listed 120VAC US power cord for power supplies. Furnish and install two SFP 1000-base-LX adaptors in each switch with corresponding SFP modules at distribution switches.

D. Coordinate with the Systems Manager and LAWA IT to develop a standard template configuration for all Access Layer PoE stackable switches and industrial switches. Template shall include switch names, temporary password, spanning tree configuration, trunk configuration, storm control, multi-tiered Quality of Service, multicast and disabling of unnecessary services. Once approved by LAWA IT and the Systems Manager, apply templates to all switches.

E. Contractor shall work with LAWA to provide basic configuration for the switch stacks including uplink trunks, HSRP configuration, spanning tree configuration, quality of service, switch naming, passwords and disabling of unnecessary services for each concourse 3750 switch stack to ensure uniformity with similar LAWA switch stacks, configuration of access ports for end devices, as well as complete configuration of IE-3000 industrial switches.

F. Related documents included in the specification requirements:

Section 01 11 00 – Summary of Work

Section 01 25 00 – Substitution Procedure

Section 01 31 00 – Administrative Requirements

Section 01 33 00 – Submittal

Section 01 40 00 – Quality Requirements

Section 01 43 00 – Quality Assurance

Section 01 64 00 – Owner Furnished Products

Section 01 77 13 – Preliminary Closeout Reviews

Section 01 77 16 – Final Closeout Review

Section 01 78 00 – Close Out Submittals

Section 27 05 00 – Basic Telecommunication Requirements

Section 27 13 33 – Communications Systems Interfaces (Legacy Systems)

G. Systems to be supported on the Local Area Network shall include but are not be limited to the following:

1. Electronic Visual Information Display System
2. Terminal Area Support Systems (TASS)
3. VoIP and analog telephone
4. Closed circuit television
5. Access control and video surveillance systems
6. Public address
7. LAWA administrative network
8. Tenant local area networks
9. Tenant high speed internet access & VPN transport
10. Building automation
11. Other networks

NOTE: VoIP supports the Common Use Systems (CUTE) used at airline ticket counters and gates. Coordinate with LAWA to ensure correct CISCO design configuration to support CUTE functionality and CUTE interface with the Avaya VoIP Telephone System.

H. Provide all necessary fiber patch cords for connection of network equipment uplinks and downlinks. Provide all copper patch cords to interconnect switches to horizontal cabling at access layer switch locations. Provide patch cords from wall jack faceplates to VoIP telephones. Tenant and subsystem users will provide their own patch cords from wall jack faceplates to their respective equipment.

I. Furnish, install, and configure new Wireless LAN access points at locations shown on the contract drawings as specified in Section 27 2133 - Wireless Communication System. Configure access points to provide public internet access as well as private wireless services.

J. Furnish and install new analog courtesy telephones, utility room telephones, loading bridge telephones and elevator telephones as shown on the contract drawings. Connect telephones to voice gateway using single pair circuits in the Premise Wiring and Distribution System. Configure telephones with telephone numbers, auto ring-down or other features as instructed by LAWA IT.

K. Furnish, install and configure desk style 6-button VoIP telephones at gate podiums and other locations shown on the contract drawings. Connect telephones to PoE switch ports at IDF using circuits assigned by the Premise Wiring and Distribution System. Configure each telephone and associated switch port with line appearances and feature sets as directed by LAWA IT.

L. The System Manager will compile a list of LAN connections, VoIP telephones and analog gateway circuits required by each tenant and subsystem. Provide all necessary configurations for trunks, switch ports and gateway connections to support these connections. Fully test all connections prior to releasing them to the Systems Manager for use by tenants and subsystems.

M. Perform a complete bandwidth analysis for each access layer switch uplink. Initial analysis shall be based on expected trunk traffic profiles for each access layer port. Once trunks are activated measure peak bandwidth use on each uplink port on a weekly basis as devices are added to the system. Provide a weekly report to LAWA IT and the System Manager reflecting the switch name, uplink name, link bandwidth, peak bandwidth utilization and percentage of bandwidth the peak represents

N. Products furnished (but not installed) under this section:

O. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Definitions:
1. AAA: authentication, authorization, and accounting
2. GBIC: gigabit interface converter
3. CCIE: Cisco Certified Internetwork Expert
4. QoS: quality of service
5. LAN : local area network
6. MPLS: multi-protocol label switching

7. NTP: network time protocol
8. PoE: power over Ethernet
9. SNMP: simple network management protocol
10. TCP/IP: transmission control protocol / Internet protocol
11. VLAN: virtual local area network
12. VoIP: voice over Internet protocol

B. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the Codes, Standards and References as specified in Section 27 05 00 – Basic Telecommunications Requirements Cisco Recommended Practices.

C. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate all aspects of this specification section with the requirements and responsibilities of the Systems Manager and LAWA IT.

B. Coordinate the Local Area Network transport requirements with the Systems Manager as specified in 27 13 33 Communications Systems Interfaces (Legacy Systems) and other systems vendors to ensure that LAN resources to support the network carriage requirements of other systems (dependent systems) is provisioned and configured and prioritized to support the phased installation and commissioning of the dependent systems and the operational requirements of those systems including their commissioning and testing. Systems that are dependent on the Local Area Network include (but not limited to):

1. Legacy Systems as described in Communications Systems Interfaces (Legacy Systems)

2. Wireless Communications Systems (WiFi)

3. Electronic Visual Information Display Systems (EVIDS)

4. Common User Terminal Equipment (CUTE)

5. Paging Systems (PA)

6. Access Control and Alarm Monitoring Systems (ACAMS)

7. Video Surveillance Systems (VSS)

8. Voice Communications systems including the connectivity requirements of

- VoIP Telephones
- Defibrillator Alarms thru the Analog interface
- Other Analog Circuits thru the Analog interface
- Building Management Systems as specified in Division 23
- Network Lighting Control Systems as specified in Division 26
- Power Monitoring Systems as specified in Division 26
- Fueling Systems
- Others not identified at this point in time

C. The Contractor shall be required to coordinate the work in this contract with related works contracts and contractors where infrastructure resources being provided and installed in this project are extended into related works projects.

D. Coordinate IP addressing schema for switches, voice gateways, and end devices with LAWA IT.

E. Coordinate configuration of call managers, voice mail system and network management with LAWA IT.

F. Coordinate requirements for uplink circuits and circuit assignment to end devices with the Premise Wiring and Distribution System contractor.

G. Coordinate activation and commissioning schedule for network services with LAWA IT. Schedule network activation to support test and commissioning activities for all supported subsystems.

H. Coordinate requirements for network end device connections, IP address assignments with each subsystem contractor, LAWA IT and Airline Users.

1,05 SUBMITTALS

A. General – Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

1. Contractor shall provide submittals as specified in Section 01 33 00 – Submittal Procedures and Section 27 05 00 – Basic Telecommunication Requirements.

2. Product Data

   a. Distribution Switch Blades
   b. Access Layer Switches and redundant power supplies
   c. Voice Gateways
   d. SFP and GBIC Modules
   e. VoIP and analog Telephones

3. Composite Network Diagram – Provide a complete diagram indicating all access layer switch stacks, voice gateways and uplinks. Indicate specific interfaces used for uplinks and downlinks and management IP addresses for all devices.

4. Test Plans and Procedures

    a. Sample of data forms to be used during performance testing.
    b. Certification that Contractor has successfully completed operational and field testing of the systems and it is ready for demonstration of compliance with Contract requirements.

B. As-Built Documentation

1. Provide a comprehensive network diagram reflecting all switches, voice gateways, device names, IP address assignments and uplink / downlink interfaces.

2. Provide a spreadsheet indicating IP addresses and switch ports, and VLAN assignments used to support all connected LAN devices.

3. Provide documentation of all switch configurations in hard and soft copy format proposes to use in this project.

1.06 QUALITY ASSURANCE

A. Contractor shall develop a complete test plan to ensure that all network devices are functioning and configured in a consistent manner in accordance with requirements of this specification and LAWA requirements. Include failover testing for all redundant paths and links recording recovery times after a forced failover. The Test Plan developed by the contractor shall be coordinated with the Systems Manager (refer to Specification Section 27 13 33 – Communications Systems Interfaces (Legacy Systems) for specific Systems Manager responsibilities and duties related to this specification).

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A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment, refurbished or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

C. Major items of equipment that serve the same function must be the same make and model / version/service pak.

D. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

1.08 DELIVERY, STORAGE AND HANDLING

1.09 FIELD/SITE CONDITIONS

A. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

B. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

C. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

D. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

E. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

F. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

G. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

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I. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

1.10 WARRANTY

A. Contractor shall provide a warranty for products and work provided under this Section as specified in Section 27 05 00 – Basic Telecommunications Requirements.

B. Provide one year Cisco SmartNet coverage on all new items of Cisco equipment excluding SFP and GBIC modules. Smartnet coverage shall be 8 x 5 x Next Business Day.

C. Submit a copy of all manufacturer warranty information.

PART 2 - PRODUCTS

Contractor Please Note: All references to model numbers or manufacturers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment currently installed at LAWA. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

2.01 ACCESS LAYER SWITCHES

A. Access Layer PoE switches shall be Cisco WS-C3750G-24PD-F or WS-C3750G-48PD-F units. Switches shall provide full 802.3AF Power over Ethernet support on all ports. In stacks that exceed two switches include a wraparound one meter stackwise cable to interconnect top and bottom switch in stack. Switch quantities are shown on the contract drawings. Each switch stack shall be provided with one X2-10GB-LR module located in the top switch in the stack with a second X2-10GB-LR uplink module in the bottom switch in the stack. X2-10GB-LR modules shall also be provided at ports on distribution switches to support uplinks.

B. Access Layer switches located at gate cabinets shall be Cisco IE-3000-8TC-E industrial switches. Each switch shall be provided with one Cisco IEM-3000-8TM 10/100-BASE-T expansion module and PWR-IE3000-AC power supply module and two GLC-LH-SM SFP Modules. Provide DIN rail mount for switch, expansion module and power supply. Provide UL listed grounding power cord for power supply. Include two GLC-LH-SM SFP modules for ports on distribution switch to receive uplinks. Equip each IE-3000 at gate cabinets with one Panduit model DPOEKIT 8-port midspan power inserter kit with DPOEWM8B wall mount bracket to supply power to 6-button VoIP Telephones at gates.

2.02 REDUNDANT POWER SUPPLIES

A. Redundant power supplies shall be Cisco model PWR-RPS2300 units with two C3K-PWR-1150WAC power supply modules and CAB-RPS2300 power cables. One RPS chassis shall be provided for each stack of up to six switches or fraction thereof. Power supply DC power cable shall be provided for each supported switch.

2.03 VOICE GATEWAYS

A. Voice Gateways shall be Cisco model VG-224 units in quantities shown on the contract drawings. Each voice gateway shall be provided with one 25-pair Amphenol connectorized cable terminated on the 110-block equipment termination field at each room. Provide machine imprinted labels on the 110-block equipment field indicating the voice gateway name and circuits one through xx.

2.04 DISTRIBUTION SWITCH MODULES

A. Distribution / PE switch modules and new Cisco 6509E switches shall be provided and configured.

2.05 VOICE OVER IP TELEPHONES

A. Voice over IP telephones shall be Cisco model 7960G six-button units. Provide and configure sixty-three (63) 7960G telephone appliances.

2.06 ANALOG WALL TELEPHONES

A. Analog wall mount telephones shall be Allen Tel trimline units with DTMF dial pad, hookswitch and cradle, armored handset cord and hearing aid compatible receiver. Units shall be Allen Tel model GB2554V44AC or approved equal. Color shall be ash. Provide and configure sixty-three (63) units.

2.07 WIRELESS LAN ACCESS POINTS

A. Wireless LAN access points shall be Motorola AP-7131 dual radio 802.11a.b/g/n units. Access points and associated antenna configuration shall be located as shown on the contract drawings. Access points shall be configured to work with existing Motorola RFS 7000 LANswitches.

2.08 PATCH CORDS

A. Copper patch cords shall be factory manufactured units certified to Category 6 specifications. Coordinate patch cord colors for voice and data services with the LAWA IT department. Cables shall be provided in various lengths to allow for neat, organized installation with a minimum of excess cable. All RJ-45 connectors shall be provided with no-snag boots. Coordinate color code for patch cords with LAWA IT.

B. Fiber patch cords shall be provided in a duplex configuration with connector types as appropriate for the connected equipment. Patch cords shall be provided with factory installed SC/APC connections.

2.09 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable Manufacturers:
   1. W.H. Brady
   2. Ideal
   3. Panduit
   4. Other equal

PART 3 - EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

3.02 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.03 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.04 GENERAL SWITCH CONFIGURATION

A. The 3750 switch stack shall be configured in a manner that is consistent with similar existing switch stacks in the LAWA network. This configuration will include configuration of uplinks, trunks, spanning tree, HSRP, switch names, passwords and other general configuration required to activate the switches.

B. Provide complete configuration for all IE3000 switches and configuration for all 3750 access ports to support end devices.

3.05 DEPLOYMENT OF VoIP TELEPHONES

A. Furnish and install Category 6A patch cords and VoIP telephones at locations shown on the contract drawings. Test each telephone for correct operation.

B. Furnish and install all analog telephones and provide patch cables to interconnect phones to assigned ports on voice gateways. Test all analog telephones for correct operation.

C. Provide all necessary patching from assigned ports on voice gateways to third party telephones in locations such as elevator cabs. Test each telephone after connections are made.

3.06 INSTALLATION

3.07 FIELD SITE QUALITY CONTROL

A. Test Plan/Procedure: The Contractor shall develop and submit a comprehensive Network Test Plan that has been coordinated with LAWA IT for testing of the network to the LAWA Systems Manager for review and approval 60 days prior to the beginning of any testing activities. The test plan shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein.

B. Contractor shall provide full staff and equipment support to LAWA IT staff during testing of the network. This support shall include failover testing for all uplinks, pre-emptive fail back and testing of uplink bandwidth utilization. Support shall include provision of two (2) network technicians with CCIE certifications for a period of at least two weeks.

1. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

   a. Commentary on test results.

   b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

   c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

   d. Signatures of persons who performed and witnessed the test.

   e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

2. Termination

   a. Performance verification test shall be terminated when:

1) Individual components, subsystems, or the integrated system fail to perform as specified.

2) It is determined that system is missing components or installation is not complete.

b. Upon termination, corrective work shall be performed and performance verification test rescheduled with LAWA IT.

c. Retesting shall be performed by Contractor at no additional expense.

d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of LAWA IT.

C. Final Inspection and Acceptance

1. After testing is complete, review tabulated records with LAWA IT.

2. The Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3.08 STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.09 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.10 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA CMMS: Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.11 CLOSEOUT ACTIVITIES – ACCEPTANCE, MAINTENANCE, TRAINING

A. Acceptance - Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the system for a 60-day period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

3.12 MAINTENANCE

END OF SECTION 27 21 00

SECTION 27 21 00 – LOCAL AREA NETWORK

PART 1 - GENERAL

1.01 SUMMARY

A. General: Los Angeles World Airports (LAWA) has deployed a large scale campus-wide Cisco Multi-Protocol Label Switching (MPLS) layer three network with Cisco ~~6500~~6500E/6800 series core switches at two physically separate locations on the Airport. Individual Terminals and various other locations around the airport have Cisco ~~6513~~6500E/6800 series switches that serve as distribution layer switches as well as the campus MPLS provider edge switches. Telecommunication Rooms deploy Cisco ~~6509~~6500E/6800 distribution/provider edge switches. These switches contain 10GBASE-LR blades and modules that accept uplinks from Cisco ~~3750 switch stacks.~~ 3850/4500E series access switches. All assignments of distribution / PE switch ports are coordinated with LAWA.

B. Furnish and install new Access Layer PoE stackable switches with redundant power supplies and voice gateways as shown on the contract drawings. Include all cabling between redundant power supplies and stackable switches. Include all stack-wise cabling for both switch-to-switch connections and for a wrap-around StackWise link from top to bottom switch in stack. Furnish and install X2 10GB adapters as shown on the contract drawings, both at the switch stack and at the blades at the distribution switches.

C. Furnish and install new industrial switches, expansion modules and power supplies as shown on the contract drawings. Include DIN rail mounting for each switch, expansion module and power supply. Provide UL listed 120VAC US power cord for power supplies. Furnish and install two SFP 1000-base-LX adaptors in each switch with corresponding SFP modules at distribution switches.

D. Coordinate with the Systems Manager and LAWA IT to develop a standard template configuration for all Access Layer PoE stackable switches and industrial switches. Template shall include switch names, temporary password, spanning tree configuration, trunk configuration, storm control, multi-tiered Quality of Service, multicast and disabling of unnecessary services. Once approved by LAWA IT and the Systems Manager, apply templates to all switches.

E. Contractor shall work with LAWA to provide basic configuration for the switch stacks including uplink trunks, HSRP configuration, spanning tree configuration, quality of service, switch naming, passwords and disabling of unnecessary services for each concourse 3750 switch stack to ensure uniformity with similar LAWA switch stacks, configuration of access ports for end devices, as well as complete configuration of IE-3000 industrial switches.

F. Related documents included in the specification requirements:

Section 01 11 00 – Summary of Work

Section 01 25 00 – Substitution Procedure
Section 01 31 00 – Administrative Requirements
Section 01 33 00 – Submittal
Section 01 40 00 – Quality Requirements
Section 01 43 00 – Quality Assurance
Section 01 64 00 – Owner Furnished Products
Section 01 77 13 – Preliminary Closeout Reviews
Section 01 77 16 – Final Closeout Review
Section 01 78 00 – Close Out Submittals
Section 27 05 00 – Basic Telecommunication Requirements
Section 27 13 33 – Communications Systems Interfaces (Legacy Systems)

G. Systems to be supported on the Local Area Network shall include but are not be limited to the following:

1. Electronic Visual Information Display System
2. Terminal Area Support Systems (TASS)
3. VoIP and analog telephone
4. Closed circuit television
5. Access control and video surveillance systems
6. Public address
7. LAWA administrative network
8. Tenant local area networks
9. Tenant high speed internet access & VPN transport
10. Building automation
11. Other networks

NOTE: VoIP supports the Common Use Systems (CUTE) used at airline ticket counters and gates. Coordinate with LAWA to ensure correct CISCO design configuration to support CUTE functionality and CUTE interface with the Avaya VoIP Telephone System.

H. Provide all necessary fiber patch cords for connection of network equipment uplinks and downlinks. Provide all copper patch cords to interconnect switches to horizontal cabling at access layer switch locations. Provide patch cords from wall jack faceplates to VoIP telephones. Tenant and subsystem users will provide their own patch cords from wall jack faceplates to their respective equipment.

I. If applicable, furnish, install, and configure new Wireless LAN access points at locations shown on the contract drawings as specified in Section 27 21 33 - Wireless Communication System. Configure access points to provide public internet access as well as private wireless services.

J. If applicable, furnish and install new analog courtesy telephones, utility room telephones, loading bridge telephones and elevator telephones as shown on the contract drawings. Connect telephones to voice gateway using single pair circuits in the Premise Wiring and Distribution System. Configure telephones with telephone numbers, auto ring-down or other features as instructed by LAWA IT.

K. If applicable, furnish, install and configure desk style 6-button VoIP telephones at gate podiums and other locations shown on the contract drawings. Connect telephones to PoE switch ports at IDF using circuits assigned by the Premise Wiring and Distribution System. Configure each telephone and associated switch port with line appearances and feature sets as directed by LAWA IT.

L. The System Manager will compile a list of LAN connections, VoIP telephones and analog gateway circuits required by each tenant and subsystem. Provide all necessary configurations for trunks, switch ports and gateway connections to support these connections. Fully test all connections prior to releasing them to the Systems Manager for use by tenants and subsystems.

M. Perform a complete bandwidth analysis for each access layer switch uplink. Initial analysis shall be based on expected trunk traffic profiles for each access layer port. Once trunks are activated measure peak bandwidth use on each uplink port on a weekly basis as devices are added to the system. Provide a weekly report to LAWA IT and the System Manager reflecting the switch name, uplink name, link bandwidth, peak bandwidth utilization and percentage of bandwidth the peak represents

1.02 REFERENCES

A. Definitions:
1. AAA: Authentication, Authorization, and Accounting
2. CCIE: Cisco Certified Internetwork Expert
3. GBIC: Gigabit Interface Converter
4. LAN : Local Area Network
5. MPLS: Multi-Protocol Label Switching
6. NTP: Network Time Protocol
7. PoE: Power over Ethernet
8. QoS: Quality of Service
9. SNMP: Simple Network Management Protocol
10. TCP/IP: Transmission Control Protocol / Internet Protocol
11. VLAN: Virtual Local Area Network
12. VoIP: Voice over Internet Protocol

B. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the Codes, Standards and References as specified in Section 27 05 00 – Basic Telecommunications Requirements Cisco Recommended Practices.

C. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate all aspects of this specification section with the requirements and responsibilities of the Systems Manager and LAWA IT.

B. Coordinate the Local Area Network transport requirements with the Systems Manager as specified in 27 13 33 Communications Systems Interfaces (Legacy Systems) and other systems vendors to ensure that LAN resources to support the network carriage requirements of other systems (dependent systems) is provisioned and configured and prioritized to support the phased installation and commissioning of the dependent systems and the operational requirements of those systems including their commissioning and testing. Systems that are dependent on the Local Area Network include (but not limited to):
   1. Legacy Systems as described in Communications Systems Interfaces (Legacy Systems)
   2. Wireless Communications Systems (WiFi)
   3. Electronic Visual Information Display Systems (EVIDS)
   4. Common User Terminal Equipment (CUTE)
   5. Paging Systems (PA)
   6. Access Control and Alarm Monitoring Systems (ACAMS)
   7. Video Surveillance Systems (VSS)
   8. Voice Communications systems including the connectivity requirements of
      - VoIP Telephones
      - Defibrillator Alarms thru the Analog interface
      - Other Analog Circuits thru the Analog interface
      - Building Management Systems as specified in Division 23
      - Network Lighting Control Systems as specified in Division 26
      - Power Monitoring Systems as specified in Division 26
      - Fueling Systems
      - Others not identified at this point in time

C. The Contractor shall be required to coordinate the work in this contract with related works contracts and contractors where infrastructure resources being provided and installed in this project are extended into related works projects.

D. Coordinate IP addressing schema for switches, voice gateways, and end devices with LAWA IT.

E. Coordinate configuration of call managers, voice mail system and network management with LAWA IT.

F. Coordinate requirements for uplink circuits and circuit assignment to end devices with the Premise Wiring and Distribution System contractor.

G. Coordinate activation and commissioning schedule for network services with LAWA IT. Schedule network activation to support test and commissioning activities for all supported subsystems.

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   a. Sample of data forms to be used during performance testing.
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1. Provide a comprehensive network diagram reflecting all switches, voice gateways, device names, IP address assignments and uplink / downlink interfaces.

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5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

C. Major items of equipment that serve the same function must be the same make and model / version/service pack.

D. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

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E. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

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G. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

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Contractor Please Note: All references to model numbers or manufacturers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment currently installed at LAWA. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

2.01 ACCESS LAYER SWITCHES

A. Access Layer PoE switches shall be Cisco WS-~~C3750G-24PD-F~~C3850-24P-S or WS-~~C3750G-48PD-F~~ C3850-48F-S or non-stack WS-C4510RE-S7+96V+/WS-C4507RE-S7+96V+/units~~.~~ with dual Supervisors. Switches shall provide full 802.~~3AF~~3AT Power over Ethernet + support on all ports. In stacks that exceed two switches include a wraparound one meter StackWise cable to interconnect top and bottom switch in stack. Switch quantities are shown on the contract drawings. Each switch stack shall be provided with one X2-10GB-LR module located in the top switch in the stack with a second X2-10GB-LR uplink module in the bottom switch in the stack. X2-10GB-LR modules shall also be provided at ports on distribution switches to support uplinks.

B. Access Layer switches located at gate cabinets shall be Cisco IE-3000-8TC-E industrial switches. Each switch shall be provided with one Cisco IEM-3000-8TM 10/100-BASE-T expansion module and PWR-IE3000-AC power supply module and two GLC-LH-SM SFP Modules. Provide DIN rail mount for switch, expansion module and power supply. Provide UL listed grounding power cord for power supply. Include two GLC-LH-SM SFP modules for ports on distribution switch to receive uplinks. Equip each IE-3000 at gate cabinets with one Panduit model DPOEKIT 8-port midspan power inserter kit with DPOEWM8B wall mount bracket to supply power to 6-button VoIP Telephones at gates.

2.02 REDUNDANT POWER SUPPLIES

A. Redundant power supplies shall be Cisco model PWR-RPS2300 units with two C3K-PWR-1150WAC power supply modules and CAB-RPS2300 power cables. One RPS chassis shall be provided for each stack of up to six switches or fraction thereof. Power supply DC power cable shall be provided for each supported switch.

2.03 VOICE GATEWAYS

A. Voice Gateways shall be Cisco model VG-224 units in quantities shown on the contract drawings. Each voice gateway shall be provided with one 25-pair Amphenol connectorized cable terminated on the 110-block equipment termination field at each room. Provide machine imprinted labels on the 110-block equipment field indicating the voice gateway name and circuits one through xx.

2.04 DISTRIBUTION SWITCH MODULES

A. Distribution / PE switch modules and new Cisco 6509E switches shall be provided and configured.

2.05 VOICE OVER IP TELEPHONES

A. Voice over IP telephones shall be Cisco model 7960G six-button units.

2.06 ANALOG WALL TELEPHONES

A. Analog wall mount telephones shall be Allen Tel trimline units with DTMF dial pad, hookswitch and cradle, armored handset cord and hearing aid compatible receiver. Units shall be Allen Tel model GB2554V44AC or approved equal. Color shall be ash.

2.07 PATCH CORDS

A. Copper patch cords shall be factory manufactured units certified to Category 6 specifications. Coordinate patch cord colors for voice and data services with the LAWA IT department. Cables shall be provided in various lengths to allow for neat, organized installation with a minimum of excess cable. All RJ-45 connectors shall be provided with no-snag boots. Coordinate color code for patch cords with LAWA IT.

B. Fiber patch cords shall be provided in a duplex configuration with connector types as appropriate for the connected equipment. Patch cords shall be provided with factory installed SC/APC connections.

2.08 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

PART 3 - EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

3.02 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.03 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.04 GENERAL SWITCH CONFIGURATION

A. The 3750 switch stack shall be configured in a manner that is consistent with similar existing switch stacks in the LAWA network. This configuration will include configuration of uplinks, trunks, spanning tree, HSRP, switch names, passwords and other general configuration required to activate the switches.

B. Provide complete configuration for all IE3000 switches and configuration for all 3750 access ports to support end devices.

3.05 DEPLOYMENT OF VoIP TELEPHONES

A. Furnish and install Category 6A patch cords and VoIP telephones at locations shown on the contract drawings. Test each telephone for correct operation.

B. Furnish and install all analog telephones and provide patch cables to interconnect phones to assigned ports on voice gateways. Test all analog telephones for correct operation.

C. Provide all necessary patching from assigned ports on voice gateways to third party telephones in locations such as elevator cabs. Test each telephone after connections are made.

3.06 INSTALLATION

A. All installation shall follow applicable manufacturer manuals and/or industry best practices.

3.07 FIELD SITE QUALITY CONTROL

A. Test Plan/Procedure: The Contractor shall develop and submit a comprehensive Network Test Plan that has been coordinated with LAWA IT for testing of the network to the LAWA Systems Manager for review and approval 60 days prior to the beginning of any testing activities. The test plan shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein.

B. Contractor shall provide full staff and equipment support to LAWA IT staff during testing of the network. This support shall include failover testing for all uplinks, pre-emptive fail back and testing of uplink bandwidth utilization. Support shall include provision of two (2) network technicians with CCIE certifications for a period of at least two weeks.

1. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

a. Commentary on test results.

b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

d. Signatures of persons who performed and witnessed the test.

e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

2. Termination

a. Performance verification test shall be terminated when:

1) Individual components, subsystems, or the integrated system fail to perform as specified.

2) It is determined that system is missing components or installation is not complete.

b. Upon termination, corrective work shall be performed and performance verification test rescheduled with LAWA IT.

c. Retesting shall be performed by Contractor at no additional expense.

d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of LAWA IT.

C. Final Inspection and Acceptance

1. After testing is complete, review tabulated records with LAWA IT.

2. The Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3.08 STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.09 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.10 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA CMMS: Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.11 CLOSEOUT ACTIVITIES – ACCEPTANCE, MAINTENANCE, TRAINING

A. Acceptance - Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the system for a 60-day period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 27 21 00

SECTION 27 21 33 – WIRELESS COMMUNICATION SYSTEM (WiFi)

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the minimum requirements for wireless communication systems contractor proposes to install as part of Terminal renovations.

B. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational system shown and described in the Specifications.

C. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

D. The Contractor shall coordinate with electrical contractor for provision of horizontal conduit and field boxes required to accommodate cabling of all wireless access points and other system equipment.

E. The Contractor shall coordinate specialty electronic, Information Technology (IT) data networks and any other IT infrastructure systems that depend on or are transported by wireless communications.

F. Related documents:

1. Section 27 05 00 – Basic Telecommunication Requirements

1.2 GLOSSARY

A.	ANSI	American National Standards Institute
B.	AP	Access Point (wireless receive and transmit antenna)
C.	ASTM	American Society for Testing Materials
D.	BFU	Board of Fire Underwriters
E.	BICSI	Building Industry Consulting Services International
F.	CSA	Canadian Standards Association
G.	DEC	Department of Environmental Conservation
H.	EIA	Electronics Industry Association
I.	ER	Equipment Room
J.	FCC	Federal Communications Commission
K.	FM	Factory Mutual
L.	IEEE	Institute of Electrical and Electronics Engineers
M.	ISO	International Standards Organization
N.	NEC	National Electrical Code

O. NEMA National Electrical Manufacturers' Association
P. NESC National Electrical Safety Code
Q. NFPA National Fire Protection Association
R. OSHA Occupational Safety and Health Administration
S. TIA Telecommunications Industry Association
T. TR Telecommunications Room
U. TWC Tenant Wiring Closet
V. UFBC Uniform Fire Prevention and Building Code
W. UL Underwriter's Laboratories, Inc.

1.3 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

C. Submit all proposed labeling materials and nomenclature for approval.

D. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.

2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.

E. Submit details of proposed wireless system, access point locations (refer to paragraph 3.4), bandwidth(s) and other details to LAWA for approval and coordination with other existing wireless systems and LAWA wireless usage agreements and procedures.

F. Submit floor plans with heat maps overlaid that show the results of contractor's wireless vendor's predicative analysis modeling to indicate areas of coverage and extrapolated signal strength.

G. Submit all testing plans (acceptance, and endurance) for review and approval prior to the performance of any testing.

H. Project Record Documents required include:

1. Marked-up copies of Contract Drawings

2. Marked-up copies of Shop Drawings

3. Newly prepared Drawings

4. Marked-up copies of Specifications, Addenda and Change Orders

5. Marked-up Project Data submittals

6. Record Samples

7. Field records for variable and concealed conditions

8. Record information on Work that is recorded only schematically

9. As-built drawings

10. Record drawings

11. Electronic as-built and LAWA LUSAD requirements

I. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

J. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

1. Upon completion of the as built drawings, the Design Consultant will review the as built work with the Contractor.

2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

K. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.4 CODES, STANDARDS AND REFERENCES

A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

1. IEEE 802.11 (a, b/g, n) - Information Technology - Telecommunications And Information Exchange Between Systems - Local And Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) And Physical Layer (PHY) Specifications

2. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09

3. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009

4. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08

5. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994

6. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

7. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications

8. IEEE National Electrical Safety Code (NESC); 2007

9. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises

10. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code

11. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)

12. NFPA-70 National Electric Code; 2008

13. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

B. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.5 QUALITY ASSURANCE

A. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.8).

1.6 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.7 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

4. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.8 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of fifteen (15) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

B. Submit a copy of all manufacturer warranty information.

1.9 ON-SITE PERSONNEL REQUIREMENTS

A. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

B. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

C. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

D. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

E. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

F. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

G. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

H. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

I. Following each day’s work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

PART 2 - PRODUCTS

2.1 WIRELESS EQUIPMENT GENERAL SPECIFICATIONS

A. RF Management:

1. RF management shall be set to restrict performance-impacting operations such as channel changes when voice over IP traffic is present.

B. User Bandwidth Control:

1. The bandwidth contract shall be implemented to ensure that one single user cannot monopolize bandwidth and can limit users to a maximum amount of bandwidth. Bandwidth contracts can be specified by user role for simple administration, and can be applied per-user (one user cannot exceed 2Mbps, for example) or per-group (all guest users together cannot exceed 2Mbps.)

C. Privacy Protection:

1. AP’s shall contain no configuration, passwords, encryption keys, or security information. The AP shall have no exposed serial port, no recoverable passwords, no vendor-installed certificates, and no way for an intruder to tap into the wired side of the AP to eavesdrop on wireless communication.

2. AP’s shall be FIPS-140 Level 2 compliant.

D. Simplified Management:

1. The system shall be manageable through a single interface and a single web-based URL. Each of these devices shall have a software image, configuration file, and run-time statistics, as well as different configuration and operation commands.

2. The system shall not require a separate management appliance or software package for basic functionality such as RF visualization, location tracking, or multi-controller management.

E. Security:

1. All security functionality shall be centralized and housed in the mobility controller (including encryption) and not the AP, guaranteeing that AP does not have to be replaced as security standards evolve to protect the investment, and ensure the continuous security of the network.

F. Application Bandwidth Control:

1. The system shall support a stateful protocol inspection for voice protocols with automatic mapping to bandwidth control and quality of service schemes. These schemes shall limit the maximum bandwidth and/or guarantee a minimum bandwidth, latency, and jitter for an application. This way, a mixed-use wireless network can support both voice and data with both getting sufficient resources.

G. User/device Controls:

1. The system shall support the ability to restrict the types of protocols on a wireless LAN, as well as to restrict the types of resources a wireless device can access (for example, the system permits administrators to block or restrict client-to-client communication, dramatically reducing malicious attacks, viruses, and worms).

2. The system shall possess the ability to allow modification of network access permissions at any time during the life of a session, based on both internal controls and integration with external systems through SNMP, syslog, XML, and RADIUS.

H. Secure Guest Access:

1. The system shall differentiate between internal users and guest users through integrated authentication, encryption, and authorization. All three functions shall be managed by the mobility controller. The external firewall, knowing users only through IP addresses, will pass the traffic into the network.

2. The system shall not be vulnerable to such an attack, making it safe to deploy internal and guest users on the same infrastructure.

I. Integrated Intrusion Protection:

1. The system shall support a wireless intrusion detection system that is integrated with the wireless infrastructure. By placing these two functions in the same device, the system becomes a protection system rather than simply a detection system.

2. The system shall detect then lock out rogue APs, ad-hoc networks, bridges, DoS attacks, man in the middle attacks, impersonation attacks, and many others.

J. Users shall be capable of using wired access, wireless access, remote access, or a combination of these accessed.

K. Extended policy criteria shall be capable make access control decisions based on parameters, such as identity, physical location, time of day, authentication method, device type, device integrity state, protocol, and application. Put in more general terms, a per-packet access control decision can be made based on:

1. Who the user is
2. How the user is accessing the network
3. Where the user is
4. When the access is made
5. What resource the user is trying to access

2.2 WIRELESS EQUIPMENT FUNCTIONAL SPECIFICATIONS

A. Provide the required number of Access Point antenna devices needed to provide 100% coverage to all areas of the terminal and provide an additional 25% spare amount of APs.

B. Provide a minimum of -50 dBm RSSI at the following locations:

1. Curbside areas
2. Ticketing check-in and ATO office spaces
3. Tenant and concessions areas
4. Concourses and holdrooms
5. Ramp areas
6. Inbound and outbound baggage makeup areas.

C. Access Points shall be capable of the following minimum functional specifications:

1. FIPS 140-2 802.11i, Military Grade L2 Security
2. Domain/Realm AAA Server Control
3. LAN Speed VPN Authentication/Termination
4. AP VPN/IPSec Tunnels
5. Remote Traffic Bridging with Central/Mgmt
6. Security Extension via 3rd Party (A/V, IPS, etc.)

7. Web-Based/Clientless Scanning/Remediation
8. Virtual Desktop/Clean Erase
9. Identity/Role/Policy-Based Traffic Separation
10. Stateful Access Rights
11. Time, Location Access Policies
12. WiFi Anomaly Thresholds and Blacklisting
13. Advanced Captive Portal / Web-Authentication
14. Complete Intrusion Prevention (All Threats)
15. Integrated Blacklisting & Location Tracking
16. Integral Wired Access Control
17. Advanced Location Tracking & Heatmaps
18. End-to-End QoS/Voice Optimization
19. Remote 802.11 Packet Capture
20. Per User/Device Troubleshooting (RealTime)
21. AP Self Provisioning & Optimization (RealTime)
22. Rogue/Threat Classification
23. Strong/Complete Intrusion Detection
24. Central Authentication, L2/L3 Fast Roaming
25. Rogue Detection/Containment/Location
26. AP Monitoring, Config Mgmt, Reporting (Offline)
27. Multi-SSIDs (Hidden/Broadcast), VLANs, NAT
28. Encryption/Authentication (WPA1.0/2.0)
29. Integral Wired Port Access Control
30. Seamless Small/Branch Site Solution
31. Eliminate Campus LAN Integration

32. End-to-End Data Encryption
33. Auto/Self Provisioning AP's
34. Real-Time AP RF Optimization/Tuning
35. Dynamic/Smart Load Balancing
36. "Any Device" Location Tracking
37. Client-Client Fire-walling
38. AP Failure Detection/Recovery
39. SNMP Monitoring & Basic Reporting
40. AP Configuration / Update Mgmt
41. Offline Analysis & Config Tuning
42. "Assisted" AP Install/Configuration
43. Advanced, Stand-alone Access Point
44. Multiple SSID's
45. VLANs, NAT, DHCP, 1 x Radio Adjustments

2.3 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

2.4 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.1 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height of all equipment in finished areas.

D. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant reviews and comments on arrangement and appearance.

E. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

F. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant.

G. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.

2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.

3. Bundles shall be secured with hook-and-loop cable strap material.

   a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.

   b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.

4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.2 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.3 INSPECTIONS

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.4 AP SITE SURVEY

A. A full site survey of the Terminal(s) shall be conducted in order to determine and document the exact number, placement, and coverage of access point devices and the type of antenna required by each to provide full wireless network coverage. The contractor shall carry out and document the survey at its cost, working closely with Design Consultant and stakeholders.

B. Upon concurrence and approval of AP design and layout, provide installation, programming and commissioning of all AP and wireless network components.

3.5 TESTING REQUIREMENTS

A. Phases of Testing

1. On-Site Performance Verification Testing

2. On-Site Endurance Testing

B. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of the Design Consultant. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment

2. Test equipment is to be identified by manufacturer and model

3. Interconnection of test equipment and steps of operation shall be defined

4. Expected results required to comply with specifications

5. Record of test results with witness initials or signature and date performed

6. Pass or fail evaluation with comments.

7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

    a. Commentary on test results.

b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

d. Signatures of persons who performed and witnessed the test.

e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

C. Performance Verification Testing

1. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.

2. Schedule test with Design Consultant. Do not begin testing until:

a. All systems have been installed and individually and jointly tested to ensure they are operating properly.

b. Written permission from Design Consultant has been received.

3. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.

4. Verification: Verify correct operation of the required system functionality as defined in these specifications.

5. Adjustment, Correction, and Completion:

a. Correct deficiencies and retest affected components.

b. Make necessary adjustments and modification to system after obtaining approval of the Design Consultant.

c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by the Design Consultant.

6. Recording:

a. Describe actual operational tests performed and equipment used and list personnel performing tests.

b. Record in tabular form all test results, deficiencies, and corrective measures.

7. Termination

   a. Performance verification test shall be terminated by the Design Consultant when:

      1) Individual components, subsystems, or the integrated system fail to perform as specified.

      2) It is determined that system is missing components or installation is not complete.

   b. Upon termination, corrective work shall be performed and performance verification test rescheduled with the Design Consultant.

   c. Retesting shall be performed by Contractor at no additional expense.

   d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of the Design Consultant.

D. Endurance Testing

1. Provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

   a. Successful completion of performance verification testing.

   b. Training as specified has been completed.

   c. Correction of deficiencies has been completed.

   d. Receipt of written start notification from the Design Consultant.

3. Monitor all systems during endurance testing. Coordinate monitoring with the Design Consultant.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

   a. Date and time for all entries.

   b. Name of individual making entry.

   c. Environmental conditions.

   d. Authority activities in process.

   e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

   f. Description of all equipment failures, including software errors.

g. Description of all maintenance and adjustment operations performed on system.

h. Daily and weekly tabulations.

i. Daily entries of performance data shall be reviewed by the Design Consultant's representative designated to observe monitoring of system.

5. The Design Consultant may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing

a. Phase I - Initial Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by the Design Consultant.

3) If system experiences no failures, proceed to Phase III - Final Testing.

b. Phase II - Initial Assessment:

1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.

2) After submission of report, schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will direct Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.

c. Phase III - Final Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by Engineer.
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7. Phase IV - Final Assessment:

1) After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.

2) After submission of report schedule review meeting at job site. Schedule date and time with the Design Consultant.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, the Design Consultant will approve endurance test or direct Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance

a. During endurance testing make adjustments and corrections to system only after obtaining written approval of the Design Consultant.

b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

E. Commissioning Testing

1. The Contractor shall develop a commissioning test plan that includes the following components, as a minimum:

a. LAWA readiness

b. Operational procedures verification

c. Disaster recovery procedures

d. Computerized Maintenance Management System data verification

e. Change management procedures

2. The commissioning test plan/procedures shall be submitted to the Engineer for review and approval.

F. Final Inspection and Acceptance

1. After endurance testing is complete, review tabulated records with the Design Consultant.

2. The Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by the Design Consultant, extend monitoring period for a time as designated by the Design Consultant.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

6. Submit final report of endurance testing containing all recorded data.

3.6 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.7 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.8 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA is in the process of procuring and implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.9 TRAINING

A. By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct LAWA’s designated staff and Airline personnel in the operation, adjustment and maintenance of all products, equipment and systems.

B. The Contractor shall be required to provide all training aids, e.g., notebooks, manuals.

C. The Contractor shall provide an appropriate training area equipped with all required equipment. The location of the training area shall be coordinated with the Design Consultant.

D. All training shall be completed a minimum of two weeks prior to system cut over. Training schedule shall be subject to the Design Consultant’s approval.

E. Training shall be conducted by experienced personnel and supported by training aids. An adequate number and amount of training material shall be provided by the Contractor. The following is considered a minimum.

1. Functional flow-charts, overall block diagrams, and descriptive material for all software;

2. Schematic drawings for each of the hardware components;

3. All procedure manuals, specification manuals, and operating manuals;

4. As-built drawings.

F. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted. The courses shall be scheduled such that LAWA personnel can participate in all courses (no overlap).

3.10 TYPES OF TRAINING

A. User Training: System users shall be instructed in all aspects of operations of the system. Four (4) hours of basic user training shall be provided. Additionally, four (4) hours of advanced user training shall be provided.

B. Technician Training: Eight (8) hours of maintenance training shall be provided. Training for maintenance technicians shall be provided on site, and shall include, but not be limited to, installation, operation, renovation, alteration, inspection, maintenance and service on each system and subsystem provided, so as to enable troubleshooting and repair to the component level.

C. System Administrator Training: System Administrator Training shall be provided. System Administrator Training shall include both classroom work and on the job training and shall be provided on-site at LAX or at a location within 50 miles of LAX.

1. Classroom Training: Eight (8) hours of software training shall be provided for each system. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete software system. The course material must be presented in depth with the instructor covering detailed design, structure, and algorithms.

3.11 FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

END OF SECTION 27 21 33

SECTION 27 21 33 WIRELESS COMMUNICATION SYSTEM - WiFi

PART 1 - GENERAL

1.01 SUMMARY

A. Section 27 21 33 includes the LAWA standards for WiFi communication systems to be installed by LAWA contractors, LAWA tenants and their contractors.

B. LAWA contractors, LAWA tenants and their contractors shall include in the construction submittal all necessary details about the proposed installation, including equipment, WiFi coverage projection, network connections, WiFi access point (AP) installation, IT rooms to be accessed/used, and estimated cost /installation duration.

C. LAWA contractors, LAWA tenants and their contractors are responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to airport/terminal operations in providing complete and operational WiFi systems.

D. LAWA contractors, LAWA tenants and/or their contractors shall coordinate with LAWA for provision of horizontal conduit and field boxes required to accommodate cabling of all WiFi access points and other system equipment.

E. LAWA contractors, LAWA tenants and/or their contractors shall inform and coordinate with LAWA if there are specialty electronic systems, information technology (IT) data networks and any other IT infrastructure systems that depend on or are transported by the WiFi communications.

F. Related documents within the LAWA Design and Construction Handbook:
Section 27 05 00 – Basic Telecommunication Requirements

1.02 REFERENCES

A. Glossary

1. ANSI American National Standards Institute
2. AP Access Point (wireless receive and transmit antenna)
3. ASTM American Society for Testing Materials
4. BFU Board of Fire Underwriters
5. BICSI Building Industry Consulting Services International
6. CSA Canadian Standards Association
7. DEC Department of Environmental Conservation
8. EIA Electronics Industry Association
9. ER Equipment Room
10. FCC Federal Communications Commission
11. FM Factory Mutual

12. IEEE Institute of Electrical and Electronics Engineers
13. ISO International Standards Organization
14. NEC National Electrical Code
15. NEMA National Electrical Manufacturers' Association
16. NESC National Electrical Safety Code
17. NFPA National Fire Protection Association
18. OSHA Occupational Safety and Health Administration
19. TIA Telecommunications Industry Association
20. TR Telecommunications Room
21. TWC Tenant Wiring Closet
22. UFBC Uniform Fire Prevention and Building Code
23. UL Underwriter's Laboratories, Inc.
24. SSID WiFi Service Set Identification, also known as a WiFi network name
25. WPA2 WiFi Protected Access II protocol
26. RSSI Received Signal Strength Indication
27. AEGIS LAWA Airport Engineering Geographical Information System (also known as LUSAD – LAWA Utility Survey and Drawing System)
28. DHCP Dynamic Host Configuration Protocol, a standardized network protocol for computer servers or network controller to allocate IP addresses to computer network devices

B. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following References:

1. IEEE 802.11 (a, b/g, n, ac) - Information Technology - Telecommunications And Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) And Physical Layer (PHY) Specifications
2. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09
3. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009
4. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08
5. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
6. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

7. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications
8. IEEE National Electrical Safety Code (NESC); 2007
9. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises
10. LADBS - Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code
11. NEMA 250 - Enclosures for Electrical Equipment (1000 V Maximum)
12. NFPA-70 - National Electric Code; 2008
13. UL 1863 - Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

C. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.03 SUBMITTALS

A. General – Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Action Submittals

1. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities.
2. Submit all proposed labeling materials and nomenclature.
3. Coordination Drawings:
   a. Indicate locations where space is limited for installation and access.
   b. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.
4. Submit details of proposed WiFi system, access point locations (refer to paragraph 3.4), bandwidth(s) and other details to LAWA for approval and coordination with other existing WiFi systems and applicable LAWA wireless usage agreements and procedures.
5. Submit floor plans with heat maps overlaid that show the results of contractor’s WiFi vendor’s predicative analysis modeling to indicate areas of coverage and extrapolated signal strength.
6. Submit all testing plans (acceptance and endurance) for review and approval prior to the performance of any testing.

C. Closeout Submittals – If the construction of the proposed WiFi system is approved and the system is installed, tenants and their contractors must submit to LAWA as-built system drawings for record. The drawings shall be in current AutoCAD format (wherever applicable) and shall include:

1. Marked-up copies of Contract Drawings
2. Marked-up copies of Shop Drawings
3. Newly prepared Drawings
4. Marked-up copies of Specifications, Addenda and Change Orders
5. Marked-up Project Data submittals
6. Record Samples
7. Field records for variable and concealed conditions
8. Record information on work that is recorded only schematically
9. As-built drawings
10. Record drawings
11. Operation and maintenance manuals
12. Electronic as-built – all electronic as-built drawings covering the above, wherever applicable, shall be submitted to LAWA at the conclusion of the construction to be included as a part of the AEGIS repository.

1.04 QUALITY ASSURANCE

The Contractor shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's permit and manufacturer's specifications. Records of the inspections signed and dated by the Contractor shall be included as a part of the Closeout Submittals to LAWA. LAWA may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.09).

1.05 APPROVED EQUIPMENT & SUBSTITUTION

A. Current LAWA approved WiFi equipment (as of February 28, 2014) is listed below. All WiFi equipment is standardized on Cisco devices.

Model Name / Number	Remarks
AIR-CAP1532E-A-K9	Outdoor Access Points
AIR-CAP1532EU-A-K9	Outdoor Access Points
AIR-CAP1552E-A-K9	Outdoor Access Points
AIR-CAP1552EU-A-K9	Outdoor Access Points
AIR-CAP3702E-A-K9	Indoor Access Points with External Antenna
AIR-CAP3702I-A-K9	Indoor Access Points with Built-In Antenna
WS-C3850-xxU-PoE	WiFi Controller/Switch
WLC-5760 or 8500	WiFi Controller with Code 7.6 or Later

Approval of alternate or substitute equipment or material in no way voids specification requirements.

B. LAWA Contractors, LAWA tenants, and tenant contractors who are performing the construction of WiFi system/equipment at LAWA airports must contact LAWA IT Infrastructure Division to verify the latest approved LAWA WiFi equipment list.

C. Any substitution from the approved WiFi equipment list must receive LAWA Infrastructure Division's approval. Approval of alternate or substitute equipment or material shall in no way void other Specification requirement set forth in this document.

D. Under no circumstances shall LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to LAWA all evidence to support the contention that the item proposed for substitution is equal to the specified item. LAWA's decision as to the equality of substitution shall be final and without further recourse.

1.06 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
2. Equipment shall meet all applicable FCC Regulations.
3. All equipment and systems must conform to the Specifications.
4. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

C. Major items of equipment that serve the same function must be the same make and model.

D. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

E. Maximum standardization of components shall be provided to reduce spare part requirements.

1.07 FIELD/SITE CONDITIONS

A. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

B. The Contractor shall obtain the approval of LAWA for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

C. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

D. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

E. The Contractor shall not unreasonably encumber the site with any material or equipment. Construction, installation and operations shall be confined to areas permitted by law, permits, and contract documents.

F. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

G. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal and safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

H. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of LAWA so the area can be appropriately noted.

I. Following each day’s work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

J. The Contractor shall notify LAWA or any existing facility shutdowns through LAWA’s USR (Utility Shutdown Request) and ASR (Area Shutdown Request) process when working in the airport terminals.

PART 2 - WIFI SYSTEM AND INSTALLATION

2.01 TENANT WIFI SYSTEM GUIDELINES

<u>Section 2.01 of this document applies to LAWA tenants and their contractors.</u>

In order to mitigate potential interference between various WiFi systems in operation, the Tenant shall wire all its access points (APs) and/or Tenant’s network switch to LAWA IT Infrastructure Division designated location to be connected to a LAWA network switch.

The Tenant who plans to install WiFi system and equipment in its leased areas must adhere to the following LAWA guidelines:

A. The Tenant shall plan and design their WiFi access point (AP) distribution within the confine of the Tenant's lease area.

B. The Tenant, as a part of the construction request, shall submit the WiFi system and AP distribution design to LAWA IT Infrastructure Division for approval. In the interest of mitigating wireless interference between various WiFi systems, LAWA IT Infrastructure Division reserves the right to work with the Tenant and its Contractor in modifying the design.

C. The Tenant shall submit the plan and design with installation details, including proposed physical locations of all devices, in AutoCAD (.dwg) format. The submitted plan and design shall also include parts list.

D. LAWA's WiFi system and equipment standard is currently set to Cisco systems and equipment. The Tenant and its Contractor shall plan, design, purchase and install only Cisco WiFi systems and equipment. During the planning stage, the Tenant and its Contractors are encouraged to contact LAWA IT Infrastructure Division to receive the current approved WiFi equipment list.

E. LAWA's communications network cabling standard is currently set to single mode fiber optic and CAT 6a copper communications cables. The Tenant and its Contractor shall plan, design, purchase and install its wiring part of the system with single mode fiber optic and CAT 6a copper communications cables, wherever applicable.

F. The Tenant shall be responsible for the purchase/installation of all the APs and the Layer 2 switches that interface directly with LAWA network. The mentioned shall be managed by LAWA IT Infrastructure Division. The Tenant can choose from one of the following two options to connect its APs to LAWA's infrastructure:

   1. Wire all APs to LAWA telecommunications room or closet as designated by LAWA IT Infrastructure Division.

   2. Wire all APs to the Tenant's own telecommunications room or closet, terminate them on a Tenant's purchased (but LAWA managed) Layer 2 switch, and install an uplink cable to LAWA telecommunications room or closet. The Tenant shall provide LAWA Infrastructure Division with the Layer 2 switch for configuration. After LAWA configures the switch, the Tenant shall physically install the switch in the tenant telecom room or closet.

G. These APs shall be registered with LAWA WiFi controller(s). LAWA IT Infrastructure Division can configure up to 2 SSID's for each Tenant's WiFi system.

H. The tenant is responsible for installing network cables for the network devices mentioned in Section 2.01F above.

I. Tenant equipment that is connected to LAWA network shall become LAWA owned when the tenant terminate its lease with LAWA unless the tenant notifies LAWA of its intention to remove the equipment. In the latter case, the tenant shall be responsible for all cost associated with removing the WiFi equipment and associated cabling, and the tenant must coordinate the removal with LAWA IT Infrastructure Division to mitigate any disruption to LAWA WiFi systems.

J. The tenant WiFi system traffic will be transported to the Tenant's router (within the Tenant's leased space) through LAWA MPLS network infrastructure.

K. The Tenant is responsible to provision its own Internet service, which typically connects to a Tenant network router, for routing all Tenant Internet traffic from its WiFi equipment. The tenant shall coordinate with LAWA IT Infrastructure Division to extend its Internet service provider's demarcation from the main telecommunications room (commonly known as MPOE – minimum point of entry) to the tenant's leased area where the network router is located.

L. All wiring for the WiFi system must be installed in conduit. The Tenant and its Contractor shall provide electrical conduit and cables for the necessary work.

M. The tenant may choose one of the following options to connect to LAWA network for its wireless traffic. Option 1 and 2 may require the tenant to have a Layer 3 connection to LAWA network. Option 3 requires prior approval from LAWA IT Infrastructure Division.

   1. **Tunnel Handoff** – The tenant must have a WiFi controller (refer to the Section 1.05 A for the acceptable controller) in the tenant's space. The tenant shall provide DHCP service and authentication to its wireless clients.

   2. **Layer 3 Handoff –** The tenant does not have a WiFi controller within its space. LAWA shall assign IP address to the tenant's wireless clients.

   3. **Layer 2 Handoff** – LAWA IT Infrastructure Division approval for this option is required. The tenant may or may not have a WiFi controller within its space. The tenant shall provide DHCP and authentication services to its wireless clients.

   IT Infrastructure Division can provide details of implementing each of the above three options upon request.

2.02 WiFi EQUIPMENT GENERAL SPECIFICATIONS

A. WiFi Access Points and Other Network Equipment

   1. All APs shall be current approved Cisco equipment per LAWA list (See Section 1.05 A).

2. All network switch shall be Cisco equipment such as Cisco Catalyst 3850-XXU-PoE or later.

3. All network routers shall be Cisco equipment.

B. This section (Section 2.02B) applies to LAWA Contractors only.

Provide a minimum of -50 dBm RSSI at the following locations:

1. Curbside areas
2. Ticketing check-in and ATO office spaces
3. Tenant and concessions areas
4. Concourses and holdrooms
5. Ramp areas
6. Inbound and outbound baggage makeup areas

Provide a minimum of -70 dBm RSSI at the following locations:

1. Paging rooms
2. Mechanical rooms
3. Air conditioning (HVAC) rooms
4. IT communications rooms
5. Electrical rooms
6. LAWA shops
7. All basement area (where cell phone signal cannot be accessed due to thick walls)

2.03 LABELS

A. Labels shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Labels shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable manufacturers for labels:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

F. Each AP shall be labeled with a name that contains the last six hex number (with no dot or dash) of the AP MAC address. The label shall be placed on the top surface of the AP.

G. <u>This section (Section 2.03G) applies to LAWA Contractors only.</u>

WiFi Controller Naming: Each AP shall be named in the WiFi controller as shown below:

<u>TB-Lx-Rxxx-Cyy-Bww-zzzzzz, where</u>

TB: short for TBIT (Tom Bradley International Terminal. In similar fashion, T1 would be for Terminal 1 and so on)

Lx: floor level where x indicates the level number (L2 is Level 2)

Rxxx: R is for room and xxx for room number. This is the IT room where the WiFi network switch is located and where the AP is connected to

Cyy: C is for Cisco, and yy is for the first two numbers of the Cisco AP series being used

Bww: B is for Baggage Claim Carousel (in similar fashion, T is for Ticketing Counter, C is for Concourse Level, and M is for Mezzanine Level), followed by xx for AP sequence number or other unique identifier of the AP location

zzzzzz: this is the last six digits of the AP's MAC address

<u>Examples</u>

(1) TB-L2-R202-C36-B01-ela9

This AP is located in TBIT, Level 2, connected to IT Room #202, Cisco AP3602, near Baggage Claim Carousel 1, AP MAC address is ela9.

(2) BW-L1-R120-C36-Elevator121-e158

This AP is located in Bradley West, Level 1, connected to IT Room #120, Cisco AP3602, next to Elevator #121, AP MAC address is e158.

H. <u>This section (Section 2.02H) applies to LAWA Contractors only.</u>

Network Switch Port Naming: Each AP shall be named on the switch as shown below:

C3602-Bww-zzzzzz

C3602: Sample of Cisco access point model number.

Bww: B is for Baggage Claim Carousel (in similar fashion, T is for Ticketing Counter, C is for Concourse Level, and M is for Mezzanine Level), followed by AP sequence number or other unique identifier of the AP location

zzzzzz: last six digits of the AP's MAC address

1.02 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways.

C. The Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with LAWA the exact location and mounting height of all equipment in finished areas.

E. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, LAWA shall be notified before starting that part of the work. In areas with no ceilings, install only after LAWA reviews and comments on arrangement and appearance.

F. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

G. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of LAWA.

H. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.
2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.
3. Bundles shall be secured with hook-and-loop cable strap material.
    a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.
    b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.
4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.02 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.03 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.04 AP SITE SURVEY

A. A full site survey of the Terminal(s) shall be conducted in order to determine and document the exact number, placement, and coverage of access point devices and the type of antenna required by each to provide full wireless network coverage. The contractor shall carry out and document the survey at its cost, working closely with Design Consultant and stakeholders.

B. Upon concurrence and approval of AP design and layout, provide installation, programming and commissioning of all AP and wireless network components.

3.05 INSTALLATION

A. APs shall be mounted horizontally with facing down toward the floor. The Contractor shall notify LAWA prior to any AP installation where the AP faces a large metal object or the AP can only be mounted in vertical orientation.

B. APs shall be mounted at temper-safe places and be at least eight feet above, but not higher than fifteen feet, above ground. AP's in public areas shall have a security device installed to prevent removal of the AP by an unauthorized person. The Contractor shall confer with LAWA IT Infrastructure Division on acceptable security device.

C. The Ethernet network patch cable to the APs shall be yellow in color. This jumper cable shall be labeled with the AP's MAC address at each end.

D. APs must be installed with adequate clearance to allow a technician to perform periodical maintenance safely on a ladder.

E. APs shall be provisioned and tested before mounting. For example, the AP shall be physically connected to a switch port. The AP's working condition shall be verified by examining its LEDs according to the guidelines published in the AP's installation manual.

F. Each cable between the AP and the demarcation point must be tested end-to-end and certified with a cable tester. The report of the test results for each cable must be individually identified and submitted to LAWA IT Infrastructure Division.

G. At the end of the project, the Contractor shall configure the network switch port where the Aps are connected to as part of the switch port requirement. Contract shall contact LAWA IT Infrastructure Division for the latest switch port configuration guidelines.

3.06 QUALITY CONTROL

A. Phases of Testing

1. On-Site Performance Verification Testing

2. On-Site Endurance Testing

B. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of LAWA. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment.

2. Test equipment is to be identified by manufacturer and model. The Contractor shall provide current calibration certificates for all test equipment as well as technician training certificates.

3. Interconnection of test equipment and steps of operation shall be defined.

4. Expected results required to comply with specifications.

5. Record of test results with witness initials or signature and date performed.

6. Pass or fail evaluation with comments.

7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to witness any or all of the tests.

10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

    a. Summary and commentary on test results.

    b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

    c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

    d. Signatures of persons who performed and witnessed the test.

e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant/LAWA, before any subsequent testing phase is performed.

C. Performance Verification Testing:

1. AP Testing

   a. Verify Ethernet Link light of the AP when the other end of the cable is connected to a network switch.

   b. Verify that the AP had successfully joined a WiFi controller by examining the solid ring light on the front cover of the AP.

   c. Verify the RF coverage with AirMagnet or similar WiFi test equipment and provide a report to LAWA IT Infrastructure Division.

2. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.

3. Schedule test with LAWA. Do not begin testing until:

   a. All systems have been installed and individually and jointly tested to ensure they are operating properly.

   b. Written permission from LAWA has been received.

4. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.

5. Verification: Verify correct operation of the required system functionality as defined in these specifications.

6. Adjustment, Correction, and Completion:

   a. Correct deficiencies and retest affected components.

   b. Make necessary adjustments and modification to system after obtaining approval of LAWA.

   c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by LAWA.

7. Recording:

   a. Describe actual operational tests performed and equipment used and list personnel performing tests.

   b. Record in tabular form all test results, deficiencies, and corrective measures.

8. Termination

   a. Performance verification test shall be terminated by LAWA when:

      1) Individual components, subsystems, or the integrated system fail to perform as specified.

      2) It is determined that system is missing components or installation is not complete.

   b. Upon termination, corrective work shall be performed and performance verification test rescheduled with LAWA.

   c. Retesting shall be performed by Contractor at no additional expense.

   d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of LAWA.

D. Endurance Testing

1. The Contractor shall provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

   a. Successful completion of performance verification testing.

   b. Training as specified has been completed.

   c. Correction of deficiencies has been completed.

   d. Receipt of written start notification from LAWA.

3. Monitor all systems during endurance testing. Coordinate monitoring with LAWA.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

   a. Date and time for all entries.

   b. Name of individual making entry.

   c. Environmental conditions.

   d. Authority activities in process.

   e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

   f. Description of all equipment failures, including software errors.

   g. Description of all maintenance and adjustment operations performed on system.

   h. Daily and weekly tabulations.

   i. Daily entries of performance data shall be reviewed by LAWA's representative designated to observe monitoring of system.

5. LAWA may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing
   a. Phase I - Initial Testing:
      1) Time: 24 hours per day for 15 consecutive calendar days.
      2) Make no repairs during this phase unless authorized in writing by LAWA.
      3) If system experiences no failures, proceed to Phase III - Final Testing.
   b. Phase II - Initial Assessment:
      1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.
      2) After submission of report, schedule review meeting at job site. Schedule date and time with LAWA.
      3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.
      4) Based on report and review meeting, LAWA will direct the Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.
   c. Phase III - Final Testing:
      1) Time: 24 hours per day for 15 consecutive calendar days.
      2) Make no repairs during this phase unless authorized in writing by LAWA.

7. Phase IV - Final Assessment:
   a. After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.
   b. After submission of report schedule review meeting at job site. Schedule date and time with LAWA.
   c. At review meeting, demonstrate that all failures have been corrected by performing verification tests.
   d. Based on report and review meeting, LAWA will approve endurance test or direct the Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance:
   a. During endurance testing make adjustments and corrections to system only after obtaining written approval of LAWA.
   b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

E. Commissioning Testing

1. The Contractor shall develop a commissioning test plan that includes the following components, as a minimum:

    a. LAWA readiness

    b. Operational procedures verification

    c. Disaster recovery procedures

    d. Computerized Maintenance Management System data verification

    e. Change management procedures

2. The commissioning test plan/procedures shall be submitted to LAWA for review and approval.

F. Final Inspection and Acceptance

1. After endurance testing is complete, review tabulated records with LAWA.

2. The Contractor will not be responsible for failures caused by:

    a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

    b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to the Contractor furnished equipment, installation, or software.

    c. Failure of existing LAWA equipment provided failure was not due to the Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by LAWA, extend monitoring period for a time as designated by LAWA.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

6. Submit final report of endurance testing containing all recorded data.

3.07 STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.
4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.08 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with LAWA prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. All WiFi devices shall have a LAWA asset tag affixed. The Contractor shall obtain the asset tags from LAWA.

3.09 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM (CMMS)

A. LAWA CMMS: Information regarding all equipment including model, nomenclature, serial number, function, location, MAC address, IP address, switch/port information, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.10 CLOSEOUT ACTIVITIES – ACCEPTANCE, MAINTENANCE, TRAINING

A. Acceptance **-** Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the system for a 90-day period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, LAWA shall be provided with a numbered certificate from the Manufacturer registering the installation.

B. Training:

1 By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct LAWA's designated staff and Airline personnel in the operation, adjustment and maintenance of all products, equipment and systems.

2 The Contractor shall be required to provide all training aids, e.g., notebooks, manuals.

3 The Contractor shall provide an appropriate training area equipped with all required equipment. The location of the training area shall be coordinated with the Design Consultant/LAWA.

4 All training shall be completed a minimum of two weeks prior to system cut over. Training schedule shall be subject to the Design Consultant/LAWA's approval.

5 Training shall be conducted by experienced personnel and supported by training aids. An adequate number and amount of training material shall be provided by the Contractor. The following is considered a minimum:

   a. Functional flow-charts, overall block diagrams, and descriptive material for all software

   b. Schematic drawings for each of the hardware components

   c. All procedure manuals, specification manuals, and operating manuals

   d. As-built drawings

6. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted. The courses shall be scheduled such that LAWA personnel can participate in all courses (no overlap).

C. Types of Training

1. User Training: System users shall be instructed in all aspects of operations of the system. Four (4) hours of basic user training shall be provided. Additionally, four (4) hours of advanced user training shall be provided.

2. Technician Training: Two days or two 8-hours of maintenance training shall be provided. Training for maintenance technicians shall be provided on site, and shall include, but not be limited to, installation, operation, renovation, alteration, inspection, maintenance and service on each system and subsystem provided, so as to enable troubleshooting and repair to the component level.

3. System Administrator Training: System Administrator Training shall be provided. System Administrator Training shall include both classroom work and on the job training and shall be provided on-site at LAX or at a location within 50 miles of LAX.

4. Classroom Training: Three days or three 8-hours of software training shall be provided for each system. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete software system. The course material must be presented in depth with the instructor covering detailed design, structure, and algorithms.

End of 27 21 33 Wireless Communication System (WiFi)

SECTION 27 26 26 - COMMUNICATION SYSTEMS INTERFACES (LEGACY SYSTEMS)

PART 1 - GENERAL

1.01 SUMMARY

A. This Section describes requirements for interface to and/or connection to existing Terminal systems that are to remain.

B. The Contractor shall perform all required coordination with LAWA representatives and LAX stakeholders to finalize all functional, operational, and performance requirements for Communication Systems Interfaces. This shall include, but not be limited to, site investigation and verification, design workshops, coordination meetings, and review workshops. Interim and final design documentation shall be submitted for review and approval by the Owner's representative prior to proceeding with any installation work.

C. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational systems and to ensure that they are in compliance with requirements stated or reasonably inferred by this Specification.

D. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

E. The Contractor shall coordinate interfaces to existing systems that are being extended in the Project in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA (refer to Section 27 05 05 – Selective Demolition Telecommunication Systems).

F. Related documents included in the specification requirements:

Section 01 11 00 – Summary of Work

Section 01 25 00 – Substitution Procedure

Section 01 31 00 – Administrative Requirements

Section 01 33 00 – Submittal

Section 01 40 00 – Quality Requirements

Section 01 43 00 – Quality Assurance

Section 01 64 00 – Owner Furnished Products

Section 01 77 13 – Preliminary Closeout Reviews

Section 01 77 16 – Final Closeout Review

Section 27 51 13 - Paging Systems

Section 28 13 00 – Access Control and Alarm Monitoring System (ACAMS)

F. Products furnished (but not installed) under this section:

G. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Abbreviations and Acronyms

1. ANSI American National Standards Institute
2. ASTM American Society for Testing Materials
3. BFU Board of Fire Underwriters
4. CSA Canadian Standards Association
5. DEC Department of Environmental Conservation
6. EIA Electronics Industry Association
7. ER Equipment Room
8. FCC Federal Communications Commission
9. FM Factory Mutual
10. IEEE Institute of Electrical and Electronics Engineers
11. ISO International Standards Organization
12. NEC National Electrical Code
13. NEMA National Electrical Manufacturers’ Association
14. NESC National Electrical Safety Code
15. NFPA National Fire Protection Association
16. OSHA Occupational Safety and Health Administration
17. TIA Telecommunications Industry Association
18. TR Telecommunications Room
19. TWC Tenant Wiring Closet
20. UFBC Uniform Fire Prevention and Building Code
21. UL Underwriter’s Laboratories, Inc.

B. References

1. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:
   a. ANSI C80.1 Rigid Steel Conduit, Zinc-Coated
   b. ANSI C80-3 Electrical Metallic Tubing, Zinc-Coated
   c. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09
   d. ANSI/TIA/EIA–569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009

e. ANSI/TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08

f. ANSI/TIA/EIA - 607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994

g. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002

h. ASTM E814 Standard Test Method For Fire Tests Of Penetration Firestop Systems

i. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications

j. IEEE National Electrical Safety Code (NESC); 2007

k. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises

l. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code

m. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)

n. NFPA-70 National Electric Code; 2008

o. UL 1459 Underwriters Laboratories Standard for Safety – Telephone Equipment

p. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

2. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. Action Submittals

1. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

2. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

3. Submit all proposed labeling materials and nomenclature for approval.

4. Coordination Drawings:

a Indicate locations where space is limited for installation and access.

b Submit floor plans, elevations, and details indicating major equipment and end device locations of equipment to be provided by this contractor to interface to existing systems.

B. Project Records / Closeout Submittals

1. Project Record Documents required include:

a. Marked-up copies of Contract Drawings

b. Marked-up copies of Shop Drawings

c. Newly prepared Drawings

d. Marked-up copies of Specifications, Addenda and Change Orders

e. Marked-up Project Data submittals

f. Record Samples

g. Field records for variable and concealed conditions

h. Record information on Work that is recorded only schematically

i. As-built drawings

j. Record drawings

k. Electronic as-built and LAWA LUSAD requirements

2. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant / LAWA will periodically review Project Record Documents to assure compliance with this requirement.

3. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

4. Upon completion of the as built drawings, the Design Consultant / LAWA will review the as built work with the Contractor.

5. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

6. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

C. Maintenance Material Submittals

1.06 QUALITY ASSURANCE

A. The Contractor’s Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with LAWA’s and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant LAWA shall be notified by the Contractor of any inspection(s) and the Design Consultant / LAWA may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.08).

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to LAWA all evidence to support the contention that the item proposed for substitution is equal to the specified item. LAWA's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor

1.08 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
2. Equipment shall meet all applicable FCC Regulations.
3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.
4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.
5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.
2. Constituent parts, which are alike, shall be from a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.09 DELIVERY, STORAGE AND HANDLING

1.10 FIELD/SITE CONDITIONS AND ON-SITE PERSONNEL REQUIREMENTS

A. The Contractor shall employ the maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection or configuration of existing systems that might be affected by this Work.

B. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

C. The Contractor shall obtain the approval Design Consultant/LAWA for the final layout of equipment to be installed in existing or new telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation (refer to Paragraph 1.05).

D. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of LAWA.

E. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

F. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

G. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

H. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

I. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Design Consultant / LAWA so the area can be appropriately noted.

J. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas

1.11 LEGACY SYSTEMS

A. In addition to Systems listed above, LAWA requires that provisions be made for extension or interface to the following legacy systems:

1. Common Antenna Television System (CATV)
2. Telephone Systems

B. CATV Systems:

1. Cable television service is provided in existing LAX terminal buildings by the Time Warner Cable. LAWA Commercial Development manages this service contract for LAWA.
2. Contractor shall provide all cable, conduit, equipment and connection to bring "last mile" service to required areas from the Time Warner Cable fiber cabinet in existing or new telecommunications rooms to the tenant, concession or other required space.
3. Coordinate with Time Warner Cable to ensure all necessary cable and active and passive components are provided to provide cable television ready outlets where required.
4. Submit proposed installation plans and details for approval.

C. Telephone Systems:

1. Telephone service is provided in existing LAX terminal buildings by various vendors.
2. Contractor shall provide all cable, conduit, equipment and connection to bring "last mile" service to required areas from the incoming service in the existing or new telecommunications rooms to the tenant, concession or other required space.
3. Coordinate with tenant or concession to ensure all necessary cable and active and passive components are provided to provide voice ready outlets where required.
4. Provide Category 6 UTP cabling to all outlets to enable future conversion to voice over Internet Protocol voice services.

D. Submit proposed installation plans and details for approval.

1.12 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of fifteen (15) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.
2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

B. The Bidder shall submit a copy of all manufacturer warranty information.

PART 2 - PRODUCTS

2.01 GENERAL

A. Interface to existing or legacy systems shall be accomplished with products of the same manufacturer, currently available fully compatible make and model. Verify with equipment manufacturer what model or part number is recommended for the intended interface or extension of the existing system.

2.02 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18” above all direct buried services, underground conduits and duct-banks.

F. Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

2.03 FIRESTOPPING

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

2.04 QUALITY CONTROL

PART 3 - EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

   1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

C. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant/LAWA the exact location and mounting height of all equipment in finished areas, such as equipment racks and telecommunications devices.

E. The Contractor shall use existing conduit and surface raceway where possible and practicable. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Design Consultant/LAWA shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant / LAWA reviews and comments on arrangement and appearance.

F. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed that may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of Design Consultant / LAWA and approval received before such alterations are made.

G. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. All Telecommunication Room cabinets and racks shall be mounted a minimum of 36-inches from the wall, any wall mounted equipment, other cabinets, equipment or power panels (or per NEC for voltages exceeding 120VAC).

H. Where required, the Contractor shall be responsible for cutting, patching, coring and associated work for the complete cabling system at no additional cost to the Owner. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

I. All conduit and sleeve openings used by the Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

J. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

K. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

L. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:

1. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.

2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:

   a. Floors – three (3) hours

   b. Corridor walls – two (2) hours

   c. Offices – three-quarters (0.75) hour

   d. Smoke partitions – three-quarters (0.75) – one (1) hour

5. Provide fire stop pillows for existing cable tray penetrations through firewalls.

M. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

N. The Contractor shall seal all foundation penetrating conduits and all service entrance conduits and sleeves to eliminate the intrusion of moisture and gases into the building. This requirement also includes spare conduits designated for telecommunications use.

O. Spare conduits shall be plugged with expandable plugs.

P. All service entrance conduits through building shall be sealed or resealed upon cable placement.

Q. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant / LAWA.

R. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.
2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.
3. Bundles shall be secured with hook-and-loop cable strap material.
   a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.
   b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.
4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.02 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.03 PREPARATION

3.04 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.05 FIELD QUALITY CONTROL - Testing

A. Site Test and inspections

B. Non-Conforming Work

3.06 STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.
2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
3. System wiring has been tested and verified as correctly connected as indicated.
4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.07 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant / LAWA prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. All outdoor cables shall be labeled with ACP FT-LAWAATAG-2.5X4 plastic tags and pre-printed with permanent ink, outdoor cables shall be labeled (and secured with heavy duty straps) in every manhole and handhole within 12 inches of where the cable enters and exits the manhole or handhole and on the slack coil.

E. Backbone cables shall be marked at each endpoint and at all intermediate pull/ access points or junction boxes. Label shall indicate origination and destination TR ID's, sheath ID and strand or pair range.

3.08 COMPUTERIZED MAINTENANCE

A. LAWA is in the process of procuring and implementing a CMMS. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.09 CLEANING

3.10 CLOSEOUT ACTIVITIES AND ACCEPTANCE

A. Final Inspection and Acceptance

1. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in LAWA management system and successful performance System Interface for a Sixty-Day (60) period will constitute acceptance of the system.

3.11 MAINTENANCE

END SECTION 27 26 26

SECTION 27 32 43 RADIO COMMUNICATION SYSTEM & EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the minimum requirements for Radio Communication Equipment (System) required as part of LAWA renovations. LAWA uses a 2-way trunked radio system. The newest Radio System currently deployed at Los Angeles County Airports is Motorola Astro 25 UHF Trunked Digital Radio System. However, any LAWA approved P25 trunk based system will be considered. The current installed Motorola System includes dispatch consoles, core system equipment, tower site equipment, dispatch alpha-numeric paging system, and end-user radios. All airport renovations that require trunked radios shall be an extension of this System and therefore must be 100% compatible. Design / Installation requirements may include radio site improvements, subject to site assessment and gap analysis.

B. Contractor shall include in the Bid all labor, equipment, materials, software, licenses, installation, integration, testing, training, warranties, maintenance, tools, transportation cost, storage costs, insurance, bonds, temporary protection, permits, inspections, taxes, on-site and remote project management cost, and all necessary and related items required to provide complete and operational system shown and described in the Specifications and Drawings.

C. After Notice to Proceed (NTP): Contractor shall:

a. Meet with the LAWA project team to review operational requirements, establish a defined baseline for the system design and identify any special product and/or user requirements including additional reports.

b. Conduct site evaluations to capture site details for the final system design.

c. Submit final design document to Design Consultant for LAWA Approval.

d. Meet with LAWA user groups to develop user requirements and obtain approval of fleet map for the Radio Communication System.

D. Related documents included in the specification requirements:

1. Section 01 11 00 – Summary of Work
2. Section 01 25 00 – Substitution Procedure
3. Section 01 27 00---P25 Inter RF Subsystem Interface (**P25** **ISSI**)
4. Section 01 31 00 – Administrative Requirements
5. Section 01 33 00 – Submittal
6. Section 01 40 00 – Quality Requirements
7. Section 01 43 00 – Quality Assurance

8. Section 01 64 00 – Owner Furnished Products
9. Section 01 77 13 – Preliminary Closeout Reviews
10. Section 01 77 16 – Final Closeout Review
11. Section 01 78 00 – Close Out Submittals
12. Section 23 81 23.13 and .15 HVAC for MPOE and Telecommunication Rooms
13. Section 27 05 00 – Basic Telecommunication Requirements
14. Section 27 11 00 – Telecommunication Room Requirements

E. Products furnished (but not installed) under this section:

F. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Glossary

1.	ANSI	American National Standards Institute
2.	AP	Access Point (wireless receive and transmit antenna)
3.	ASTM	American Society for Testing Materials
4.	BFU	Board of Fire Underwriters
5.	BICSI	Building Industry Consulting Services International
6.	CSA	Canadian Standards Association
7.	DEC	Department of Environmental Conservation
8.	EIA	Electronics Industry Association
9.	ER	Equipment Room
10.	FCC	Federal Communications Commission
11.	FM	Factory Mutual
12.	IEEE	Institute of Electrical and Electronics Engineers
13.	ISO	International Standards Organization
14.	P25 ISSI	Project 25 Inter RF Subsystem Interface (**P25** **ISSI**)
15.	NEC	National Electrical Code

16. NEMA National Electrical Manufacturers' Association
17. NESC National Electrical Safety Code
18. NFPA National Fire Protection Association
19. OSHA Occupational Safety and Health Administration
20. TIA Telecommunications Industry Association
21. TR Telecommunications Room
22. TWC Tenant Wiring Closet
23. UFBC Uniform Fire Prevention and Building Code
24. UL Underwriter's Laboratories, Inc.

B. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as with federal, state and local governmental agencies, including, but not limited to the following References:

1. IEEE 802.11 (a, b/g, n) - Information Technology - Telecommunications And Information Exchange Between Systems - Local And Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) And Physical Layer (PHY) Specifications
2. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09
3. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009
4. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08
5. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
6. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002
7. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications
8. IEEE National Electrical Safety Code (NESC); 2007
9. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises
10. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code
11. NEMA 250 Enclosures for Electrical Equipment (1000 V-Symmetrical Maximum)

12. NFPA-70 National Electric Code; 2008
13. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

C. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

D. All supplied equipment must have “UL Approved” Label.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. General – Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Action Submittals – Contractor shall submit:

1. A detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.
2. All proposed labeling materials and nomenclature for approval.
3. Coordination Drawings:
   a. Indicate locations where space is limited for installation and access.
   b. Submit drawings showing all access points and antennas.
   c. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.
4. Details of proposed Radio Equipment, access point, bandwidth(s) and other details to LAWA for approval and coordination with other existing or concurrent systems.
5. Floor plans with heat maps overlaid that show the results of contractor’s wireless vendor’s predicative analysis modeling to indicate areas of coverage and extrapolated signal strength.
6. All testing plans (acceptance and endurance) for review at least 60 days prior to test date for LAWA approval.
7. Comprehensive Parts Lists, detailing all equipment and infrastructure that will be installed.

8. A detailed Installation Work Plans (including WBS) showing work schedule, tasks, labor and material for all work being performed during the three week look ahead.
9. A Master Schedule with weekly updated three-week look ahead. Three-week look ahead to bring out any risks and unresolved issues that threatens the schedule.
10. A detailed (1) Factory Acceptance Test Plan, (2) Coverage Acceptance Test Procedure, (3) Final Acceptance Test Procedure, and (4) Endurance Test
11. A Training Plan
12. Cutover Plan
13. A Maintenance Plan
14. Any Applicable Metrics
15. Project Management Plan

C. Closeout Submittals - Project Record Documents required include:

1. System Level Diagram
2. Site Block Diagram
3. Site Floor Plans
4. Site Equipment Rack Final Configurations
5. Antenna Network Drawings for RF Sites
6. Test Reports for FAT, CATP, FAT and Endurance Test sheets and results
7. Final Equipment Inventory List
8. Console Programming Template
9. Operation, Maintenance Manuals
10. User Manuals for each subscriber
11. Console Operator Manual (2 each for each dispatch center)
12. Technical Service Manuals
13. Marked-up copies of Contract Drawings
14. Marked-up copies of Shop Drawings
15. Newly prepared Drawings
16. Marked-up copies of Specifications, Addenda and Change Orders
17. Marked-up Project Data submittals
18. Record Samples
19. Field records for variable and concealed conditions

20. Record information on Work that is recorded only schematically
21. As-built drawings
22. Record drawings
23. Electronic as-Built
24. Warranty Status on Installed and/or Spare Equipment
25. Final Project Report
26. Scope Verification Report
27. Pilot Test Report: with applicable Metrics & Data
28. Phase Gate Entry and Exit Reports and Related Metrics

D. Electronic as-built and LAWA requirements:

1. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided by Contractor for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.
2. At every calendar quarter, submit Project Record Documents to Design Consultant for LAWA's records.
3. Upon completion of the as built drawings, the Design Consultant will review the as-built work with the Contractor.
4. If the as-built work is not complete, the Contractor will be so advised and shall complete the work as required.
5. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.06 QUALITY ASSURANCE

A. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with the LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Consultant. The Design Consultant shall be notified by the Contractor of any inspection(s) and the Design Consultant/LAWA may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.09). Contractor shall be responsible for all project Scope Gaps for which corrective action is required to meet base-lined constraints, operational requirements and performance specifications.

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall the LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Consultant is required to provide additional engineering services as a result of substitution of materials or equipment deemed equivalent by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.08 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly of installed and/or spare equipment. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements and shall be at the expense of the Contractor. Under no circumstance shall the Contractor installed used and/or damaged equipment as a part of project installations.
2. Equipment shall meet all applicable FCC Regulations.
3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.
4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.
5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.
4. All integration Scope Gaps shall be the responsibility of the Contractor

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment. There exists the likelihood that some equipment items do not have serial numbers.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result. Manufacture shall be responsible for all integration school

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.09 DELIVERY, STORAGE AND HANDLING

1.10 FIELD/SITE CONDITIONS

A. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

B. The Contractor shall obtain the approval of Design Consultant / LAWA for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval at least 21 calendar before beginning installation.

C. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of LAWA.

D. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

E. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

F. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

G. All work shall be performed within the guidelines LAWA policies. Contractor’s bid shall include all labor regardless of time shift required to work.

H. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

I. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

J. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

1.11 WARRANTY

PART 2 - PRODUCTS

2.01 RADIO EQUIPMENT – GENERAL REQUIREMENTS: (includes, but are not limited to)

Note: All references to model numbers or manufacturers and other pertinent information herein are intended to establish standards of performance, quality and construction. These model numbers are based on equipment currently installed at LAWA. Equivalent products may be considered if adequate information is submitted to the specifying engineer for approval beforehand.

A. Contractor shall provide a P25 Trunked Base System, including but not limited to:

1. All required software, licenses, and integration, including warranty per LAWA requirements.
2. Access Points.
3. Antenna Systems for RF Sites and Dispatch.
4. Portable Radios, battery, remote speakers, single-unit dual rate rapid tri-chemistry 110V battery charger, associated belt clip, carry case, one spare replacement battery (per radio)
5. Dispatch Site Equipment.
6. Terminal RF Hotspots – all equipment, services and installation. Includes Motorola's AP7131 access points, or approved equal.
7. Base Stations(s) and Repeaters(s).
8. Central Electronics Banks(s) including logging Recorder Interface and Network Hubs.
9. Channel Banks.
10. Computers, keyboards, mice and trackballs, flat screen monitors.
11. Consoles - dispatch control center, including all required software and network hardware for a fully functional Control Center including headset jacks, dual footswitches, and Gooseneck microphones.
12. Controller(s) – Trunking for prime and remote sites.
13. Recording Equipment and Software.
14. Digital Interface Unit(s).
15. Digital Signaling Modem(s).
16. Digital Voice Modem(s).
17. Management Terminals with interface with the Communications Systems.
18. Microwave Equipment.
19. Flat Panel with touch screen displays connected to computers that directly interface with or control the Radio Communications System.

20. Remote Terminal Unit (TRU) that provides data collection and processing unit with intelligence to operate SCADA systems.
21. Network Fault Management.
22. Printers that directly interface with Radio Communication System.
23. Remote Access Server(s).
24. Base Station/Repeater/Receiver.
25. Simulcast Distribution Amplifier(s).
26. Site Frequency Standards including Atomic Clock, GPS and Netclocks Systems.
27. Simulcast Controller Interface(s).
28. UPS Systems with batteries.
29. Zone Manager and Zone Controller terminals, Zone Statistical server and software.
30. Packet routing network, packet data gateway server.
31. Conventional channel gateway.
32. Gateways and site controllers.
33. PBX.
34. Database server, full vision server, interconnect server.
35. Air traffic router.
36. System statistics server.
37. User configuration server.
38. Cross connect switch.
39. RF Site with site controllers, comparators, stations.
40. Repeater RF Site with site controllers and Stations.
41. Network includes, but not limited to: racks, servers, gateway peripheral border and site routers, HP switches; Ethernet switches, protocol routers, transceivers, surge protection, master prime, console and repeater site switches.
42. System shall be capable of providing required reports, such as Case Activity and Network Monitoring Service Reports – per user requirements. All reports must be exportable to Excel.
43. Power Cord for RF Controller Power Supply.
44. Wireless Security & Compliance, infrastructure management and network assurance solution.
45. Wireless Intrusion Protection System.

46. Power Supply/Injector for Access Points.
47. Radio Frequency Management Software.
48. Wireless LAN (WLAN) Switch/controller.
49. RF Switch for redundancy and clustering.
50. Spectrum Analysis Module.
51. Core Security Management Server with firewall, intrusion detection sensors, anti-virus management application, authentication management application and centralized logging server.

2.02 MODEL NUMBERS

A. Actual devices, currently in use at LAWA, that new equipment must include or be equal to and compatible with include, but are not limited to, the following:

1 Motorola Astro 25 UHF Digital Trunked Radio System, or approved equal.

2 MCC75 P25 Astro Dispatch Console

3 MCC7100 Dispatch Consoles

4 MCC5500 Dispatch Consoles

5 XTS5000 Model 3 (hardware encryption) Portable Radios with standard RSA 3-yr Warranty, Speaker Microphone, Carry Case & Single Unit Charger or approved equal.

6 XTS2500 Model 1.5 Portables Radios with remote speaker microphone with emergency button. Standard RSA 3-yr Warranty or approved equal.

7 XTS1500 Model 1.5 Portables Radios with standard RSA 3-yr Warranty or approved equal.

8 XTS5000 Model 3 Mobiles with standard RSA 3-yr Warranty or approved equal.

9 Control Stations / Consolettes with standard RSA 3-yr warranty or approved equal.

10 XTS5000/160 XTL5000 Flash Upgrades.

11 MC55 Field Service Mobile Computers with Comprehensive Warranty. Includes single slot cradle kit with power supply or approved equal.

12 MC75 3G Mobile Phone, Windows Mobile 6.0 Computer with GPS, Bluetooth and Laser (1D) Barcode Reader with comprehensive warranty. Includes single slot cradle kit with power supply or approved equal.

13 EWP2000 Ruggedized Team Phones with 3-yr comprehensive warranty on equipment and software. Includes WSM, NSM, Desktop Charger, Installation and Commissioning or approved equal.

14 RFS7000 wireless switch, power cord with required number of licenses and 1-year software and Hardware Maintenance including next business day replacement of equipment or approved equal.

15 Zero Port RFS7000 RF Switch for redundancy and clustering or approved equal.

16 WLAN Access Point – Dual Radio 802.11n Adaptive Access Point – Dependent Mode, with QIG and 1-yr Software and Hardware Maintenance for Access Point, including next business day replacement of equipment.

17 Dual-Band Dipole Antenna (Environment: Indoor, Type: Dipole, Gain:3dBi@2.4GHz, 4dBI@5GHz; Beam Width: E-Plane: 35 degrees, H-Plane: 360 degrees; Connector: RP-SMA Male and 1-yr Software and Hardware Maintenance for Access Point, including next business day replacement of equipment.

18 802.3af Power Supply/Injector, 100-250 VAC; with Power Cord and 1-yr Software and Hardware Maintenance for Access Point, including next business day replacement of equipment.

19 Radio Frequency Management Software (RFMS) that provides intuitive browser-based Wi-Fi site planning, management, troubleshooting and monitoring including Server software and 50 user base License and 1-yr Support for RFMS Server Software. Includes all applicable materials, conduit, cabling, installation, configuration, programming and testing. Includes, as applicable, any license certificate upgrades and corresponding 1-yr support for those license upgrades or approved equal.

20 Wireless Intrusion Protection System (WIPS) License for sensor with 1-yr Software Support for WIPS Sensor License, including technical support and software updates for base WIPS License or approved equal.

21 AirDefense (24x7 Wireless Security & Compliance, infrastructure management and network assurance solution) Advance Forensics for Historical Storage and 1-yr Software support for Advanced Forensics Module or approved equal. Includes all applicable materials, conduit, cabling, installation, configuration, programming and testing.

22 AirDefense (Wireless Security & Compliance, infrastructure management and network assurance solution) Advance Troubleshooting and 1-yr Software support for advance troubleshooting module (per sensor license quantity) or approved equal. Includes all applicable materials, conduit, cabling, installation, configuration, programming and testing.

23 Spectrum Analysis Module License per sensor. Includes 1-yr Software Support for Spectrum Analysis Module; price per sensor license. Includes technical support and software updates for Spectrum Analysis software license or approved Equal.

24 AirDefense (Wireless Security & Compliance, infrastructure management and network assurance solution) Appliance Model 4250 including first year maintenance/service program or approved Equal.

25 Other Products and Systems TBD

2.03 ADDITIONAL REQUIREMENTS

A. Additional Contractor requirements associated with Radio Communication Equipment Installation include, but are not limited to:

1. Development and validation of Equipment List for all items required to meet LAWA requirements, including but not limited to: Ensuring valid model numbers, versions, and compatible options to main equipment. Equipment List must contain the correct model numbers, versions, options and delivery data. Ensure all Licenses, Warranties, and Maintenance Plans are identified. Equipment List must include 100% of everything needed to provide a fully functional System. Contractor shall certify new equipment is 100% compatible with existing System.
2. Responsibility to provide, install, program, integrate, configure, interconnect and test all System devices and fixed network equipment necessary for Radio Communication System to operate per Manufacturer Specification, Contract Specification and for the purpose intended.
3. Responsibility to provide and set up all mobile and portable radios and ensure each are 100% functional and meets intended purpose, including operation and function requirements.
4. Provision, installation, programming, integrating, configuring, interconnection and testing of all third party equipment (non-Motorola) equipment necessary for the fully operational system.
5. Responsibility for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to LAWA operations and provide complete and operational systems.
6. Providing / installing horizontal conduit and field boxes required to accommodate cabling of all radio access points and other system equipment.
7. Coordination of specialty electronic, Information Technology (IT) data networks and any other IT infrastructure systems that depend on or are transported by Radio communications. Contractor is required to provide and install all such specialty electronic, network devices and any other IT infrastructure required for a fully operational Radio Communication System.
8. Installation of all required power panels, circuit breakers, new feeders, disconnect switch, transient voltage suppression devices, grounding bus-bars and battery back-up for complete provision of a back-up emergency power in the event of power outage that may be required.
9. Installation of any HVAC units and ducts as may be required.
10. Installation of all cable trays, conduits and cables with terminations as may be required.
11. Installation of radio communications racks and equipment.
12. Installation of all antennas and mounting devices.

13. Installation of RF Site roof top GPS, weather-head. TVSS. power, UPS, conduit, cables.
14. Any demolition described in the drawings.
15. Designing, manufacturing, and installing any concrete slabs with all foundation work and plan checks ground rods as may be required.
16. Ensuring that installation meets all Seismic requirements.
17. Providing any required telephone line and dial tone as may be required.
18. Providing all network devices (including but not limited to: Cisco devices/cards and upgrades, power supplies, cables, connectors, licenses, router, switch, T1 interface, fiber to copper converter, microwave T1 circuit cards, UPS).
19. Provision of all terminations, installation, and perform all testing requirements for all devices, systems, and equipment provided under this contract.
20. Provision of room temperature monitoring to transmit same via a telco line to Telecom Dispatch.
21. Providing Ground Clamp Meter for Ground resistance measurements.

2.04 LABELS

All labels and labeling schemes shall be pre-defined and meet the following guidelines:

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Conform to the Following Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

2.05 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways and layout of all devices including access point, antennas, and Telecom Room layouts.

C. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

   1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least two (2) times the rated load to all fastenings and supports of system components.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable conduit, etc. before installation. Coordinate with all the entities and parties responsible for Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Consultant the exact location and mounting height(s) of all equipment in finished areas.

E. All work shall be appropriately concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Design Consultant shall be notified before starting that part of the work. In areas with no ceilings, install only after Design Consultant / LAWA reviews and comments on arrangement and appearance.

F. The Contractor shall patch all openings remaining around and inside all conduit, sleeve and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

G. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of Design Consultant/LAWA.

H. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

   1. Cables shall be combed and each strand shall run parallel with the other strands.

2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.
3. Bundles shall be secured with hook-and-loop cable strap material.
   a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.
   b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inches wide.
4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

I. System installation include, but is not limited to, the following:
1. Provision of dedicated connectivity for monitoring the P25 System.
2. Verification of connectivity and event monitoring prior to System Acceptance / Start Date. System must be able to interpret System events and determine appropriate response.

3.02 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule, with updated weekly three-week look ahead.

B. Provide detailed work plan for each phase 30 days before start of each work phase.

C. Provide Phase Gates entry and exit reports.

D. Obtain approval prior to start of each phase.

3.03 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and shall prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. If the installation parameters must be varied from the original design parameters prior to submitting such modification request to LAWA, the Contractor is required to also submit a new coverage map along with the requested design modification (as applicable) for LAWA's consideration and approval. The new maps will reflect the measured losses and gains associated with the proposed infrastructure and subscribers change.

E. Submit installation drawings for LAWA review and approval.

3.04 RF / AP SITE SURVEY

A. A radio frequency (RF) site survey shall be performed and submitted for approval prior to deployment of the Wireless network. Contractor shall ensure at a minimum the following steps are performed:

1. Obtain a facility diagram in order to identify the potential radio frequency (RF) obstacles.
2. Visually inspect the facility to look for potential barriers or the propagation of RF signals and identify metal racks.
3. Identify user areas that are highly used and the ones that are not used.
4. Determine preliminary access point (AP) locations. These locations include the power and wired network access, cell coverage and overlap, channel selection, and mounting locations and antenna.
5. Perform the actual surveying in order to verify the AP location. Ensure that the same AP model that is used for the survey is used in production. While the survey is performed, relocate APs as needed and re-test.
6. Document the findings. Record the locations and maintain log of signal readings as well as data rates at outer boundaries.

B. A full site survey of the affected areas shall be conducted to determine RF coverage per area, check for RF interference and determine and document the exact number, placement, and coverage of access point devices and the type of antenna required by each to provide full wireless network coverage. The Contractor shall carry out and document the survey at its cost, working closely with the Design Consultant and stakeholders.

C. Upon LAWA concurrence and written approval of Factory Acceptance Test, RF/AP design, layout and coverage map and other required submittals, Contractor shall proceed with installation, programming and commissioning of all AP and wireless network components.

3.05 INSTALLATION

A. Contractor shall:

1. Install, program, System network equipment as specified by the Equipment List, System Description, System Specification, and System Drawings ensuring a fully functional System.
2. Install, program, set-up all Wireless Network Infrastructure and Equipment as specified by the Equipment List, System Description, System Specification, and System Drawings ensuring a fully functional System.

3. Install all dispatch consoles, install dedicated Local Area Network at each dispatch center and connect to the console as specified by the Equipment List, System Description, System Specification, and System Drawings ensuring a fully functional System.
4. Install appropriate equipment to ground system.
5. Perform the console programming based on LAWA approved Contractor submittals.
6. Optimize System: (1) Verify all equipment is operating properly and that all electrical and signal levels are set accurately. (2) Optimize all subsystems.
7. Verify that all audio and data levels are at factory settings.
8. Check forward and reflected power for all radio equipment, after connection to the antenna systems to verify that power is within tolerances.
9. Check audio and data levels to verify factory settings.
10. Test features and functionality to ensure that these are in accordance with manufacturers' and Contract Specifications and drawings, and that they comply with the final configuration established during the Acceptance Test.
11. Install, test and optimize the System in accordance with manufacturers' and Contract Specifications and drawings and that they comply with the final configuration established during the Acceptance Test.
12. Set up consoles to perform the dispatching operations in accordance with manufacturers' and Contract Specifications and drawings and that they comply with the final configuration established during the Factory Acceptance Test.
13. Perform test to verify site link performance prior to the interconnection of the new supplied equipment to the link equipment.
14. Program, install and test mobile radios in accordance with manufacturer and Contract Documents, and that they comply with the final configuration established during the Factory Acceptance Test, LAWA approved programming templates, and fleet-map.
15. Install all the mobile radios in the vehicles, as identified in the equipment list, and in accordance with the installation schedule and permanently mount the antennas on each vehicle according to the approved prototype appropriate for the vehicle type. Install the antennas close to the same location as the existing antennas and where practical, in vehicles that already have antennas installed. However, install the antennas on the roof where practical, on new antenna installations. Plug the old antenna hole with an appropriate rubber plug, if the antenna requires a new location on the vehicle. Remove the existing mobiles from the vehicles at the time of installation of new radios.
16. If any installations require variations from the approved plan, LAWA must approve, before proceeding with the changed scope.
17. Program and test portable radios in accordance with manufacturer and Contract Documents, and ensure that they comply with the final configuration established during the Acceptance Test, LAWA approved programming templates, and fleet-map.

B. Cutover Plan

1. Contractor and LAWA shall develop a mutually agreed upon cutover plan. During cutover, contractor shall follow the written cutover plan. Contractor shall conduct cutover meetings with the user groups to address both how to mitigate technical and communication problems impact to the users during cutover and during the general operation of the System.

3.06 QUALITY CONTROL

A. Phases of Testing:

- Staging Acceptance Test Plan
- Coverage Acceptance Test Procedure
- Final Site (System) Acceptance Test Procedure
- 60-day Endurance Test

B. Test Plan/Procedure: The Contractor shall submit a comprehensive Test Plan/Procedures, (each Testing Phase) for the review and approval of the Design Consultant, LAWA IT and Stakeholders. The test plan and procedure for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least sixty (60) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment.
2. Test equipment is to be identified by manufacturer and model.
3. Interconnection of test equipment and steps of operation shall be defined.
4. Expected results required to comply with specifications.
5. Record of test results with witness initials or signature and date performed.
6. Pass or fail evaluation with comments.
7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.
8. Documentation verification, both interconnects and functionality shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.
9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

10. Test Reports: The Contractor shall submit, for each test, a test report document that shall certify successful completion of that test. Submit the test results for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

    a. Commentary on test results.

    b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

    c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

    d. Signatures of persons who performed and witnessed the test.

    e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to LAWA. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by the Design Consultant, before any subsequent testing phase is performed.

C. Factory Acceptance Test Plan

1. Major components of the voice system may be operationally staged at the factory site. Functional testing of the staged equipment will be conducted to demonstrate and verify that the new system operates as designed. Representatives of LAWA will be in attendance to observe this testing. The result of this testing will be documented and submitted for LAWA approval prior to release for shipment or to begin Site Installation.

2. Factory Acceptance Test is a functional test which will be performed on the actual new equipment assembled at the Factory's integration center. All issues must be resolved prior to shipment to site and eventual installation.

3. In tests where a majority of the supplied equipment is identical, LAWA may elect to perform the Factory Acceptance Test on a sampling of the available equipment. A failure of a test shall not require the re-running of the entire Factory Acceptance Test. However the Contractor is required to re-run any failed portion of the test following resolution of the problem. This resolution and re-test must be successfully performed to the satisfaction of LAWA prior to approval to proceed with installation.

D. Coverage Acceptance Test Plan – Voice System

1. The Coverage Acceptance Test Plan (CATP) is designed to verify that the voice radio system implemented meets or exceeds the required coverage reliability within LAWA's service area as indicated on the submitted and approved coverage maps. The CATP shall define the coverage testing method and procedure, the coverage acceptance criteria, the test documentation.

2. The CATP shall be based upon a coverage prediction that accurately represents the implemented infrastructure and parameters that are consistent with the Contract requirements.

3. To verify that the radio coverage reliability is met, the indicated coverage area within LAWA's operating area will be divided into:

   a. Portable Talkout (transmit to portable) on the street – ¼ mile X ¼ mile equally sized test grids within 1 mile boundary of the airport.

4. The CATP shall also prove the coverage area meets or exceeds design requirements. The CATP also shall include test for the Channel Performance Criteria. The Channel Performance Criteria (CPC) is the specified minimum design performance level in a faded channel. For this system's voice communication, the CPC is a 2.0 BER, which under standard faded performance conditions provides a Delivered Audio Quality of DAQ-3.4 (the DAQ definitions are provided in the table below). For this system's data communication, the CPC provides a Message Success Rate (MSR) of 98%. The Reliability (percentage of the locations within the coverage area that meet or exceed specified CPC) must be at least 98%.

5. Submit final report of CATP testing containing all recorded data for LAWA Approval.

E. Site (System) Acceptance Test

1. Contractor shall provide test procedure and scripts that prove all equipment installed under this Contract operates per manufacturers and LAWA design specification. This encompasses from the Handheld Radios, the antennas, the P25 System, the associated network and/or infrastructure, power and HVAC – everything as a system operating as designed.

2. Submit final report of Site Acceptance testing containing all recorded data for LAWA Approval.

F. Endurance Testing

1. Contractor shall provide personnel to monitor the Systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

   a. Successful completion of Coverage Acceptance Test and Final System Acceptance Test.

   b. Training as specified has been completed.

   c. Correction of deficiencies has been completed.

   d. Receipt of written start notification from the Design Consultant.

3. Monitor all systems during endurance testing. Coordinate monitoring with the Design Consultant.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

a. Date and time for all entries.

b. Name of individual making entry.

c. Environmental conditions.

d. Authority activities in process.

e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

f. Description of all equipment failures, including software errors.

g. Description of all maintenance and adjustment operations performed on system.

h. Daily and weekly tabulations.

i. Daily entries of performance data shall be reviewed by the Design Consultant's representative designated to observe monitoring of system.

j. Location

5. During Endurance Testing make adjustments and corrections to System only after obtaining written approval of the Design Consultant/LAWA.

6. The Design Consultant /LAWA may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described below, verify corrections, resolved the problem(s) and restart the 60 day Endurance Test again.

7. After endurance testing is complete, review tabulated records with the Design Consultant/LAWA.

G. Factory Acceptance Testing, Site Acceptance Testing and Endurance Testing Failures – Procedure:

1. After conclusion of any testing or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.

2. After submission of report, schedule review meeting. Schedule date and time with the Design Consultant / LAWA.

3. At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4. Based on report and review meeting, the Design Consultant / LAWA will direct Contractor to repeat Testing.

5. Based on the severity of any failure during the Endurance Test, Design Consultant/LAWA has to right to instruct the Contractor to restart the 60-day Endurance Test from the beginning.

H. Exemptions from Contractor Responsibility:

1. The Contractor will not be responsible for failures caused by:

   a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

   b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

   c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3.07 STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient voltage protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency, as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.08 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.09 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. LAWA CMMS: Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.10 CLOSEOUT ACTIVITIES – ACCEPTANCE, MAINTENANCE, TRAINING

A. Acceptance **-** Completion of the installation, all testing phases, receipt of the test and close-out documentation including data input of all installed cables in the LAWA management system and successful Endurance Test Performance of the system for a 60-day period (indicated by LAWA Approval of all Test Results) will constitute Acceptance of the System.

B. Training:

1 Contractor shall adhere to the requirements of the Training Plan Submittal in the time frame specified in Section 1. Training cannot begin until Training Plan has been Approved.

2 By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct LAWA's designated staff in the operation, adjustment and maintenance of all products, equipment and systems.

3 The Contractor shall be required to provide all training aids, e.g., notebooks, manuals.

4 The Contractor shall provide an appropriate training area equipped with all required equipment. The location of the training area shall be coordinated with the Design Consultant.

5 All training shall be completed a minimum of two weeks prior to system cut over. Training schedule shall be subject to the Design Consultant/LAWA approval.

6 Training shall be conducted by experienced personnel and supported by training aids. An adequate number and amount of training material shall be provided by the Contractor. The following is considered a minimum.

a. Functional flow-charts, overall block diagrams, and descriptive material for all software;

b. Schematic drawings for each of the hardware components;

c. All procedure manuals, specification manuals, user manuals, and operation and maintenance manuals;

d. As-built drawings.

6. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted. The courses shall be scheduled such that LAWA personnel can participate in all courses (no overlap).

7. Training Course class times shall cover both day and night time shifts of LAWA Users.

C. Types of Training

1. Radio Technician Training. Two Sessions - Five (5) days of training for Radio Technician Training for five (5) attendees per session. Course material must include Portable and mobile radio maintenance and programming. Training class must have lab exercises and troubleshooting practice.

2. System Manager / Administrators Training: Two Sessions – Each Session set up for 5 attendees each. Each Session contains four courses. First Course - Basic – bridging the gap to new P25 Network based system (5 days). Second Course – Networking, provides technicians with necessary networking information required to understand the network components of the newly installed system (1 day). Third Course provides instructions into the Radio System Management Applications (5 day). Fourth Course shall be a workshop that covers management functions for the P25 integrated voice and data system (5 days).

3. Operator Training – Console Operator Training– 20 each / 5-day Sessions (10 each day time shift and 10 each night time shift) – Each class day is four hours with a total of four attendees per class session. A maximum of 80 dispatch/supervisors and managements will be able to attend one of these sessions. Attendees shall learn how to perform tasks associated with console operations through hands-on activities.

4. Console Administrator Training – shall be one 4-hr daytime session and one 4-hr nighttime session for Console administrator/Supervisor. Participants will be provided the knowledge and skills to manage and utilize the console administrator functions through hands-on activities. This course shall also show the Console Administrator how to customize the console screens.

5. Radio Trainer Training (Trainer) – shall be a one 8-hr day time session and one 8-hr night time session, each session for up to 5 attendees. Provide attendees with the knowledge and practice that will enable them to successfully train their students. Course material must include a combination of Video, instructor training, and hands-on activities to become proficient with the operation and subsequent ability to train employees on the use of the radios. This course must be provided after programming but PRIOR TO cutover.

3.11 MAINTENANCE

END OF SECTION 27 21 33

SECTION 27 42 20 – COMMON USE SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the minimum requirements for common use check-in and passenger processing systems that are to be included in Terminal renovations.

B. Provide a functional extension of the existing common use systems currently being used. Work defined for this Section is for the installation of CUTE/CUPPS equipment and programming of system functionality. All programming, system configuration and set up is proprietary and is to be completed by the existing CUTE maintenance service provider, SITA (Societe Internationale de Telecommunications Aeronautiques). The contact at SITA is Tony Thien, he can be reached at (310) 652-5257.

C. Existing Common Use System Description: SITA CUTE Airport Connect is integrated with various LAWA systems via IBM WebSphere. This integrated platform provides multiple systems including, but not limited to:

1. Electronic Visual Information Displays (EVIDS)
2. Airline Data Feeds
3. IATA Messaging
4. Resource Management
5. Baggage Information
6. Avaya VoIP
7. Other systems

D. SUS workstations provide user access to Airport Connect (CUTE/CUPPS) as well as additional resources available through the Websphere platform.

E. Work defined for this Section includes, but is not limited to:

1. Expansion of the existing SITA Airport Connect Gate Agent Checkin Desk SUS equipment sets
2. Coordination with Networking and Premise Wiring Trades
3. Coordination with Millwork Trades
4. Coordination with Electrical Power Trades
5. Coordination with Airline Data Feeds
6. System Implementation Phasing
7. Systems Programming
8. Systems Testing
9. Systems Training

F. Installation shall include licenses, provisioning of equipment, software and programming, associated with installation of the equipment for a fully functional extension of the existing SITA common use system

G. The Common Use Systems (“Systems”) shall integrate with SITA systems currently installed at LAWA. The key elements of systems integration include:

1. Integration with and/or upgrade as required of the existing airport operations database (DB) including an existing storage area network as the data repository.
2. Electronic Visual Information Display System (EVIDS) which includes flight, baggage, dynamic signage, visual paging and way finding signage.
3. Integration / Interfaces with the Passenger Messaging (PM) and the IED paging system including both audio and visual messaging.
4. Resource Management System (RMS) including gate, ticket counter, shared baggage, and bus resource allocation.
5. Shared Use Systems including common use passenger processing (CUPPS) and common use self-service (CUSS).
6. Integration / Interfaces to the Local Departure Control System (LDCS).
7. Interface to the existing LAWA Message Broker System (MB) supporting both international and domestic bag routing messages as required.
8. Voice Over Internet Protocol (VoIP) telephone system.
9. Baggage Reconciliation System (BRS) to support all Terminal operations.

H. Systems shall support all airlines that inhabit the new (renovated) Terminal/Gate Hold area along with alliance partners and charter airlines. It also shall be capable of provisioning domestic carriers that will inhabit the renovated area via the same flexible provisioning systems in use at TBIT.

I. Systems will utilize common physical telecommunications infrastructure. Contractor will provide whatever active data network components are required to interface and integrate with the TBIT TASS and data network.

J. Contractor is responsible for providing all data cabling information and closely coordinating with data cabling subcontractor to ensure that all conduit and Category 6 UTP cabling is provided wherever needed. Contractor is responsible for providing all power load information and closely coordinating with electrical subcontractor to ensure that all conduit, cabling, power circuits (particularly for special needs such as core network switches or servers that require extra power) needed for the components of the Systems in this Specification.

K. Contractor is responsible for providing heat loads in all telecommunications rooms where Systems equipment is to be installed and for closely coordinating with mechanical contractor to ensure that appropriate cooling is provided for the components.

L. Contractor shall include in the Bid all labor, materials, tools, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes, installation, software licenses, software, software integration, all required testing/documentation and all necessary and related items required to provide complete and operational system shown and described in the Specifications.

M. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

N. The Contractor shall coordinate with electrical contractor for provision of horizontal conduit and field boxes required to accommodate cabling of all wireless access points and other system equipment.

O. The Contractor shall coordinate specialty electronic, Information Technology (IT) data networks and any other IT infrastructure systems that depend on or are interfaced to Common Use Systems.

P. Related documents included in the scope of this work:

Section 01 11 00 – Summary of Work

Section 01 25 00 – Substitution Procedure

Section 01 31 00 – Administrative Requirements

Section 01 33 00 – Submittal

Section 01 40 00 – Quality Requirements and all sub-sections

Section 01 43 00 – Quality Assurance

Section 01 64 00 – Owner-Furnished Products

Section 01 77 13 – Preliminary Closeout Reviews

Section 01 77 16 – Final Closeout Review

Section 01 78 00 – Close Out Submittals

Section 01 79 00 – Demonstration and Training

Section 27 05 00 – Basic Telecommunication Requirements

Section 27 21 00 – Local Area Network

Section 27 21 33 – Wireless Communication System (Wi-Fi)

Section 27 26 26 – Communications Systems Interfaces

Section 27 51 13 – Paging Systems

Q. Products furnished (but not installed) under this section:

R. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. ABBREVIATIONS AND ACRONYMS

ANSI	American National Standards Institute
AP	Access Point (wireless receive and transmit antenna)

ASTM	American Society for Testing Materials
BFU	Board of Fire Underwriters
BICSI	Building Industry Consulting Services International
BTP	Bag Tag Printer
CSA	Canadian Standards Association
CUPPS	Common Use Passenger Processing System
CUSS	Common Use Self Service
DEC	Department of Environmental Conservation
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
EIA	Electronics Industry Association
ER	Equipment Room
EVIDS	Electronic Visual Information Display System
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FM	Factory Mutual
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standards Organization
LDCS	Local Departure Control System
MB	Message Broker
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
PM	Passenger Messaging System
RMS	Resource Management System
SITA	Société Internationale de Télécommunications Aéronautiques
SNMP	Simple Network Management Protocol
TASS	TBIT Airline Support System
TBIT	Tom Bradley International Airport
TIA	Telecommunications Industry Association
TR	Telecommunications Room
TWC	Tenant Wiring Closet
UFBC	Uniform Fire Prevention and Building Code
UL	Underwriter's Laboratories, Inc.
UPS	Uninterruptible Power Supply
VoIP	Voice over Internet Protocol
VPN	Virtual Private Network

B. REFERENCE STANDARDS

All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:

1. IATA RP 1797 Common Use Passenger Processing Systems Technical Specification
2. IATA RP 1797 Common Use Passenger Processing Systems Technical Requirements
3. Latest Version of IATA CUPPS Specification and Recommended Practices as posted at http://www.cupps.aero/documents
4. IEEE 802.11 (a, b/g, n) - Information Technology - Telecommunications And Information Exchange Between Systems - Local And Metropolitan Area Networks - Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) And Physical Layer (PHY) Specifications
5. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09
6. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009
7. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08
8. ANSI/TIA/EIA -607- Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
9. ANSI/TIA/EIA 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002
10. FCC 47 Part 68 -Code of Federal Regulations, Title 47, Telecommunications
11. IEEE National Electrical Safety Code (NESC); 2007
12. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises
13. LADBS - Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code
14. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)
15. NFPA-70 National Electric Code; 2008
15. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate all work of this specification with the responsibilities of the Systems Manager. Refer to specification 27-1333 Communications Systems Interfaces.

B. Related works coordination.

C. Coordinate with millwork and power trades to assure proper fit and functionality of CUTE/CUPPS equipment sets in gate check-in desk millwork.

D. Coordinate with Network and PWDS trades to verify proper “single sign on” and general communication support for system. This coordination shall include expansion of the VoIP telephone handset synchronization with authorized sign-on at gate desk SUS workstations. Provide all necessary technical support to the network contractor and the Systems Manager to successfully develop, test, implement and configure interfaces between the network and the Common Use system.

E. The Common Use System workstations shall include an application that will present the airline user with airline specific calling lists. Selecting a destination phone number in a “click2dial” operation shall cause the adjacent Cisco VoIP telephone to dial the number and connect in speakerphone mode. Lifting the handset on the telephone shall return the call to handset operation. Provide all necessary technical support, configuration programming and coordination to successfully develop, test, implement and configure this functionality.

F. Coordinate with LAWA and Airline Users to plan activation, training and testing of the system.

G. Contractor shall coordinate all work with the “Systems Manager” as defined in Section 27 26 26. Specific coordination tasks include, but are not limited to:

1. Network cabling and outlet assignments for support of Common Use Systems.
2. Data circuit requirements for support of Common Use and interface to existing TASS.
3. IP address assignments and VLAN allocation for support of Common Use.
4. Scheduling activation of Common Use.
5. Equipment labeling and LAWA asset management tracking.
6. Software Change Management approval through LAWA program.
7. System Testing and Commissioning.

H. Other Coordination Requirements: SITA –LAWA Terminal Areas Support Systems (TASS) provider. For the purposes of this project, Terminal Area Support Systems include:

1. Active networks
2. Common Use Terminal Equipment (CUTE) – Common Use Systems
3. Electronic Visual Information Display Systems (EVIDS)
4. Any software updates, patches and revisions shall be approved by the LAWA Change Management Process prior to installation on an active, production system

1.05 SUBMITTALS

A. Contractor shall comply with all LAWA submittal procedures given in other Sections including 27 05 00 – Basic Telecommunications Requirements. The following is in addition to or complementary to any requirements given elsewhere.

B. Block diagrams indicating system architecture, component manufacturers and model numbers, wiring types, and all proposed connections to new and existing equipment.

C. Network identities and system administration records for each workstation shall be coordinated with network service providers and submitted for approval.

D. Contractor shall provide detailed scheduling listing activities, dates and milestones for:

1. Network Coordination.
2. Installation of Common Use SUS workstation equipment sets as in locations as noted on drawings.
3. Testing of SUS workstations and associated peripheral equipment sets for basic functionality.
4. Testing of SUS workstations and associated peripheral equipment sets for use by each affected airline.
5. Testing of interface to LAWA Terminal Airport Support System (TASS and subsequent interfaces to VoIP, RMS and EVIDS.

E. Bill of Material: Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

F. Labeling: Submit all proposed labeling materials and nomenclature for approval.

G. Coordination Drawings:

1. Indicate locations where space is limited for installation and access.
2. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.

H. Test Plans: The Contractor shall prepare test procedures and reports for the Contractor's field test and the performance verification test. Such procedures must be submitted for LAWA approval at least 120 days prior to installation. Contractor shall provide a step-by-step test plan and procedure with check off lines for LAWA and Airline representative witness initials. Test Plan and Procedures shall include:

1. Quality control verification of CUTE/CUPPS equipment.
2. Demonstration of workstation features and functionality.
3. Testing of interfaces to TASS.
4. Provision of TASS user interface migration from Avaya to CISCO for VoIP.
5. Demonstration CUTE /CUPPS workstations and peripheral support of airline applications.
6. Noted and initialized copies of LAWA and Airline representative's witnessed final performance verification and test/demonstration procedures and report shall be submitted after completion of the test.

I. Training Manuals shall be submitted for approval 120 days prior to training sessions with airlines and LAWA. Training manuals shall include user's troubleshooting guides providing resolution to common use problems with software and hardware. Admin Training Manuals shall include physical and logical data flow and interface diagrams, rack elevations, system configurations, and users troubleshooting guides providing resolution to common use problems with software and hardware.

J. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Consultant will periodically review Project Record Documents to assure compliance with this requirement.

K. At every quarter, submit Project Record Documents to Design Consultant for LAWA's records.

   1. Upon completion of the as built drawings, the Design Consultant will review the as-built work with the Contractor.

   2. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

L. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.06 QUALITY ASSURANCE

A. The Contractor shall not install any new software types, versions or patches on the active (production) system or LAWA network, without written approval from the LAWA Change Management Process. The Contractor shall be responsible for testing the software change item, prior to submission to the LAWA Change Management Process for approval.

B. Installations not meeting the approval of LAWA shall be reworked or replaced until acceptable to LAWA.

C. Standards of workmanship shall meet or exceed IATA industry installation practices.

D. Refer to Sections 01 40 00 through 01 45 00 and 27 05 00 for additional QA requirements.

1.07 SUBSTITUTION OF EQUIPMENT

1.08 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

   1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

1.09 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 27 05 00 – Basic Telecommunication Requirements.

B. Equipment shall be delivered in original packages with labels intact and identification clearly marked.

C. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants.

D. Equipment damaged, lost or stolen prior to system acceptance shall be replaced at no cost to the Airport.

E. The Contractor shall protect equipment from theft and vandalism.

1.10 FIELD / ON-SITE REQUIREMENTS

A. The Contractor shall obtain the approval of Engineer or Design Consultant for the final layout of any equipment to be installed in new or existing telecommunications rooms, tenant wiring closets, and casework prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

B. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of the LAWA.

C. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

D. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

E. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

F. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

G. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

H. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

1.11 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of (…..) years from Final Acceptance.

B. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

C. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

D. Submit a copy of all manufacturer warranty information.

PART 2 – PRODUCTS

2.01 GENERAL

A. Due to the rapid advancement and antiquation of hardware technology, the supplied hardware shall be the "contemporary technical and operational equivalent" of the specified hardware. The following requirements shall be met:

1. Contemporary technical and operational equivalent shall be based on a comparison of technology at the time of publication of this Section to the technology at the time of ordering the equipment for each phase.

2. Hardware shall be ordered as close to the actual installation date for a given phase as reasonable (i.e., latest responsible date). Final hardware approval and scheduled order date are at the sole discretion of the Engineer.

3. Hardware equivalence shall be based on both technical equivalence and operational equivalence.

4. Contractor is responsible to verify and certify that newer technologies or models chosen will be compatible with the existing systems and technologies being interfaced or integrated with.

2.02 COMMON USE SYSTEM EXPANSION PRODUCTS

A. Gate Agent Equipment Sets

1. SUS Workstations – HP Product, latest SITA certified model
2. Specialty Keyboards – Access Product, Latest SITA certified model with OCR and MSR readers
3. Boarding Pass Printers – IER 400 or latest SITA certified model
4. Boarding Gate Readers – Access Product, providing magnetic strip and OCR scanning or latest SITA certified model
5. General Purpose Document Printers (8.5 x 11) Okidata 430 or latest SITA certified model.

B. System Software

1. Operating Software – Windows XP
2. Application Software – SITA Applications
3. Anti-Virus Software – SITA certified
4. Include software and software licenses for all software installed
5. Common Use workstations should scale to support Windows 7 OS and applications.

2.03 MIACELLANEOUS HARDWARE, CABLING AND WIRING

A. Furnish miscellaneous hardware, power and communication cords, cabling and wiring as required to properly install and activate the SUS Workstations and associated peripheral equipment sets.

2.04 GENERAL INTEGRATION REQUIREMENTS

A. Contractor shall be responsible for writing all necessary code, performing all stakeholder interviews and data gathering, and performing all data level systems integration and interfaces for the Systems components identified herein.

B. Contractor shall be responsible for the development of Interface Design Documents as follows:

1. An Interface Design Document (IDD) shall be developed for each interface and shall provide the functional and technical descriptions and guidelines for the required data, hardware, transport, protocol, and software configurations for each interface. This document should reflect standards based protocols, interfaces, and a modular approach to each system to be integrated.

2. Each IDD shall include the following sections: General Characteristics, General Architecture, Functional Characteristics, Data Formats (as applicable), application programming interfaces, Translation Tables (as applicable), Transport Definition, Physical Characteristics, and Required Hardware/Software Configuration Items.

3. Each IDD shall be submitted for review and approval in accordance with the overall submittal schedule.

C. All Systems workstations shall have the ability to run all applications and modules that are provided as part of Common Use Systems. This shall include common use applications, database applications, resource management applications, baggage reconciliation applications, and EVIDS applications. As an example, the Systems workstation at a common use ticket counter or gate shall have the ability to perform common use applications as well as EVIDS applications. In the bag makeup location, the Systems workstation shall have the ability to perform common use applications as well as BRS applications. The use of a particular application at a specific workstation shall be secured via user log in access rights. A simple pointing device or keyboard action shall allow the agent to switch between the common use applications and any other available applications.

2.05 RESOURCE MANAGEMENT SYSTEM INTEGRATION REQUIREMENTS

A. The Resource Management System (RMS) shall assist Operations in the assigning of common use resources including gates, ticket counters, baggage claim carousels, baggage makeup conveyors, buses, remote gate operations, and off-gate parking stands. The RMS shall provide planning functions, 'best-fit' recommendations, and real-time conflict warnings to assist Operations in the management of these resources.

B. The RMS application shall utilize the existing DB as its database tier for all of its data storage requirements. The RMS shall be fully integrated with the DB and shall utilize it for the storage and retrieval of all RMS application data; this includes current assignments, status (out of service, available, etc.), planned assignments, and other RMS data fields. The RMS application shall contain and make use of all airport, airline, and other operations organizations related business rules for staff, equipment, and processing parameters.

C. The RMS shall store, access, maintain, and control current (real-time and day of operation) and planned (season schedules) assignment information in the DB for dissemination to other systems such as the EVIDS, MB, and shared use system.

D. The RMS shall access information controlled by other systems (e.g., EVIDS) via the DB such as current flight status and other flight and baggage related information. The RMS shall have an interface to PASSUR data streams, ACARS, SITA Text, Station Manager updates, and LAWA Operations staff updates to assist in making resource assignments. The RMS shall also take FAA related data streams to account for arrival and departure delays due to weather, route congestion, and global aviation system information not readily available via an automated input stream.

E. The RMS shall provide resource information that includes, but is not limited to, gate assignments, baggage carousel assignments, and ticket counter assignments to the EVIDS for incorporation into the information that is displayed on the flight and baggage displays. The RMS shall receive current flight information from all available sources to use in its real-time management of gates and baggage devices.

F. The RMS shall provide the shared use system with resource assignment information in an automated fashion. This shall be the same information that is provided to the EVIDS to support the accurate display of all resource assignments.

G. The MB shall send the RMS current resource information from the baggage handling system (makeup belts unavailable, etc.) for utilization in its resource planning and assignments. The RMS shall transmit baggage resource assignments to the MB.

H. The RMS shall include the appropriate interfaces and integration with the TBIT LAN as necessary to support the functional requirements of the Systems.

2.06 EVIDS INTEGRATION REQUIREMENTS

A. The EVIDS shall provide flight and baggage information to the traveling public and operational information to other systems and to aviation and airline staff members. This component shall also manage all electronic signage throughout the facility creating a single "administrator" of all dynamic signage. This component shall also allow remote monitoring and management of all the signage connected to the EVIDS platform. The signage to be controlled by the EVIDS shall include but not be limited to, flight, baggage, way finding, visual paging, art features and advertising.

B. The EVIDS shall utilize the DB for all of its database-tier functions. As such, the EVIDS shall receive and transmit data as required via the DB. All data related to flights, baggage, and other information to be displayed on any monitor controlled by the EVIDS shall be stored and accessed via the DB. EVIDS information stored in the DB shall be available for distribution to other systems via the DB.

C. The EVIDS system shall receive two types of flight information from airline host systems. The first type of information is the airline's seasonal flight schedules which are input into the DB via the EVIDS on a periodic basis. This information shall be used to create daily flight schedules. The second type of information is current flight status. This information shall be used to update the daily flight schedules showing both scheduled time of arrival/departure and actual or estimated time of arrival/departure.

1. Airline flight information shall be obtained via multiple methods including a direct link to airline host systems (via WAN interfaces or local TCP/IP connections) and updates via portable media and manual input. In addition to these methods, flight information updates shall be obtained via a third party (real-time) flight information interface utilizing the existing Passur (Megadata) subscription service that is in place at LAX. In implementing these interfaces to tenant host or third party sources, appropriate security measures shall be put in place to ensure data integrity is maintained.

2. The Contractor shall develop "rules" in the DB to set priority for the source of the flight information to be used. These priority rules shall be defined for each airline in coordination with the PMT Representative and the airlines.

3. The interface to host systems shall be through WAN interfaces (T1, frame relay, etc.), or local Ethernet or RS-232/485 with the specific connection dependent on the individual host. The Contractor shall coordinate with each airline operating in the Terminal to determine the specific interface requirements. These interfaces may also be incorporated as a part of other modules or Systems applications.

D. The EVIDS shall control the information on all electronic displays throughout the Terminal. All information to be displayed shall be stored in the DB and formatted by the EVIDS for display on the specific display device. The displays supported include; public display banks art features, gate displays (counter, backwall, PBB, and general gate information), ticket counter displays (backwall and ANDS), baggage makeup operational displays, public baggage displays, and visual information displays. A brief description of the functionality of each sign type is provided below. The final functional requirements for each type of signage will be established during the required design workshops.

1. Public display banks – these displays will show information related to flight status including, but not limited to; city of origin/destination, scheduled time of departure/arrival, estimated time of departure/arrival, remarks/comments, baggage carousel assignment, etc. The information displayed on these monitors shall be provided through the DB and information will be updated through automated feeds and manual input.

2. Gate displays – these displays will show gate related flight information. The system shall configure these displays to show the appropriate information related to gate usage (i.e. flight number, airline, destination, etc.) when assigned through the RMS. In addition, the local gate operator (with the appropriate log in credentials) shall have override capabilities to modify the information displayed.

3. Ticket counter displays – these displays will show ticket counter related information including, but not limited to, airline name and logo, flight information, position information (e.g. open/closed, first class, ticketing, etc.). Upon assignment from the RMS, the displays shall automatically be configured to display the appropriate airline and their desired "default" display. In addition, the local ticket counter operator (with the appropriate log in credentials) shall have override capabilities to modify the information displayed.

4. Baggage makeup operational displays – these displays will show flight related information that is pertinent to the baggage handling operators. Information displayed on these devices will be from assignments provided by the RMS and from the data associated with EVIDS (i.e. flight arrival/departure times, gate, bag claim device, etc.).

5. Public baggage displays – these displays will show flight information on the baggage carousel. This will display the arriving flight number and origination city for the public. Information displayed on these devices will be from the database (from EVIDS and RMS) and may be manipulated by the baggage handlers via input through the baggage input consoles.

6. Visual information displays – these displays will show visual paging information from inputs provided by the passenger messaging system.

E. The EVIDS shall interface with the audio portion of the IED Public Announcement System (via Passenger Messaging – PM) to provide the ability to visually display messages that are audibly broadcast. The PM interface shall provide the ability to synchronize visual and audio messages.

F. The EVIDS shall interface with the video portion of the PM to provide the ability to display any visual announcement on any EVIDS display device.

G. The EVIDS shall support multiple input devices for the updating, configuration, and manipulation of flight and other display information. The inputs that shall be supported include baggage input consoles and TASS workstations. All input devices shall be interfaced through a standard LAN connection.

H. The Contractor shall provide control of the dynamic visual displays and associated equipment in the Terminal including Ticket Counter backwall displays, Gate Counter backwall and Passenger Loading Bridge (PLB) displays, Baggage Information Displays (BIDS) and Baggage Input Consoles (BICs), Airline Name Displays (ANDS), and Airline Assignment Displays (ticket counter locations).

I. The EVIDS shall be interfaced to the Resource Management System to provide and receive flight updates and resource assignments.

J. EVIDS displays associated with allocated resources (i.e., ticket counter displays, gate counter displays, loading bridge displays, etc.) shall display the most recent assignment information as provided by the RMS. The changing of displayed information shall be triggered by RMS assignments and scheduling through the DB.

K. The RMS assignments / schedules shall trigger associated EVIDS displays on and off times. The RMS assignments / schedules shall trigger information display and removal on associated EVIDS displays. Trigger time shall be based on RMS schedules plus/minus a system configurable (on a per display per location basis) amount of time.

1. The day of operation's resource allocation shall determine the associated EVIDS signage display information (based on airline defined preferences). The day of operation resource allocation shall determine display information start and stop times.

2. Any authorized modifications to the day of operation's allocation assignments in the RMS shall adjust dynamic signage display information accordingly.

3. Final configuration and sequence of operation shall be coordinated with each airline and LAWA Operations.

4. EVIDS signs, associated with unassigned resources, shall display a pre-defined screen (e.g., LAX logo). The pre-defined, default, screen shall be assignable on a per location per display basis.

L. EVIDS should provide standard API capabilities for potential future interface requirements.

M. EVIDS shall provide real-time flight information to the MB for baggage related messages allowing for proper sortation of baggage.

N. The EVIDS systems shall provide a provision to interface with Passenger Messaging and Common Use Systems to automatically alert passengers of scheduled changes in operations.

2.07 PASSENGER MESSAGING INTEGRATION REQUIREMENTS

A. The passenger messaging application (PM) shall control the broadcast of public messaging information to the traveling public in both an audio and visual format utilizing the IED Public Address System (refer to Section 27 51 13) and EVIDS display devices respectively. This information shall include public announcements, personal pages, and flight information specific to individual gate areas. The system shall also include mechanisms for generating messages for airport and airline staff and shall provide for the ability to retrieve messages in an audio or visual format.

B. The visual portion of the PM shall be fully integrated to the EVIDS and data pertaining to this function shall be stored in the DB.

C. The audio portion of the PM shall be interfaced to the IED paging system and shall not have a direct link to the DB; however, common information such as messaging statistics (announcement logs, retrieval times, courtesy announcement records, audio messages, etc.) that are controlled by the PM shall be stored within the DB.

D. The PM shall be integrated with the EVIDS and interfaced with the IED paging system to synchronize the broadcast of audio messages with visual messages.

E. The PM shall maintain overall control and administration of both visual and audio announcements. The PM shall provide the ability to monitor and administer the retrieval of messages from the system.

2.08 SHARED USE SYSTEM AND CUSS INTEGRATION REQUIREMENTS

A. The shared use system shall allow multiple airlines to operate in the facility using their host software and a common set of compatible hardware, increasing the flexibility and efficiency of the facility.

B. The shared use system shall provide the use of each airline’s native system from all shared use system locations within the Terminal. The shared use system shall allow the extension of the airline host network onto the telecommunications infrastructure through a secure connection.

C. The shared use system provided shall ensure that any applications which are available on the host system are also accessible through the shared use system. As such, the airline processes shall be no different than their operations at a non-common use airport.

D. The shared use system shall provide connection for the shared use system workstations to each participating airline’s host computer (e.g., System One, Sabre, etc.) via a dedicated interface that is specifically configured to meet the individual airline requirements (e.g., gateway, router, etc.).

E. The shared use system shall provide access to the LDCS via the shared use system workstations. The LDCS shall include a self-service interface. The LDCS self-service application shall be accessible on the CUSS kiosks.

F. The RMS shall control and provide all resource allocations for specific users. The shared use systems shall fully support the schedule of resources developed by the RMS. As such, when the RMS has assigned a resource to a specific user, the applications and functionality required by the assigned user shall be available on the assigned resource during time slot allotted by the RMS. Conversely, if the RMS has not assigned a specific user to a resource, the resource and all applications and functions shall not accessible to that user. However, any assigned or unassigned resource shall be able to be manually overridden at the workstation level with the appropriate log in credentials.

G. The RMS and shared use systems shall provide the ability to block any user from the utilization of any resource. The default configuration at each shared use resource shall be to deny access, unless it has been assigned by the RMS.

H. The shared use system shall be interfaced with the VoIP system to dynamically assign the VoIP handsets to match the shared use system requirements. Once resource assignments are made by the RMS and transmitted to the shared use system, the shared use system shall configure the VoIP handset at the assigned resource into the appropriate configuration. The system shall allow the specific telephony requirements associated with each tenant to be dynamically allocated to any shared use system station regardless of physical location.

I. The existing SITA Common Use Terminal Equipment (CUTE) system shall be accessible through any workstation associated with the new shared use system. Any airline selecting to use the SITA CUTE must be able to access the SITA CUTE at any shared use system workstation.

J. The BRS shall be interfaced with the shared use system and LDCS to receive Baggage Service Messages to support all baggage reconciliation functionality.

2.09 MESSAGE BROKER (MB) INTEGRATION REQUIREMENTS

A. The MB will serve as the information broker for passenger related information that is contained within the Airlines Departure Control System. This includes baggage service messages (and other related bag messages) to support the Terminal baggage sortation system, inter-airline transfers, baggage reconciliation, and inter-terminal transfers throughout the LAX campus as well as other information including any data regarding the security status of a given passenger when that capability is made available by the Airlines host systems.

B. The MB will include its own data storage repository (database). The DB shall replicate required database tables and fields to the MB database. The replicated data includes baggage resource assignments, flight information data, and baggage information.

C. In turn, the MB shall replicate a limited number of fields or tables to the DB including equipment status and statistical data. The MB fields shall be replicated to the DB to provide overall integration with other TBIT systems.

D. The MB shall obtain real-time flight from the EVIDS and resource information from the RMS via the DB to pass to the BHS for the proper sortation of baggage.

E. The MB shall provide BHS specific resource information (carousels out of service, etc.) to the DB for use by the RMS for the proper allocation / reallocation of resources.

F. The MB, the shared use system, and the LDCS shall be interfaced to send / receive Baggage Service Messages to the baggage reconciliation system.

G. The MB shall also be integrated with airline host systems or a message.

2.10 BAGGAGE RECONCILIATION SYSTEM INTEGRATION REQUIREMENTS

A. The BRS shall be interfaced with the Shared Use System, the LDCS and the Message Broker System to receive IATA compliant baggage services messages. These messages will include all IATA defined BSMs including; Baggage Transfer Message (BTM), Baggage Source Message (BSM), Baggage Processed Message (BPM), Baggage Unload Message (BUM), Baggage Not Seen Message (BNS), Baggage Control Message (BCM), and Baggage Manifest Message (BMM). These messages will be stored in the BRS database allowing the system to construct and maintain information of the baggage being processed.

2.11 LOCAL DEPARTURE CONTROL SYSTEM INTEGRATION REQUIREMENTS

A. The LDCS will provide automated check-in departure control for non-hosted airlines and will support irregular flight operations for all airlines operating out of the Terminal.

B. The LDCS shall interface with the RMS so that it can be provided with resource assignments.

C. The LDCS shall interface with the MB and BRS to transmit and receive Baggage Service Messages (BSM) for baggage checked. The LDCS shall transmit this information via Systems to the MB and BRS. The LDCS shall also receive baggage processed messages from the MB and BRS.

D. The LDCS shall have a data replication interface with the DB to transmit statistical and accounting data to the DB and to receive required data for LDCS operations.

E. The LDCS shall interface with all peripheral devices including, but not limited to, 2D Bar Code Printer, BTP, document printer, and Bar Code Scanner.

F. Any Systems workstation shall have the ability to run the LDCS. These workstations shall be fully functional workstations. A simple pointing device or keyboard action shall allow the agent to switch between the LDCS and any other available applications.

2.12 VoIP INTEGRATION REQUIREMENTS

A. The VoIP system shall be implemented to support the dynamic nature of a shared use environment and shall allow telephony services to be dynamically and temporarily allocated to specific locations throughout Terminal. With the VoIP system in place, a tenant’s telephony functional requirements shall be met regardless of their location throughout the Terminal.

B. Based on RMS assignments, the VoIP handsets shall be dynamically configured to provide the assigned user’s full set of telephone functionality, regardless of the location of the handset within the LAX campus. This functionality shall be based on successful user login and validation through the system. The shared use system shall provision the VoIP handset configurations and the specific handset configurations shall be accessible in the DB.

2.13 STORAGE AREA NETWORK (SAN) INTEGRATION REQUIREMENTS

A. As a key hardware component to the DB, a Storage Area Network (SAN) shall be provided. The SAN shall provide the basis for data storage and archival for the Systems. The SAN shall provide a highly resilient and easily expandable data storage platform that shall provide a structured means to grow hard drive storage for data systems.

B. The SAN will not be limited to data storage for the DB only, but shall also support future system’s and module’s storage requirements.

C. A secondary, offsite SAN, shall be provided for further redundancy. The location of this SAN shall be coordinated with the Engineer.

2.14 PRIMARY SERVERS

A. The Contractor shall recommend and provide the server configuration that best serves the Contractor's overall design solution. LAWA's existing standard for server technology is based upon Hewlett Packard®. Alternative solutions for high processor capacity servers may be submitted for review and approval.

B. The servers shall be fault tolerant via clustering, mirroring or other vendor technology. The implemented configuration shall allow a server to be powered down and replaced without disruption to the network or applications. Server failover shall occur if the primary server fails for any number of reasons including: power failure, hardware failure, software failure, and network connection failure. Multiple load sharing application servers or other configurations shall be considered viable alternatives to redundant application server pairs if equivalent or improved system redundancy and resiliency can be demonstrated. The system shall be configured as a geographically distributed clustered and/or load balanced server cluster. These systems shall be installed at two separate core rooms in the Terminal. The server solutions shall be available for 99.9999% on an annual basis.

C. Servers shall be standard 19-inch rack mountable.

D. Servers shall be capable of upgrading the number of processor units by simply adding another processor or processor card.

E. Servers shall be "dual-homed" to the LAN core switches via server grade Gigabit Ethernet NICs. Final requirements and configuration shall be coordinated with Design Consultant.

F. Disk Storage: Total useable disk capacity shall be at least 4 times the estimated storage requirements of the application and operating system. RAID shall be implemented as best suits the application. Internal RAID 6 shall be provided unless justification for alternative configuration is provided. RAID shall not be implemented via the operating system, but by a hardware controller. Disk arrays shall have open frames to allow the capacity to be doubled by addition of RAID drives without system shutdown. Disk storage systems shall be configured so that an increase in capacity of 33% can be made without purchasing any other components other than the disk drives.

G. Monitor: Shared rack-mounted monitor per rack (provide rack-mounted input switching device). The monitor provided shall meet the requirements provided under the section titled Workstation Monitors.

H. Servers shall be configured to meet or exceed the minimum hardware requirements detailed below and also meet or exceed the performance, operational, and functional requirements of this Specification.

2.15 FILE SERVERS

A. Two (2) 2.8 GHz processors (latest version) with 1MB cache. Architecture should be Intel or RISC as required by the operating system.

B. 1 GB DDR2 400 MHz RAM. Sufficient memory shall be provided to meet the maximum transaction load and ensure the memory is never a restriction on system performance

C. Minimum 72 GB useable internal hardware RAID 6 disk storage (10,000 rpm)

D. Two (2) NICs (server-class card) for LAN connection (coordinate network requirements with network administrator)

E. Minimum 72 GB internal Tape Backup Unit with SCSI card and back up software

F. 24X IDE CD-RW/DVD ROM drive

G. Remote Access Card

H. Multiple hot-pluggable redundant power supplies

I. Standard windows keyboard and USB 2-button wheel mouse

J. Minimum of two (2) USB 2.0 ports

2.16 APPLICATION SERVERS

A. Two (2) 3.2 GHz processors (latest version) with 1MB cache. Architecture should be Intel or RISC as required by the operating system.

B. 4 GB DDR2 400 MHz RAM. Sufficient memory shall be provided to meet the maximum transaction load and ensure the memory is never a restriction on system performance

C. Minimum 36 GB useable internal hardware RAID 6 disk storage (10,000 rpm)

D. Two (2) NICs (server-class card) for LAN connection (coordinate network requirements with network administrator)

E. Minimum 36 GB internal Tape Backup Unit with SCSI card and back up software

F. 24X IDE CD-RW/DVD ROM drive

G. Remote Access Card

H. Multiple hot-pluggable redundant power supplies

I. Standard windows keyboard and USB 2-button wheel mouse

J.Minimum of two (2) USB 2.0 ports

2.17 DATABASE SERVERS

A. Four (4) 2.7 GHz processors (latest version) with 2 MB cache. Architecture should be Intel or RISC as required by the operating system.

B. 8 GB DDR Mirroring. Sufficient memory shall be provided to meet the maximum transaction load and ensure the memory is never a restriction on system performance

C. Minimum 144 GB useable internal hardware RAID 6 disk storage (10,000 rpm)

D. Two (2) Host Bus Adapters for redundant data storage system interface (refer to data storage system requirements for further details)

E. Two (2) NICs (server-class card) for LAN connection (coordinate network requirements with network administrator)

F. Minimum 144 GB internal Tape Backup Unit with SCSI card and back up software

G. 24X IDE CD-RW/DVD ROM drive

H. Remote Access Card

I. Minimum of two (2) USB ports

J. Multiple hot-pluggable redundant power supplies

K. Standard windows keyboard and USB 2-button wheel mouse

2.18 DATA STORAGE SYSTEM

A. A Storage Area Network (SAN) shall be provided to accommodate data storage and retrieval for the TASS. The SAN shall provide the sharing of data among different servers in a network, disk mirroring, backup and restore, archival and retrieval of archived data, and data migration from one storage device to another.

B. The Contractor shall implement a Tier 1 storage environment to aggregate the Tier 2 systems being deployed for all systems with TBIT. This Tier 1 solution shall include IBM SAN Volume controller, Fiber Channel component architectures for integration, and Tier 1 controllers and backup systems.

C. The Contractor shall provide only the necessary resources to support the integration of the building systems data, back-up and recovery, and business continuity and disaster recovery for the TBIT programs. The Contractor shall provide operations and guidance to LAWA ITS staff as needed for operational support and integration to the LAWA ITS campus wide SAN systems.

D. IBM System Storage solution, or approved equivalent

2.19 UNINTERRUPTIBLE POWER SUPPLIES

A. All server and local area network equipment installed in telecommunications rooms shall be UPS backed to prevent unnecessary service interruptions. The Contractor shall be responsible for coordinating with the CMJV and PMT to ensure that existing UPS capacity will support the additional load of the new equipment. In any case where new hardware is installed in a location where the capacity of the existing UPS is exceeded, it shall be the responsibility of the Contractor to supplement or replace the UPS in such a fashion that the UPS is capable of supporting required load for the minimum period of time.

B. The UPS equipment shall have batteries that are capable of being replaced in the field.

C. The UPS interface port shall have a 10 Base-T Ethernet for LAN management.

D. Each UPS shall provide a minimum of 30 minutes standby power at full load.

E. The UPS shall be rack mountable in a standard 19 inch equipment rack/cabinet.

F. The control panel shall have a LED status display for load and battery bar-graphs in addition to replace battery and overload indicators.

G. Each UPS shall include software and interface card to provide Web/SNMP management through 10Base-T Ethernet port. Management software shall include the following attributes:

1. Shall allow complete configuration of the UPS devices from a remote location
2. Shall provide periodic UPS self-tests
3. Shall provide full control over UPS transfer settings
4. Shall provide user name and password security

5. Shall log all power events with a description

H. Standard UPS warranty of two years shall be provided. Contractor shall submit recommended standard and optional warranty and maintenance plan per TASS RFP.

2.20 SYSTEM WORKSTATIONS

A. LAWA standard desktop is manufactured by Hewlett Packard.

B. Performance Workstation

1. 3.6 GHz Pentium 4 processor with hyper threading technology
2. 4 GB DDR2 SDRAM
3. 160 GB ATA Hard Drive (7200 rpm)
4. 10/100/1000 Mbps Ethernet card
5. 128 MB PCI Video card
6. 48x CD-RW drive plus 16x DVD+RW/+R drive
7. 2 serial ports, 1 parallel port, and 4 2.0 USB 2.0 ports
8. Standard windows keyboard and USB 2-button wheel mouse
9. 21-in LCD monitor (refer to monitor requirements)

C. Standard Workstation

1. 3.2 GHz Pentium 4 processor with 1 MB cache
2. 1 GB RDRAM
3. 80 GB ATA Hard Drive (7200 rpm)
4. 10/100 Mbps Ethernet card (auto-negotiating)
5. 64 MB PCI Video card
6. 48x CD-ROM
7. 2 serial ports, 1 parallel port, and 4 USB 2.0 ports
8. Standard windows keyboard and USB 2-button wheel mouse
9. 17-in LCD monitor (refer to monitor requirements)

D. Display Device Controllers (DDC)

1. Device Display Controllers are being provided by the base project. If any new DDCs are required they shall match the DDC configuration provided by the base project.

2.21 INTEGRATED SYSTEM DEVICES

A. CUSS Kiosk

1. The CUSS Kiosks shall be full function kiosk with a modular design for improved scalability. It shall provide ease of use. A lockable panel shall be provided for easy authorized access to internal components for maintenance. The kiosks shall conform to the following, as a minimum:

a. Compliance with IATA/ATA

b. Compliance with ADA

c. Stand alone version

d. 17-in touchscreen, card reader, and ticket printer

e. Powered by a PC meeting the requirements of a performance workstation

f. Baggage tag printer

g. Thermal 1D/2D barcode printer

h. Card reader (credit card, frequent flyer card, and contactless smart cards)

i. Passport reader

j. Optional 1D/2D barcode reader

k. Compatible with IEEE 802.11 wireless communications

l. Ability to provide customization with CMJV specific signage and markings (to be coordinated with the CMJV)

m. Include a leaflet holder

n. Be supported by CUSS middleware

o. Include CUSS remote monitoring software to manage both the hardware and the CUSS applications of the kiosk

2.22 WORKSTATION MONITORS

A. Payment module

B. Workstation Monitors shall meet, at a minimum, the following requirements

1. 17-in flat screen monitor shall meet the following minimum requirements:

a. 1280 x 1024 @ 75 Hz refresh rate
b. Pixel Pitch 0.264mm (H) × 0.264mm (V)
c. 4:3 aspect ratio
d. 17-in viewable area
e. Viewing angle of 140 degrees
f. Contrast ratio of 400:1
g. Brightness of 250 candelas/meter2

C. 20-in LCD monitor shall meet the requirements of 20-in LCD displays under LCD displays.

2.23 LCD DISPLAYS

A. 20-in LCD: 20-in LCD monitors are being provided by the base project. Any new monitors provided by the TASS shall meet the following minimum requirements:

1. 1600 x 1200 native resolution

2. 0.255 mm pixel pitch

3. 16:9 aspect ratio

4. Response time 16 ms

5. Viewing angle minimum 170 degrees
6. Contrast ratio of 400:1
7. Brightness of 250 candelas/meter2

B. 32-in LCD: 32-in LCD monitors are being provided by the base project. Any new monitors provided by the TASS shall meet the following minimum requirements:

1. 1366 x 768
2. 0.511 mm pixel pitch
3. 16:9 aspect ratio
4. Viewing angle of 176 degrees
5. Contrast ratio of 600:1
6. Response time 18 ms
7. Brightness of 500 candelas/meter2

C. 40-in LCD: 40-in LCD monitors are being provided by the base project. Any new monitors provided by the shall meet the following minimum requirements:

1. 1366 x 768
2. 0.641 mm pixel pitch
3. 16:9 aspect ratio
4. Viewing angle of 176 degrees
5. Contrast ratio of 1000:1
6. Brightness of 450 candelas/meter2

D. 46-in LCD: 46-in LCD monitors are being provided by the base project. Any new monitors provided by the TASS shall meet the following minimum requirements:

1. 1366 x 768
2. 0.746 mm dot pitch
3. Viewing angle of 178 degrees
4. Contrast ratio of 1000:1
5. Brightness of 450 candelas/meter2

2.24 PERIPHERAL DEVICES

A. Baggage Input Console

1. Baggage Input Consoles (BIC): There will be Baggage Input Consoles located throughout the baggage breakdown area for use by the baggage handlers. The BICS shall have the following minimum attributes:

   a. The BIC shall be a workstation with an integrated touch-screen with the following minimum requirements:

      1) Pentium III 500 MHz.

2) 256 MB DRAM.

3) Internal 10 GB hard drive.

4) Integrated, bus-mastering Fast Ethernet (10 / 100 Mbps) controller.

5) 8 MB video adapter.

6) 15” LCD TFT resistive touch-screen capable of 1024x768 resolution.

7) Rugged, spill resistant ABS housing suitable for harsh, high-use environments such as the baggage make-up levels of the Airport.

b. The Contractor shall provide materials to mount and attach the BICs in the required area of intended operation. The Contractor shall coordinate exact BIC mounting locations with the CMJV and PMT.

c. SuperLogics model SL-PPC-150A, or approved equivalent.

B. 2D Ticket Printer

1. A receipt style printer shall be provided that is able to print 2D (PDF417) barcodes. The barcodes shall include machine-readable boarding pass data formatted to support single segment, multi-segment, and interline data encoding.

2. Interface: USB.

3. The Contractor is required to determine additional 2D printer requirements in coordination with tenant requirements.

C. Bag Tag Printer (BTP)

1. Interface: Ethernet LAN (TCP/IP)

2. The printers shall be set up for direct thermal printing only. The printers shall not include a cutter or burster.

3. The BTP shall conform to the IATA resolutions relating to ATB’s and shall be compatible with the AEA specification for PECTAB's. All required firmware shall be provided and installed.

4. The Contractor is required to determine additional bag tag printer requirements in coordination with tenant requirements.

D. Optical Character Recognition (OCR)

1. Desko BMOL 4000 with integrated OCR or PMT approved equivalent substitution. Option pricing shall be provided for the AiT PAX Reader.

2. The OCR shall be capable of reading passports and other standard travel documents.

3. Per unit option pricing shall be provided for a bar code scanner, smart card reader, photo ID scanner, and fingerprint sensor along with the required drivers.

4. The Contractor is required to determine additional OCR requirements in coordination with tenant requirements.

E. Boarding Gate Reader (BGR)

1. The supplied BGR shall read 2D bar code printed boarding documents and shall support the various functional requirements of all airlines supported by TASS.

2. All required firmware shall be provided and installed.

3. The Contractor is required to determine additional boarding gate reader requirements in coordination with tenant requirements.

F. Shared Use System Standard Printer (DOC)

1. LaserJet printer with the following minimum specifications:

a. Print speed up to 25 pages per minute (ppm)

b. Utilize laser print technology

c. 1200 x 1200 dpi resolution

d. Two (2) paper trays

e. Support 8.5 x 11 and 8.5 x 14 inch paper

f. Minimum memory 64 MB

G. IP addressable:

1. The Contractor is required to determine additional document printer requirements in coordination with tenant requirements.

H. General Document Printer:

1. Provide two (2) general document printers. The location of the printers shall be coordinated with the PMT.

2. The specifications shall be that of the shared use system Standard Printer.

I. BRS Handheld Scanner:

1. Ruggedized wireless handheld device for scanning bag tags with the following minimum specifications:

a. WLAN – Compatible with 802.11 a/b/g

b. 53 key keyboard

c. Minimum RAM – 64 MB

d. Data capture – 1D and 2D supported

e. Drop specification – multiple drops to concrete: 6 feet / 1.8 meters

f. Electrostatic discharge: ±15 kVdc air discharge; ±8 kVdc direct discharge; ±8 kVdc indirect discharge

g. Sealing: IP64 (electronic enclosure, display, and keypad)

h. Rechargeable batteries

2. Environmental:

a. Operating Temperature: -4º to 122º F

b. Charging Temperature: 32º to 104º F

c. Storage Temperature: -40º to 158º F

d. Humidity: 5% to 95% non-condensing

e. UL Certified

2.25 SOFTWARE

A. Software provided shall be at least 32-bit based applications. Software shall be built around a compliant operating system as defined in this Specification.

B. The Contractor shall deliver all required system and application software for a fully functioning Integrated IT System. Each shall be identified by the generic, off-the-shelf name. The software provided by the Contractor to operate the Systems shall be delivered in a ready-to-run form, including all necessary utility programs and documentation.

C. The systems shall use industry standard components. The systems shall not contain any proprietary interfaces or components. The system shall use industry standard application development software such as Java, JavaScript, Perl, Visual Basic, C/C++ and XML. CMJV approval shall be required for use of alternative application development software.

D. All new inter-relationships between the applications, databases, and operating system shall be the responsibility of the Contractor.

2.26 USER INTERFACE

A. Systems shall have an interface to manage data and the individual applications. The user interface shall provide a common look and feel for each component and/or application.

B. The user interface shall, to the extent feasible, be web enabled to provide additional flexibility for the users of the system.

C. The client Operating System user interface shall be configured to limit access to each application based on user login. Authorized users shall select an authorized application(s) to execute (e.g., shared use system, EVIDS, DB, BRS, RMS application) from the client desktop.

D. Software modules shall have a Graphical User Interface (GUI) and use a true windowing navigation interface.

E. The system shall support a pointing device, touch screen, and keyboard interface. Standard pointing device actions shall have a "hot key" equivalent. Pointing device functions without a “hot key” equivalent shall be noted.

F. The systems shall provide context sensitive, on-line help capabilities. The online help system shall contain enough information to inform the user of the nature of the current form/window, and provide a reference for the user to gather further information. The Contractor shall populate the on-line help messages prior to Performance Verification Testing and provide a facility for maintenance and update of online help.

2.27 SYSTEMS ARCHITECTURE

A. Operating System

1. Server Operating System: The Contractor shall select a standardized Operating System to use across all servers such as Windows (latest version). The proposal shall specify the server operating system(s) along with any exceptions. The server operating system shall support Symmetric Multi-Processing (SMP). Systems applications provided shall take advantage of the SMP server capabilities.

2. Client Operating System: Client and desktop devices shall use the Windows XP Professional operating system, or approved equivalent.
3. The operating system for the Contractor's products shall meet the minimum criteria below. All exceptions shall be noted in the contractor's bid.
   a. 64-bit, multi-tasking, multi-threading.
   b. Support TCP/IP network protocol.
   c. Latest version and service pack of the operating system at time of initiation of systems testing.

B. System Architecture

1. The systems shall adhere to a Client / Server model. The end devices shall be the clients to the primary/secondary servers. All information shall be communicated between the server(s) and the clients via the assigned Virtual Local Area Network (VLAN).
2. Network connectivity shall be via the assigned VLAN on the data network provided by this Section. Network communications shall utilize TCP/IP network communications protocol. The Contractor shall identify the network bandwidth requirements such as 10 Mb, 100 Mb, or Gigabit Ethernet.
3. End device addressing shall be coordinated with the LAWA.
4. Sufficient resiliency / redundancy and logic shall be provided to assure that the availability objectives (refer to Performance Requirements) can be met without manual intervention. All major system hardware components shall be designed so that there is not any single point of failure that can cause operations to be disrupted.
5. The system shall synchronize the date and time on all devices. The system servers shall receive a time synchronization signal from the local area network using the Network Time Protocol (NTP).
6. Workstations shall support web access without rebooting or changes to the workstation configuration.
7. The systems shall use industry standard components. The systems shall not contain any proprietary interfaces or components.
8. System components shall be independent and capable of co-existing on the system to allow for an increased level of capacity. Modular design and flexibility shall be provided for easy expansion of the system without degradation to the system's performance.

C. Database

1. The Systems will be integrating with and upgrading as necessary the existing TBIT TASS database. The requirements below are given to assure the new Systems database requirements are consistent and compatible with the existing system.
   a. The provided database(s) shall be capable of supporting real time data warehousing. The database(s) shall use a common relational database to store all data. The database(s) shall be based on accepted and recognized industry standards. The LAWA preferences for databases are MS SQL or Oracle. The TASS database is Oracle.

b. The database(s) shall be open database connectivity (ODBC) compliant and support the simple object access protocol (SOAP).

2. Database Architecture: The database(s) shall meet the following requirements:

a. Provide read consistency (data seen by a statement is consistent with respect to a single point-in-time).

b. Provide creation of a read-consistent set of data when a table is being queried (read) and simultaneously updated (written).

c. Provide original data values upon query when updated transaction remains uncommitted.

d. Utilize rollback methodology for uncommitted transactions.

e. Utilize record locking mechanisms to prevent simultaneous updates to the same record. Only the record(s) being updated shall be locked.

f. Provide support for both distributed processing and distributed multiple databases along with standard DML operations, including queries, inserts, updates, and deletes of remote table data.

g. Provide support for automatic recovery from system or network failures (i.e., automatically commits or rolls back any in-doubt distributed transactions consistently on all involved nodes when a failure occurs).

h. Provide referential integrity for all data such that modifications to current data does not affect historical data.

i. Provide capability of online "live" backup of all database objects.

j. Provide capability of "point of failure" recovery of all database objects within one hour of the failure (i.e., dump transaction logs hourly) with a native utility package.

3. Database Security: Third-party database and reporting tools shall support database security functions. Database security shall include the following items as a minimum:

a. Encryption capability for defined data fields within database objects such as tables or views

b. Prevention of unauthorized database access

c. Prevention of unauthorized access to schema objects

d. Control of system resource usage (such as CPU time)

e. Auditing of user actions and database transactions

f. Assignment of valid username/password combinations

g. Assignment and control of resource limits for a user including hardware, database and application resources

h. Control of user access rights including database, table, record and field level authority

i. Control of which system functions a user can perform

4. The Contractor shall submit all database schema(s) for review and approval. The Contractor shall coordinate with the LAWA, airlines, and applicable third party vendors

to identify unique database requirements. The Contractor shall add needed fields as requested by LAWA. The database(s) shall be designed such that the addition of fields and/or tables is easily accommodated. The database schema shall be provided in a chart format showing all tables, key fields, and hierarchical relationships.

5. SQL: The utilized native structured programming language shall be storable in the database. The database shall employ a native structured programming language that can utilize standard Structured Query Language (SQL) which includes the following:
   a. Data Definition Language (DDL) statements
   b. Data Manipulation Language (DML) statements
   c. Transaction control statements
   d. Session control statements
   e. System control statements
   f. Embedded SQL statements
6. Database Maintenance: The database maintenance system shall be capable of maintaining configuration control (i.e., keep track of changes and compare versions of the database). Database maintenance software shall be provided to allow modification of designated database fields. Database documentation shall be provided to enable the updating or regeneration of the database tables when inputs are changed and added and as programs are modified or added.

7. Archival Viewing: The database shall provide an archive capability that provides “near time” retrieval of archived data. The data held within the “operational” portion of the database shall include a minimum of 7 days of operational data. The Contractor shall propose, and submit for approval, the maximum amount of operational data to be stored for real time access that will not impact the efficiency of the database. In addition to real-time (daily) operational data, the database shall provide the ability to generate real-time reports for operational data for a minimum of thirty-six (36) months.

8. The database shall include the functionality and capability to allow the authorized user to view or report on historical data. If the user wishes to view or report on data which has been archived, an automated mechanism shall be provided to have the requested data put online. The methodology for providing this functionality must be approved by the Engineer prior to implementation.

2.28 SYSTEM CONFIGURATION

A. Security

1. Authorized users shall log into the system using a unique user name and password. Depending on assigned user access privileges, the user shall be either granted or denied access to individual applications. In no case shall any user identified via user name and password as an airline employee or any other user without proper authorization gain access to any other airline's data, other than that pertaining to their own flights and baggage. Data that can be viewed at the user's workstation pertaining to data by airlines other than the user's airline shall be limited to data that can be viewed on public displays.

2. The System Administrator shall be able to add, delete, set, and change user privileges and access authorization via a GUI. System security parameters shall be configurable by the System Administrator.
3. Workstations shall have an "inactivity timeout period" such that if any workstation is determined to be inactive by having no input/output performed at that workstation for the defined timeout period, that workstation shall be automatically logged out of the application.
4. The timeout feature shall be turned on or off by the System Administrator. The timeout period shall be configurable by the System Administrator.
5. The occurrence of an inactivity timeout occurring as described above shall be recorded in the fault log, showing date, time, workstation identifier, and the user name of the user who was logged in at the time when the inactivity timeout occurred.
6. Systems shall prevent a user name from being logged in more than one time concurrently.
7. Systems shall provide an audit trail of all transactions. The audit trail shall track on a per user basis. The audit trail file shall indicate any changes that occurred to applications configuration, data structure, or database fields/records, and shall contain the date and time of the change, the user identification of the user who made the change, and the details of the change.
8. Systems shall provide automated tracking of the audit trail database, and shall alert the System Administrator when this file has exceeded pre-determined size restrictions. The System Administrator shall then have the ability to archive this database, along with the ability to restore it for reporting purposes. The system shall also include the option of a “rolling window”. In this case, the audit trail database shall use a rolling window with a System Administrator configurable window (i.e., after defined period of time oldest records are automatically dumped).
9. If remote access is required for system administration, a security feature such as secure VPN encryption shall be used.

B. Availability Requirements

1. System Availability:
    a. At any given time, the overall Systems shall be considered unavailable if two (2) percent or more of the end devices are non-operational, not fully functional, or do not meet response time criteria.
    b. Software and system devices shall execute, without degradation, at the scheduled periods and response times for the systems to be considered available.
    c. The systems shall operate as specified twenty-four (24) hours per day, seven 7 days per week.
    d. Availability of the overall Systems shall be at least 99.9999 percent.
2. Device Availability:
    a. A system server and PC shall be considered available only if all components are operating and fully functional.

b. A peripheral device shall be considered unavailable if it cannot be placed on-line and perform its intended function(s).

c. Besides scheduled downtime, as identified below, individual device availability shall exceed 99.80 percent (17 hours 30 minute maximum downtime per year).

3. Scheduled Downtime:

a. Downtime to update the computer operating system or repair a component shall be acceptable reasons for downtime, but at no time shall more than 5 percent of the system be non-operational.

b. Scheduled downtime shall be anticipated to be between 12:01am and 3:59am, or during CMJV and PMT approved hours and must be coordinated with the CMJV and PMT a minimum of 48 hours in advance of any work being performed.

c. If the operating system of the servers requires maintenance or updates, or if the servers require system maintenance, each server shall be brought down individually to be updated/maintained, such that at no time is more than one server down at the same time.

d. If the operating system of the end device computer requires maintenance or updates, or if the end device computers require system maintenance, the end device that requires the maintenance shall be brought down during non-peak hours of operation.

e. It shall be acceptable to perform maintenance/updates on an end device computer system during other than non-peak hours if the particular end device is non-functional without having the maintenance or updates performed.

C. Performance Requirements

1. The performance requirements in this section are for system design and testing and not service response time.

2. Capacity: Systems shall be designed to support the operational, functional, and performance requirements, specified herein, for a minimum of 400 flight operations per hour and 40 different airlines with a total of 200 users simultaneously conducting 60 user operations per minute with a minimum of 750 end devices being updated.

3. Response time criteria shall be met under maximum capacity conditions as defined above.

4. External System Interface: The total additional delay for a transaction between a Systems workstation to an external system shall not exceed 1.5 seconds for 95 percent of all transactions. The remaining 5 percent of delays shall not exceed 3.0 seconds.

5. Database Transactions: For 95 percent of database transactions, there shall be no more than a 0.5 second delay between the time that a user selects an action and the system responds in some way that the input has been received. The remaining 5 percent of transactions shall not exceed 1.0 second.

6. Peripheral Command: For 95 percent of peripheral commands, there shall be no more than a 3.0 second delay between the time that a user selects an action and the associated peripheral responds to the request. The remaining 5 percent of command responses shall not exceed 5.0 seconds.

7. Peripheral Configuration: For 95 percent of peripheral configuration changes, there shall be no more than a 6.0 second delay between the time that a user selects an action and the associated peripheral responds to the request. The remaining 5 percent of peripheral configuration changes shall not exceed 10.0 seconds.

8. Display: For 95 percent of dynamic display device changes, there shall be no more than a 30.0 second delay between the time that a user inputs a database change and the affected display devices reflect the change. The remaining 5 percent of transactions shall not exceed 45.0 seconds.

D. System Management

1. The devices connected to the network shall be SNMP manageable. A positive relationship (e.g., system heart beat) shall exist between the system devices and the controlling server(s) at all times.

2. Managed system failures shall include, but not be limited to, PC failure, display device failure, application failure (server and local applications), network connectivity failure, and server failure. Server failure shall include hardware, software, network, and power based failure.

3. System failures shall be viewable at a central control point (i.e., the system administrator's workstation). A failure shall initiate an alarm and add a failure record to the failure database table. The system administrator shall receive a warning message on the System Administrator workstation, notifying them of the failure. The system shall provide e-mail, pager, and text messaging notification. The Contractor is responsible for providing all hardware, software, and WAN/PSTN access necessary to support the notification functions.

4. End user devices shall have remote administration and monitoring capabilities. This capability shall allow the specific machine to be remotely configured and to provide a status report to the management system. Data included in the reporting capabilities shall include: data pertaining to the machine's memory, storage devices, network connections, and general health of the machine.

2.29 DATA NETWORK

A. Refer to Section 27 21 00 for Network Requirements.

2.30 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable Manufacturers:

a. W.H. Brady

b. Ideal

c. Panduit

d. Other equal

PART 3 – EXECUTION

3.01 GENERAL

A. Contractor shall coordinate installation with LAWA, Airline Tenants and TASS system to plan for start-up and testing as required to meeting operations.

B. Contractor shall acquire and apply LAWA asset tags to each major equipment item. A list of asset tag numbers and locations shall be submitted for review by the systems manager, LAWA and the design team.

C. Determine that area is finished as required for equipment installation. SUS equipment shall not be installed until the Gate counter positions and equipment rooms are clean environments free of dust and debris, and shall not be exposed to construction activity in the immediate area. Contractor to protect or remove and reinstall equipment that will be exposed to dust and debris that is the result of subsequent construction.

3.02 EXAMINATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

3.03 PREPARATION

3.04 PHASES OF IMPLEMENTATION

A. Provide a consolidated and integrated schedule.

3.05 INSTALLATION, PROGRAMMING AND INTEGRATION

A. Programming

1. Each SUS Gate workstation and associated peripheral equipment set shall be programmed to provide full support of departure operations tasks to each of the airlines using the LAWA Common Use System.

2. Each SUS workstation and peripheral equipment shall be programmed for use by each of Common Use System airline user.

3. Each Gate SUS Workstation shall have a VoIP handset associated with it. The SUS workstations shall be provisioned to activate a pre-configured telephone user profile for

the VoIP telephone handset upon valid sign on of a SUS workstation user. Coordinate this interface between the VoIP and CUTE system with the System Manager, telephone system and network providers as required to support each airline log on to SUS workstations.

B. Integration

1. Each new SUS Gate Workstation and associated peripheral equipment set shall be integrated into the existing LAWA TASS.

2. Integration plans and testing shall be witnessed and approved by the Systems Manager as defined in Section 27 26 26.

C. Functionality

1. Each SUS workstation shall be installed and programmed as IATA RP 1797 CUTE/CUPPS compliant and be fully functional to meet airline operational requirements.

D. Printer Adjustments

1. Each Printer shall be adjusted to correct boarding pass coupon production and provisioned with Pectabs suitable for each airline user operations.

3.06 FIELD / SITE QUALITY CONTROL

A. Equipment Set Testing, Commissioning and Demonstration Requirements

1. Each SUS workstation and associated peripheral equipment set shall be demonstrated and fully tested to meet basic functionality and airline operational requirements.

2. Each SUS workstation and associated peripheral equipment set shall be commissioned using SITA certified commissioning program.

B. Final Testing

1. Develop a comprehensive Common Use Equipment Test Plan and submit to the Systems Manager for review and approval.

2. Conduct testing with Airline, LAWA and Design Team representatives present.

3. Rework all failed tests until acceptable test results are achieved.

4. All workstations and associated peripheral equipment set shall be tested to meet operational requirements for each airline and to allow any airline to operate at any Gate.

5. Test and demonstrate each workstations integration with the existing LAWA Systems and each participating airline application.

6. Submit Test Reports initialed by Airline and LAWA witnesses.

C. Termination

1. Performance verification test shall be terminated by the Design Consultant when:

   a) Individual components, subsystems, or the integrated system fail to perform as specified.

   b) It is determined that system is missing components or installation is not complete.

2. Upon termination, corrective work shall be performed and performance verification test rescheduled with the Design Consultant.

3. Retesting shall be performed by Contractor at no additional expense.

4. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of the Design Consultant.

3.05 SYSTEM STARTUP

A. The Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.

5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.

B. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.06 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with the Design Consultant prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.07 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the LAWA CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.08 CLOSE-OUT ACTIVITIES AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in the LAWA management system and successful performance of the Common Use Systems for a period of 60 days will constitute acceptance of the System(s).

B. Training:

1. Conduct training for LAWA CUTE/CUPPS administration. This training shall be a SITA CUTE refresher course developed for 8 LAWA staff members over a 4 hour period.

2. A training syllabus shall be developed and submitted for approval, then once approved, each student shall be provided with a handout copy of the syllabus.

3. Conduct airline user training on workstation, CUTE applications and peripheral equipment sets. This training shall be a 1 hour, hands on, user training session offer to all participating airlines. Training Classes shall be scheduled as 1 hour courses with an AM class and a PM class to facilitate airline and LAWA shift schedules.

4. Develop and submit 2 reproducible and 2 electronic files of troubleshooting guides/training manuals for LAWA and Airline Personnel. These troubleshooting guides/training manuals shall address common PC and peripherals troubleshooting, typical use and contact information to escalate operational issues.

3.09 MAINTENANCE

END OF SECTION 27 42 20

SECTION 27 51 13 – PAGING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the minimum requirements for public address announcement and paging systems to be installed and interfaced to existing systems as part of Terminal renovations. Contractor shall interface with the existing public address system which is manufactured by Innovative Electronic Designs, Inc. (IED) and shall provide all equipment and cabling necessary for a complete and upgraded system. Contractor shall upgrade existing IED system as required to meet the requirements given in this Specification Section.

B. Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational system shown and described in the Specifications.

C. The Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

D. The Contractor shall coordinate with electrical contractor for provision of horizontal conduit and field boxes required to accommodate cabling of all loudspeakers, microphones and other system equipment.

E. Work Included:

1. All wiring and cabling as shown on the drawings.
2. All paging system receptacles as shown on the drawings.
3. All equipment and materials as shown on the drawings.
4. Cover-plates for outlet and junction boxes.
5. Extension rings where required to provide a flush surface for cover plate mounting on finished walls.
6. Engraved nameplates on all boxes.
7. Coordination of the paging system Ethernet VLANs with the MPLS provider.
8. Integration of the new announcement control system located in the North Concourse with the existing announcement control system located in the Core. The Contractor shall hire the Installer responsible for maintenance of the existing Paging System to coordinate the linking of the new Announcement Control System (ACS) and the existing ACS.
9. The coordination of all millwork mounting of devices with the millwork providers.

10. The Paging System acoustical design shall meet or exceed the minimum acoustic performance specifications for each zone.

11. The Contractor shall ensure new equipment shall be capable of tying into existing system. Contractor shall hire the LAWA contractor responsible for maintaining the existing paging system for this work.

12. Additional conduit and cabling as required by LAWA.

13. Set-up and adjustment of digital line-array loudspeakers in the field with the manufacturer's representative.

14. All conduits, device junction boxes and pull-wires.

15. Safety wires for all fixed system equipment.

16. The isolated grounding electrode isolated grounding electrode conductor and other equipment and materials for the isolated ground system.

17. Loudspeaker back-cans for ceiling loudspeakers are furnished under this section for installation under Division 26.

F. The Contractor shall coordinate specialty electronic, Information Technology (IT) data networks and any other IT infrastructure systems necessary for transport of paging systems audio or data information.

G. Refer to Construction Drawings for device locations and details.

H. Related documents included in the specification requirements:

1. Section 01 11 00 – Summary of Work
2. Section 01 25 00 – Substitution Procedure
3. Section 01 31 00 – Administrative Requirements
4. Section 01 33 00 – Submittal
5. Section 01 40 00 – Quality Requirements
6. Section 01 43 00 – Quality Assurance
7. Section 01 64 00 – Owner Furnished Products
8. Section 01 77 13 – Preliminary Closeout Reviews
9. Section 01 77 16 – Final Closeout Review
10. Section 01 78 00 – Close Out Submittals
11. Section 27 05 00 - Basic Telecommunications Requirements
12. Section 27 05 05 – Selective Demolition Telecommunication Systems

I. Products furnished (but not installed) under this section:

J. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Abbreviations and Acronyms

ACS	Announcement Control System
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
BFU	Board of Fire Underwriters
BICSI	Building Industry Consulting Services International
CSA	Canadian Standards Association
DEC	Department of Environmental Conservation
EIA	Electronics Industry Association
ER	Equipment Room
FCC	Federal Communications Commission
FM	Factory Mutual
IED	Innovative Electronic Designs, Inc.
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standards Organization
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
TIA	Telecommunications Industry Association
TR	Telecommunications Room
TWC	Tenant Wiring Closet
UFBC	Uniform Fire Prevention and Building Code
UL	Underwriter's Laboratories, Inc.

B. References

1. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of the telecommunications industry, as well as federal, state and local governmental agencies, including, but not limited to the following:
    a. CFR 47 Part 15 Radio Frequency Devices
    b. EIA-160 Sound Systems
    c. EIA-219 Audio Facilities for Radio Broadcasting Systems
    d. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, 02/02/09
    e. ANSI/TIA/EIA –569-B Commercial Building Standard for Telecommunications Pathways and Spaces, May 2009
    f. ANSI/TIA/EIA -606-A Administration Standard for Commercial Telecommunications Infrastructure, 11/24/08
    g. ANSI/TIA/EIA -607 Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
    h. ANSI/TIA/EIA – 862 Building Automation Systems Cabling Standard for Commercial Buildings, 2002
    i. FCC 47 Part 68 Code of Federal Regulations, Title 47, Telecommunications
    j. IEC 60849 Sound Systems for Emergency Purposes
    k. IEEE National Electrical Safety Code (NESC); 2007
    l. ISO/IEC 11801 Information Technology - Generic Cabling For Customer Premises
    m. LADBS Los Angeles Department of Building and Safety - City of Los Angeles Electrical Code
    n. NEMA 250 Enclosures for Electrical Equipment (1000 V Maximum)
    o. NFPA-70 National Electric Code; 2008
    p. NFPA 72 National Fire Alarm And Signaling Code
    q. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories
2. References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.
3. System installation and construction practices shall conform to standard industry practices as defined by the National Association of Broadcasters Engineering Handbook (latest edition), and Sound System Engineering (Don and Carolyn Davis, Howard W. Sams, publisher).

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. Action Submittals:

1. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

2. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

3. Submit all proposed labeling materials and nomenclature for approval.

4. Coordination Drawings:

    a. Indicate locations where space is limited for installation and access.

    b. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.

5. Submit all testing plans (acceptance, and endurance) for review and approval prior to the performance of any testing.

6. Paging Zone Code Documents:

    a. Submit floor plans which use color coding and shading to indicate all of the individual loudspeaker zones and the codes that access each loudspeaker zone individually and each zone group. Laminated color copies and PDF format software copies shall be provided.

    b. Submit a list of all paging stations, their locations, and which buttons or codes access which zone groups. If the paging stations are of the 12-button type and require a user-access code, the document is to contain a list of the user types, a description of their level of access, and what the access code is. The user types (for instance: emergency, administrator, airline employee, etc.) and levels of access shall be determined by the Owner and submitted to the Contractor in a timely manner.

    c. The documents above are to be submitted to LAWA and the Design Engineer for approval prior to the System Acceptance testing. The final version of this document shall be created after one month of regular system use and written approval from the Owner that paging station zone group assignment are satisfactory.

B. Project / Closeout Documents required include:

1. Marked-up copies of Contract Drawings

2. Marked-up copies of Shop Drawings

3. Newly prepared Drawings

4. Marked-up copies of Specifications, Addenda and Change Orders

5. Marked-up Project Data submittals

6. Record Samples

7. Field records for variable and concealed conditions

8. Record information on Work that is recorded only schematically

9. As-built drawings

10. Record drawings:

    a. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. LAWA and the Design Engineer will periodically review Project Record Documents to assure compliance with this requirement.

    b. At every quarter, submit Project Record Documents to LAWA and the Design Engineer for LAWA's records.

    c. Upon completion of the as built drawings, LAWA and the Design Engineer will review the as built work with the Contractor.

    d. If the as built work is not complete, the Contractor will be so advised and shall complete the work as required.

    e. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

C. Maintenance Material Submittals

1.06 QUALITY ASSURANCE

A. The Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to LAWA and the Design Engineer. LAWA and the Design Engineer shall be notified by the Contractor of any inspection(s) and LAWA and the Design Engineer may elect to participate in any inspection(s). All QC information shall be provided to LAWA for input into the CMMS (refer to paragraph 3.10).

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids Specification requirements.

B. Under no circumstances shall LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. The Owner's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that LAWA or the Design Engineer is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Engineer is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Design Engineer's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any moneys owed to the Contractor.

1.08 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

4. The Contractor shall guarantee for a minimum of fifteen (15) years, the performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.09 DELIVERY, STORAGE AND HANDLING

1.10 FIELD/SITE CONDITIONS AND ON-SITE PERSONNEL REQUIREMENTS

A. Contractor shall be (or shall subcontract with an installer who is) certified by the paging system manufacturer (IED) to install their equipment.

B. The Contractor shall be responsible for the proper placement of all cabling, racks, cabinets, patch panels, cover plates, outlet boxes, and related hardware, as well as all distribution, and termination equipment.

C. The Contractor shall obtain the approval of LAWA or Design Engineer for the final layout of any equipment to be installed in new or existing telecommunications rooms and tenant wiring closets prior to the installation of any materials or equipment. Shop drawings showing proposed installation details shall be submitted for approval before beginning installation.

D. The Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of LAWA.

E. The Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Contractor.

F. The Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

G. The Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Contractor shall be the single point of contact between the Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

H. While working in the facility, the Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment throughout the site.

I. The Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Contractor at its expense. If the Contractor enters an area that has damage (not caused by the Contractor), the Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

J. Following each day's work, the Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

1.11 WARRANTY

A. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of two (2) years from Final Acceptance.

   1. The Contractor shall use qualified service personnel to conduct all maintenance work. Service personnel must be local to the project jurisdiction to allow required response times to be met.

   2. The Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

B. Submit a copy of all manufacturer warranty information.

C. The Contractor shall, within the warranty period, schedule two visits to inspect and perform preventive maintenance on the system. The first visit shall be six months after the commencement of the warranty period. The last visit shall be just prior to the end of the warranty period. All work done must be submitted to LAWA in a written report describing the work, the amount of time taken, and all the individual's names who performed the work.

D. The Contractor shall return 90 to 120 days after the system has been turned over to the Owner for additional programming, maintenance and system fine-tuning. Conduct interviews with the user group via telephone to acquire information needed to complete this task. Allow for one full day of programming in your initial bid to complete. Provide a per hour programming fee that will be charged if additional programming is needed.

E. The following items shall be furnished to the Owner by the Contractor for future maintenance and repair:

1. Provide (6) spare 12 button paging stations.

2. Provide (3) spare 200 watt amplifier cards

3. Provide (2) spare 400 watt amplifier card.

4. Provide (1) spare 500R card.

5. Provide (2) ambient noise sensors.

PART 2 - PRODUCTS

2.01 PAGING SYSTEM GENERAL DESCRIPTION

A. System shall be a professional quality, multi-function system to be used primarily for transmission and broadcast of emergency and audible paging messages and background music sources. New equipment shall consist of:

1. New loudspeakers, connectors, transformers, crossovers, signal delays, cabling, conduit, boxes, wiring, and appurtenances for a fully functional and operational systems as described herein and shown on the contract drawings. Installation shall include all branch conduits, required for a complete installation including all fittings, pull strings, seismic supports/bracing, etc.

2. Amplifiers, mixers, signal conditioning equipment, digital message repeaters and storage, compressor/limiters, switchers/routers, equalizers, operating software, test equipment, and head end equipment as described herein and shown on the contract drawings.

3. All system operations and controls shall be controlled by a microprocessor and appropriate digital processing. The microprocessor shall manage and control all system functions and hardware such as microphone stations and associated queuing, telephone interfaces, distribution of emergency announcements, local announcements, terminal announcements, background music, recorded announcements, and pre-recorded messages.

B. Public address system shall consist of the following:

1. Announcement control system (ACS)

2. System control computer

3. Ambient analysis system (AAS)

4. Monitor/test system

5. Gate, podium, and supervisory microphone stations

6. Equalizers

7. Amplifiers

8. Loudspeakers

C. Announcement control system (ACS) shall consist of:

1. The ACS microprocessor controlled multiple microphone station inputs and multiple output zones.

2. All microphone input stations shall be assignable to any combination of the output zones.

3. Assignments must be readily changeable by qualified authorized personnel through the use of the system control computer.

4. Message types shall have the following priority:

	Description:	Priority:
a.	Fire Marshalls Microphone Dispatch Center Emergency All Call (Airport-wide)	1
b.	Emergency Pre-Recorded Message -Fire Emergency Pre-Recorded Message Evacuation (Bomb Threat/Earthquake)	2
c.	Gate – Direct Podium/Supervisor – Direct Local Multi-Zoned Group (Flight Calls) Local Multi-Zoned Pre-Recorded (Area Specific Advisories) Local Multi-Zoned Group Pre-Recorded (Tenant/Airport Specific Advisories)	3
d.	Remote Zoned (Communications Center Operators) Terminal Zone Group - Prerecorded	4

D. Use of the Fire Marshall's microphone or Dispatch Center Emergency 'All Call' (Airport-wide) shall override all other messaging, including supervisory microphones.

1. Only one emergency announcement may be made at a time, regardless of zone assignments, and an emergency announcement or message shall interrupt and prevent any other use of the system.

E. A multi-local or local announcement shall not prevent a terminal announcement from playing, but it shall interrupt and override the terminal announcement in the zones that have been assigned to multi-local or local zone's use.

F. System shall be capable of making at least 8 local announcements simultaneously, as long as there is no zone overlap.

G. ACS shall be capable of recording at least 8 terminal announcements simultaneously, but shall only play 1 terminal announcement in each zone at a time.

H. All audio switching circuits shall be designed and constructed so that no switching transients, clicks, pops or microphone keying tones will be audible.

I. All external connections to the ACS shall be made with compression type screw terminal strips.

J. Redundant power supplies shall be furnished so that the system can continue to operate if a power supply fails.

K. Control system components shall be mounted on printed circuit cards installed in plug-in card files.

L. All control system equipment shall be rack mounted in standard 19-inch rack assemblies, as defined in EIA-310D.

M. ACS shall incorporate audio and control inputs from the following:

1. Main Terminal Dispatch Center: up to 6 inputs

2. Podium microphones

3. Gate microphones

4. Fire Marshall’s microphone

5. Supervisory microphones located throughout the Terminal

6. Emergency relay contact from the facility life safety system

N. Public address system control computer system:

1. Contractor shall furnish a permanent PC-compatible computer for configuration and control of the ACS, control and operation of the AAS specified functions, manipulation and operation of the DRP and PDRP, and operation of the PA system’s monitor/test system.

2. Minimum hardware/software requirements: control system computer configuration shall be sufficient to ensure proper operation of the public address system and shall incorporate, at a minimum:

a. Processor based PC-compatible computer with fastest available processor speed at time of product submittal. ACS host computer shall come equipped with multiple serial and parallel data ports.

b. 19-inch or larger color flat panel monitor.

O. Program storage:

1. Permanent program storage shall be accomplished in non-volatile memory and EPROMS.

2. Following interruption of service, power restoration shall be automatically sequenced in a minimum of two stages - processing equipment followed by amplification equipment.

3. There shall be no loss of operating configuration information and operator intervention shall not be required in order to restore system operation.

P. Digital record/playback system (DRP):

1. The DRP shall be designed so it can be installed in the ACS as an integral part of the whole system.

2. The DRP shall have at least 8 separate channels and each channel shall be able to record at least 600 seconds of audio. When a microphone station zone group selection button is momentarily pressed the following functions shall be performed:

   a. The microprocessor shall detect the action.

   b. The system shall find an open DRP channel.

   c. The ‘READY’ LED indicator shall illuminate on the microphone station.

   d. The DRP channel shall be assigned, and the announcement from the microphone station shall be stored. The announcement time duration shall be preset to 50 seconds.

   e. The green LED associated with that button shall start to flash 8 seconds before the preset announcement limit.

   f. The announcement shall be retained for playback when the microphone or announce button is released. The microphone or announce button must be released prior to the preset announcement limit or prior to any 5 second silent period.

3. The announcement will play back automatically, to the selected zones, in its assigned queue position.

4. An announcement shall be canceled when a microphone or announce button is pressed and held for a 5 second silent period. Cancellation shall be indicated by the green light going off.

5. The red ‘BUSY’ LED’s beside the zone group select buttons on the microphone station shall light when all DRPS channels are busy.

6. The microphone station shall be able to select a desired zone group when all DRPS channels are busy. The ‘BUSY’ LED will flash acknowledging acceptance of the station

into the queue (first-in, first-out). When the station reaches the top of the queue, the station beeper will sound and the green ‘READY’ LED will turn on and the microphone station can proceed with its announcement recording.

Q. Permanent digital record/ playback system (PDRP):

1. The PDRP system shall be designed as an integral part of the announcement control system.

2. The PDRP system shall have a non-volatile Memory capable of storing not less than 800 seconds of audio messages.

3. Playback of the PDRP system messages shall be assignable to any zone or zones by the microcomputer.

4. Scheduling of PDRP system messages shall be set by the microcomputer.

   a. The PDRP system shall have the ability to record and play back a limited or unlimited repeat sequence, or to play any message at a specified interval on a real time clock schedule.

   b. Initiation or interruption of a playback sequence, on site recording, or monitoring of all PDRP messages shall be possible from any assigned microphone station.

   c. It shall be possible to play a message to the zone map for multi-local group 1 of that microphone station, or to a terminal zone group instead of to the zone map assigned to the message.

5. The PDRP system shall hold in permanent storage recorded messages such as:

   a. Emergency evacuation instructions.

   b. Fire warning/life safety instructions

   c. Public service messages (clean air act announcements, white zone, vehicle parking messages, and freedom of speech area identification.)

   d. Airline regulatory announcements such as the number of bags allowed on a flight, or non-smoking flights.

   e. Institutional messages such as baggage matching/unattended baggage announcements.

R. Ambient analysis system (AAS):

1. The AAS shall control specified audio levels in response to ambient or background noise levels.

2. All parameters governing the manner in which the system responds to noise and adjusts the program signal shall be set individually for each channel.

3. Manufacturer's software package shall be provided to set up the system, observe and tailor its operation, permanently save the setup parameters, and produce a printed record of them.

4. The AAS shall have the capability to differentiate between ambient noise and the actual program material.

5. The system shall be a microprocessor based system with software which removes the contribution of the program signal from the sensed signal to determine the true level of the ambient noise.

6. The microprocessor shall direct the associated digital attenuator(s) corresponding to the appropriate program channel(s) to increase or decrease level accordingly.

7. The period of time over which levels can be adjusted shall be established in the software in the range of 1 second to 5.25 hours.

8. Each AAS shall be configured in the field from the portable control computer system. The public address system control computer shall be the permanent host for the setup software package following initial set-up.

9. A 'CALIBRATE CHANNEL' screen shall display real-time levels of 4 key parameters, allowing the Owner to accurately fine-tune the system and verify its proper operation.

10. A computer shall only be required for setup and monitoring. Once the initial set-up procedure is completed, setup parameters shall be saved in non-volatile memory in the AAS. Following set-up, the AAS shall then operate without the use of a computer.

11. The AAS shall have the ability to control one channel or a group of channels in real-time response to the ambient noise.

12. The AAS microprocessor shall be capable of controlling at least 44 channels simultaneously.

13. The system shall provide precise control of the program level in response to inputs from remote sensors.

14. AAS ambient noise sensor units shall have mounting options for deep double gang electrical boxes, or 4-inch speaker back boxes and grills.

15. One sensor shall be capable of controlling from one to forty-four attenuators simultaneously. A group of sensors shall be capable of being averaged to control one attenuator.

16. Each AAS microphone shall consist of an omnidirectional condenser microphone, a preamplifier, and an analog signal converter.

17. Each AAS microphone shall be capable of being located up to 5,000 feet from the mainframe.

18. Connections between the sensors and the mainframe shall be made using standard audio shielded twisted pair cable of 18 AWG or larger.

S. Monitor/test system:

1. The monitor/test system shall have the capability to audibly monitor the signal at any point in the system. As a part of the monitor system, manual or programmed audible frequency self-testing shall be available, as well as an inaudible (20 kHz) test designed to exceed the requirements of NFPA 72F. The monitor test system shall be a full function monitoring system with self-diagnostics systems testing capability.

2. The monitor/test system shall be designed to allow the user to check status and condition of the audio and non-audio signals both audibly and visually.

   a. Via the System control computer, the monitor/test system shall be capable of selecting and feeding any one of remotely located monitor/test points to an audio interface module which measures and attenuates the signal for use by the computer and monitor amplifier which shall be connected to a dedicated monitor/amplifier.

   b. This feature shall allow the operator of the computer to select any remote signal, measure its level and listen to this level at some fixed predetermined level independent of the original, so that a quality and magnitude comparison can be made both electronically and audibly.

   c. At the same time, the output level shall be displayed numerically on the screen. System shall also be capable of monitoring power supply voltages throughout the system. The monitor test system shall also be capable of monitoring low impedance power amplifiers (8 ohms or less), line level audio, DC voltages, and AC voltages.

   d. System shall have a useful input signal range of minus 55dB to plus 40dB.

   e. System shall consist of high quality line level amplifiers that can be switched to a single line level output.

3. The monitor/test system shall consist of two main parts: the first part shall be a rack mount unit, and the second shall be the monitor interface module. These two products shall be designed to be used together or to be used independently.

   a. The monitor/test system shall consist of the monitor test card, physical housing, power supply and motherboard. The monitor test card shall contain 64 balanced, differential, high impedance, gain adjustable, high quality audio amplifiers. These amplifiers shall normally be set to accept a standard 70 Volt line input at clipping level but shall also be capable of accepting input level from DC to 1000 Volts AC. The outputs of these 64 amplifiers shall be computer switched to an active output module. The monitor test card shall also contain necessary card edge connections and circuitry to interface a standard EIA-422 digital link to the 64 switches that select one of the inputs.

b. A support panel that serves as a card guide and mount for the plus 15 V and plus 5 V power supply shall be physically mounted to the monitor test card.

c. The monitor test system board shall be the motherboard that is the rear panel of the housing, shall provide a mounting for all internal and external connectors and shall provide the interconnecting wiring. The external connectors shall be:

1) Wire-in compression screw terminal that provides access to all 64 audio inputs with 192 individual screw terminals and three additional terminals for access to the audio line output.

2) The AC line connector which shall be a standard 3 pin male European style socket;

3) Two each 37 pin sub D connectors that shall provide access to the controlling computer and to other components in the EIA- 422 circuit.

a) Up to 255 monitor/test systems shall be able to be linked together per intercommunications port on the monitor-test system.

T. Microphone Stations:

1. Each microphone station shall originate announcements into zone groups as detailed in the floor plans and public address system drawings.

2. Any microphone station shall be capable of being programmed into any zone group.

3. Microphone stations shall be capable, if so programmed, of making emergency zone group announcements, terminal zone group announcements, local zone group announcements, and multi-local group announcements.

4. If programmed, microphone stations shall also be capable of performing any or all of the control functions of prerecorded messages. These control functions shall include initiating a playback sequence, interrupting a playback sequence, recording a message, monitoring a message, or playing back a message to its own multi local zone group, or to a terminal zone group instead of to the zone map assigned to that message.

5. Microphone stations shall include a hand-held, push-to-talk microphone. Each microphone station shall have buttons for zone group selection to activate that microphone station for announcements into pre-programmed zones. Each station shall

contain its own microphone preamplifier, limiter/compressor, and line amplifier with balanced output. Each microphone station will be provided complete with cut-outs and mounting hardware for microphone stations mounted in furniture, fixtures, equipment, or structure.

a. A green 'READY' LED shall illuminate when the desired portion of the system is ready for the announcement.

b. After the green LED is illuminated, any 5 second pause in the announcement whether before, during or at the end of the announcement, will terminate the announcement.

c. A red 'BUSY' LED on the microphone station shall indicate when the portion of the system requested is busy.

d. If the portion is busy, selecting the desired zone group will automatically enter that microphone station into the queue (first-in/first-out).

e. The red 'BUSY' LED shall begin to flash, acknowledging acceptance of the microphone station into the queue.

f. When the microphone station gets to the top of the queue, the beeper shall beep and the green LED shall illuminate, indicating that the microphone station is available for the announcement.

g. The normal procedure for making an announcement on the microphone station type being used shall be resumed before the cessation of the beeps.

U. Podium and supervisory microphone stations:

1. Supervisory microphone stations shall have a twelve (12) button keypad for data entry plus an LCD digital display.

   a. Keypad entry shall enable them to select any zone group or prerecorded message function in the system to which it has been given access by programming from the computer keyboard.

   b. Supervisory microphone stations shall have three non-announcement functions available from the keypad by entry of a number sequence:

2. Keypad disable/enable.

3. Self-test.

4. Internal oscillator 'ON/OFF' for system test purposes.

V. Gate microphone stations:

1. Gate microphone stations shall consist of a push-to-talk microphone, microphone clip and connector.

2. When a gate microphone is activated, it will activate the zone to which the associated podium microphone is normally programmed to activate.

3. Connection to the public address system shall be via a connection to the podium station with which the gate microphone is associated.

4. No access to preprogrammed announcements shall be available from the gate microphone stations.

W. Telephone interface:

1. Telephone interface stations, when addressed from a tone type telephone, shall have capabilities similar to those of the supervisory microphone stations.

2. Provide three dual input telephone interface stations.

X. Loudspeakers shall be the type and number depicted in the contract drawings and as required by the Contract Documents.

Y. Amplification shall:

1. Be provided as shown in the Contract Drawings.

2. Provide full bandwidth signals to those loudspeakers that have a single, full range audio input.

3. Provide crossovers and a high and low frequency signal to those loudspeakers which are bi-amplified.

4. Be capable of supplying 4 Ohm, 8 Ohm, 16 Ohm and 70 Volt output without the use of a transformer.

5. Be provided with adequate cooling for the amplifiers, as recommended by the amplifier’s manufacturer.

Z. Connection to the emergency announcement system:

1. Emergency messaging shall be automatically initiated whenever the system is notified of a general alarm condition in the new Terminal.

   a. Whenever a local alarm condition is detected by the fire alarm system, the fire alarm system will initiate immediate notification of the alarm condition to the Dispatch Center.

b. If a General Alarm Condition is annunciated the fire alarm system will immediately provide contact closure to the system.

c. The system shall automatically broadcast emergency instructions whenever a General Alarm notification is transmitted. The System emergency message shall repeat for a minimum of 20 minutes or until the fire alarm system is manually reset.

2. The system shall be provided with a sensing input which will accept a relay or contact closure from the fire alarm system which will completely and fully mute the system.

3. When the relay or contact closure is removed, the system shall return to normal operational status with the settings that were active and in place just prior to the system's receipt of the contact closure.

2.02 GENERAL PERFORMANCE REQUIREMENTS

A. System Performance:

1. Electrical Performance; Source Input to Power Amplifier Output:

a. Frequency Response (Equalizer flat): +/- 0.2 dB 20 Hz to 20 kHz.

b. Total Harmonic Distortion (THD): Less than 0.05%, 20 Hz to 20 kHz, 4 ohms.

c. Noise: At least -105 dB, 20 Hz to 20 kHz, referenced to input of +4 dBm.

d. Crosstalk: At least 60 dB, 20 Hz to 20 kHz.

e. Damping Factor: Greater than 20 (below 1 kHz).

2. Nominal gain from microphone station output to input of Ambient Noise Analysis system shall be 0dB.

3. Nominal voltage at input of Ambient Noise Analysis Systems shall be 1.00 volt RMS.

4. Electro/Acoustic Performance; Distributed Systems: 90 dB maximum RMS single word level, 80 dB average RMS measure at ear level in each zone with test speech source having equivalent RMS voltage equal to that measured at the microphone station output with 65dBA speech at normal microphone distance from the mouth.

5. Intelligibility Performance; objective measurements of intelligibility, as referenced in IEC standard 60268-16, shall be performed in all representative acoustical environments. Representative acoustical environments are defined as major functional areas such as Baggage Claim areas, Departures Ticketing Lobby, Departures Hold Rooms, etc. Measurements are to meet or exceed standards established by IEC 60849 which calls for a ‘Common Intelligibility Scale’ greater than or equal to 0.7 (STI equivalent of 0.5).

Measurements shall be carried out according to all provisions and limitations as provided by IEC 60849.

B. Ambient Noise Analysis System:

1. Shall be adjusted in each zone to provide variable attenuation in the range of 0 to -10dB. To be calibrated to correspond with minimum and maximum expected ambient noise levels, but not to exceed 10dB, + or – 3dB, above maximum ambient noise level, as measured when area is full of people. Ambient Noise Analysis System must be calibrated by a manufacturer-approved consultant, and calibration process must include at least 2 follow-up visits which measure all representative acoustical environments. Observations and measurements must be submitted in written form.

2. Contractor shall confirm that ambient microphone positions are not located in close proximity to noise emitting equipment which turns on and off intermittently, providing false ambient noise information to the system.

C. Monitor/Test System: Shall perform routine, automatic diagnostic tests utilizing a self-generated test tone. Refer to manufacturer’s instructions and recommendations for settings.

D. Each output zone shall be adjusted at the corresponding power amplifier and using the system software so that volume levels (using an appropriate pink noise source) from zone to adjacent zone are within 3dB of each other, before any Ambient Noise System auto-attenuation takes place.

E. General Network Requirements:

1. A 100Mbps switched Ethernet network is required for general audio, switched at a layer 2 (MAC) protocol level throughout.

2. Microphone Station to ACS - One dedicated VLAN at 100Mbps.

3. Digital Amplifier to ACS - One dedicated VLAN at 100Mbps.

4. ACS to ACS - One dedicated VLAN at 100Mbps.

5. Quality of Service - QoS shall be used to give the time sensitive CobraNet data precedence over less sensitive computer traffic, insuring that other transactions occurring over the network do not affect audio delivery.

2.03 MAJOR EQUIPMENT

A. Schedule of Major Equipment (or equivalent):

Description	**Mfr.**	**Model**
Speakers:		

Ceiling Loudspeaker – 6.5”	Atlas	FAP 62T with and without custom hanger
Ceiling Loudspeaker – 8”	Atlas	FAP 82T w. hanger
Ceiling-mount speaker system	EAW	CP621
Wall speaker	Atlas Sound	SM42T-W
Amplifier and DSP Section:		
Titan Mainframe System 120VAC	IED	TITANSYS-L
Titan DSP Software	IED	T-DSP
Titan Monitor/Test Software	IED	T-MON
Titan Backup power amp switching software	IED	T-BACK
Power Amp Card Dual 70-Volt 200W 120VAC	IED	IED6272L
Power Amp Card 70-Volt 400W 120VAC	IED	IED6470L
Ambient Analysis Sensor Collector	IED	IED6540TSYS-L
Ambient Sensor Collector Software	IED	T-AMB
Ambient Sensor - 2 Gang Plate	IED	IED0540S
Headend Section:		
ACS "System" (includes cardframe, CPU, power supplies, and "R" card)	IED	IEDA500ACS-L
Backup CPU/Hard Drive Card	IED	510CPU
Digital Frame link Card-Multimode with Back ST	IED	510N and NT
Microphone station input card and	IED	500C and FT

strip		
ACS Configuration Computer	IED	591R-S1
UPS for ACS	APC	SU3000RMXL3U with one SUA48R3XLBP
Relay input card (for Fire Alarm Interface)	IED	508BI0
Telephone Interface	IED	508T
ACS Software	IED	IED0631
FAS Software	IED	Model 632
Network Switch with (2) single-mode fiber mini-GBICs and 10/100 ports	HP Procurve	4104gl
Custom software for Duran Audio network "fault" feed	IED	IED0760
Audio Ducker	Rolls	DU-30
Network Switch	HP Procurve	2626
Keyboard, Video, Mouse Switcher	IED	MKM-RS1
Rackmount LED Display	IED	Video Display
Telephone Auto Dialer	Antx	DS8-N
Microphone Stations:		
Paging mic station - 12 button, IP digital, horizontal (flush or surface mounted depending on backbox)	IED	518HFM-H
Rackmount paging station w. spkr, IP digital	IED	508SRM

2.04 VISUAL PAGING

A. Visual Paging: The visual paging system shall be integrated into the SITA Shared Use Station (SUS) and shall meet the requirements of that system and the existing system functionality. The Contractor shall be responsible for providing the information necessary for and coordinating the programming of visual paging system so that visual and audio zones are synchronized. The Contractor shall also be responsible for any programming changes required in the visual paging system to accept from SITA flight information associated with new gates.

2.05 CUSTOM FABRICATION

A. Equipment cabinets: Telecommunications Rooms and equipment cabinets are supplied by Section 27 05 00. Contractor may arrange with cabinet supply contractor to ship cabinets to their factory for pre-rack and wiring of paging equipment. Paging system contractor is responsible for providing all cooling equipment, shelves, drawers, special power wiring, ground connections, cables, connectors, appurtenances, and adapters of any kind necessary to accommodate the PA system installation, operation, testing, or maintenance.

1. Contractor shall provide the appropriate factory or custom rack mount adapters for all equipment installed in the equipment rack, whether specifically itemized or not.

2. Contractor shall provide security covers for all equalizers, crossovers, signal delays, and other adjustable signal processors.

3. Unused slots shall be covered using blank panels provided by the system manufacturer.

4. Contractor shall provide at least one security screw for each piece of equipment and four security screw tools for the system.

B. Interface tie points: Contractor shall furnish custom-fabricated interface tie points to accommodate distribution of system program material, and to transition wiring types between the paging system equipment racks and loudspeaker zones. Contractor shall furnish operable methods for labeling, dressing, and distributing wires, shields, and grounding conductors so as not to adversely impact the quality of system voice and data transmission. Contractor shall provide test points at each audio and data circuit appearance for that tie point for maintenance and testing purposes. All circuits and cables shall be clearly labeled. All interface tie-points will be mounted within NEMA 12 enclosures, to be sized by Contractor in accordance with the requirements of the NFPA 70. Enclosures are to include integral door locks. All interface tie points are to be keyed alike. Keys shall be turned over to the Owner at Final Acceptance.

C. Transformers: Where required by the function of the system, provide appropriate impedance ratio and power handling capacity for audio transformers required in the system.

D. Loudspeaker hardware: Contractor is solely responsible for ensuring that all grilles, transformers, enclosures, baffles, and ancillary hardware to be supplied are compatible with the loudspeakers specified.

E. Pads: Contractor shall provide balanced pads, comprised of 0.5 watt, 5 percent composition resistors soldered to fixed connection points at each end, as required to achieve proper impedance matching and levels.

F. Remote control panels and receptacle plates: Contractor shall fabricate with 1/8-inch thick 6061-T6 aluminum with a brushed, anodized finish (color to match surrounding surfaces).

G. System functional diagrams: Contractor shall provide 1/2-size as-built functional diagram, framed with acrylic cover and mounted adjacent to equipment rack, for each control or audio system (including patch field designations). Mounting inside interface tie point enclosures will be acceptable.

2.06 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be pre-printed or laser printed type.

C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.

D. Where insert type labels are used, provide clear plastic cover over label.

E. Acceptable Manufacturers:

1. W.H. Brady
2. Ideal
3. Panduit
4. Other equal

F. Contractor shall provide permanently mounted 1/32-inch thick by 1/4-inch high black lamicoid or anodized, brushed aluminum labels with 1/8-inch engraved lettering for each piece of equipment and every user-adjustable control and input on the audiovisual equipment.

2.07 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.01 GENERAL

A. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

B. Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein.

1. Where undefined by codes and standards, Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components

C. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with Design Engineer the exact location and mounting height of all equipment in finished areas.

D. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, LAWA and the Design Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after LAWA and the Design Engineer reviews and comments on arrangement and appearance.

E. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

F. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support work. Supports shall meet the approval of LAWA and the Design Engineer.

G. Cable Dressing: Where fiber or copper cables enter telecommunications room it shall be neatly bundled and fastened and a suitable transition device installed to minimize tension and bend radius on cables. All cable runs shall be horizontal or vertical, and bends shall comply with minimum specified cable bending radii.

1. Cables shall be combed and each strand shall run parallel with the other strands.

2. After combing and straightening strands, Contractor shall separate strands into bundles according to routing requirements and termination points.

3. Bundles shall be secured with hook-and-loop cable strap material.

   a. Cable ties manufactured from a hard polymer material, such as plastic or nylon, shall not be used.

   b. Hook-and-loop material shall be low life cycle, back-to-back type, black in color, and ½ inch wide.

4. Contractor shall begin to bundle and strap cables within 6 inches of exit from conduit, and bundles shall have cable straps applied at intervals not greater than 10 feet for entire length of vertical and horizontal run.

3.02 EXAMINATION

A. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways. Before construction work commences, the Contractor shall visit the site and identify the exact routing for all horizontal and backbone pathways.

3.03 PREPARATION

3.04 INSTALLATION - PHASES OF IMPLEMENTATION

A. The Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

B. The Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

C. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

D. Submit installation drawings for LAWA review and approval.

E. Provide a consolidated and integrated schedule.

F. Functionality of the existing paging system shall be maintained at all times. The work shall be done in such a fashion that no existing paging zone is out of service during the hours of 5:00 am to Midnight, and no zone is out of service at all for more than 1 hour in areas which are still in use. Temporary paging must be provided as required at no additional cost to the LAWA.

3.05 QUALITY CONTROL – SITE TEST AND INSPECTION

A. Phases of Testing

1. On-Site Performance Verification Testing

2. On-Site Endurance Testing

B. Test Plan/Procedure: The Contractor shall submit a Test Plan for each testing phase for the review and approval of LAWA and the Design Engineer. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1. Functional procedures including use of any test equipment.

2. Test equipment is to be identified by manufacturer and model.

3. Interconnection of test equipment and steps of operation shall be defined.

4. Expected results required to comply with specifications.

5. Record of test results with witness initials or signature and date performed.

6. Pass or fail evaluation with comments.

7. The test procedures shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

8. Documentation verification, both interconnects and functionality, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

9. The Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

10. Test Reports: The Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

    a. Commentary on test results.

    b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

d. Signatures of persons who performed and witnessed the test.

e. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Contractor at no cost to the Owner. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by LAWA and the Design Engineer before any subsequent testing phase is performed.

C. Performance Verification Testing:

1. Complete operational testing of all components and systems shall be witnessed by designated LAWA Representatives.

2. Schedule test with LAWA and the Design Engineer. Do not begin testing until:

    a. All systems have been installed and individually and jointly tested to ensure they are operating properly.

    b. Written permission from LAWA and the Design Engineer has been received.

3. Testing: As part of performance verification, test all components of system. The tests shall demonstrate system features.

4. Verification: Verify correct operation of the required system functionality as defined in these specifications.

5. Adjustment, Correction, and Completion:

    a. Correct deficiencies and retest affected components.

    b. Make necessary adjustments and modification to system after obtaining approval of LAWA and the Design Engineer.

    c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by LAWA and the Design Engineer.

6. Recording:

    a. Describe actual operational tests performed and equipment used and list personnel performing tests.

    b. Record in tabular form all test results, deficiencies, and corrective measures.

7. Termination:

   a. Performance verification test shall be terminated by LAWA and the Design Engineer when:

      1) Individual components, subsystems, or the integrated system fail to perform as specified.

      2) It is determined that system is missing components or installation is not complete.

   b. Upon termination, corrective work shall be performed and performance verification test rescheduled with LAWA and the Design Engineer.

   c. Retesting shall be performed by Contractor at no additional expense.

   d. Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of LAWA and the Design Engineer.

D. Endurance Testing:

1. Provide personnel to monitor the systems 24 hours per day, including weekends and holidays during endurance testing.

2. Start test after:

   a. Successful completion of performance verification testing.

   b. Training as specified has been completed.

   c. Correction of deficiencies has been completed.

   d. Receipt of written start notification from LAWA and the Design Engineer.

3. Monitor all systems during endurance testing. Coordinate monitoring with the Design Engineer.

4. Recording: Record data on approved forms so as to provide a continuous log of systems performance. Include:

   a. Date and time for all entries.

   b. Name of individual making entry.

   c. Environmental conditions.

d. Authority activities in process.

e. Description of all alarm annunciations, responses, corrective actions, and causes of alarms. Classify as to type of alarm.

f. Description of all equipment failures, including software errors.

g. Description of all maintenance and adjustment operations performed on system.

h. Daily and weekly tabulations.

i. Daily entries of performance data shall be reviewed by the Design Engineer's representative designated to observe monitoring of system.

5. LAWA and the Design Engineer may terminate testing at any time when the system fails to perform as specified. Upon termination of testing the Contractor shall commence an assessment period as described in Phase II.

6. Testing

a. Phase I - Initial Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by LAWA and the Design Engineer.

3) If system experiences no failures, proceed to Phase III - Final Testing.

b. Phase II - Initial Assessment:

1) After conclusion of Phase I or terminating of testing, identify all failures, determine causes, and repair. Submit report explaining: Nature of each failure, corrective action taken, results of tests performed to verify corrective action as being successful, and recommended point for resumption of testing.

2) After submission of report, schedule review meeting at job site. Schedule date and time with LAWA and the Design Engineer.

3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

4) Based on report and review meeting, LAWA and the Design Engineer will direct Contractor to repeat Phase I, restart Phase I, or proceed to Phase III - Final Testing.

c. Phase III - Final Testing:

1) Time: 24 hours per day for 15 consecutive calendar days.

2) Make no repairs during this phase unless authorized in writing by Engineer.

7. Phase IV - Final Assessment:

   1) After conclusion of Phase III or termination of testing, identify all failures, determine causes, and repair. Submit explaining the nature of each failure, corrective action taken, results of tests performed, and recommended point for resumption of testing.

   2) After submission of report schedule review meeting at job site. Schedule date and time with the Design Engineer.

   3) At review meeting, demonstrate that all failures have been corrected by performing verification tests.

   4) Based on report and review meeting, LAWA and the Design Engineer will approve endurance test or direct Contractor to repeat all or part of Phases III and IV.

8. Adjustment, Correction, and Maintenance:

   a. During endurance testing make adjustments and corrections to system only after obtaining written approval of LAWA and the Design Engineer.

   b. During endurance testing, perform required maintenance on systems including provision of replacement parts.

E. Commissioning Testing

1. The Contractor shall develop a commissioning test plan that includes the following components, as a minimum:

   a. LAWA readiness

   b. Operational procedures verification

   c. Disaster recovery procedures

   d. Computerized Maintenance Management System data verification

   e. Change management procedures

2. The commissioning test plan/procedures shall be submitted to the Engineer for review and approval.

F. Final Inspection and Acceptance:

1. After endurance testing is complete, review tabulated records with LAWA and the Design Engineer.

2. The Contractor will not be responsible for failures caused by:

   a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

   b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

   c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

3. When performance of integrated system does not fall within the above rates, determine cause of deficiencies, correct, and retest.

4. When requested by LAWA and the Design Engineer, extend monitoring period for a time as designated by LAWA and the Design Engineer.

5. Period shall not exceed 60 days exclusive of retesting periods caused by termination of Phases I or III and assessment period of Phases II and IV.

6. Submit final report of endurance testing containing all recorded data.

3.06 SYSTEM STARTUP

A. Upon completion of the installation of all equipment in an area, perform the following tests and record results. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report. Correct all non-conforming conditions prior to requesting Acceptance Testing. Perform at least the following procedures:

B. Mechanical. Verify:

1. Integrity of all support provisions.

2. Absence of debris of any kind, tools, etc.

C. Power and Isolated Ground. Verify:

1. Isolation of Isolated Ground system from raceway and related ground.

2. Grounding of devices and equipment. Integrity of signal and technical power system ground connections.

3. Proper provision of power to devices and equipment.

D. Signal Wiring. Verify:

1. Integrity of all insulation, shield terminations and connections.

2. Integrity of soldered connections. Absence of solder splatter, solder bridges.

3. Routing and dressing of wire and cable.

4. Continuity, including conformance with wire designations on running sheets, field and shop drawings.

5. Absence of ground faults.

6. Polarity.

E. Use the proper sequence of energizing systems to minimize the risk of damage.

F. Sound Systems:

1. Electronic Tests; confirm:

a. Gain at 1 kHz.

b. Maximum output.

c. Input clipping level.

d. Frequency response.

e. Total harmonic distortion.

f. Signal-to-Noise ratio.

g. Signal-to-Crosstalk ratio.

2. Gain control settings: Establish tentative normal settings for all gain controls. Set all equalizers flat. Set all automatic gain control devices to bypass. Terminate power amplifier outputs with power load resistors with resistance value within 10% the nominal output impedance of the respective amplifier. Adjust all gain controls on equipment for optimum signal to noise ratio and signal balance and, unless they are sub panel mounted, cap them to prevent tampering. Unless specified or directed otherwise, adjust gains such

that in a given system the "front end" operates at unity gain and maintains 10 dB of clip margin referenced to the first onset of clipping of the associated power amplifier(s). Measure and document system gains at 1 kHz. Settings may require further adjustment by the Contractor, a result of testing by the representative of the Owner.

3. Freedom from parasitic oscillation and radio frequency pickup: Maintain previous setup. Set up for each mode of operation specified in the functional requirements; verify that all systems are free from spurious oscillation and radio frequency pickup using broadband oscilloscope. Correct any such defects.

4. Hum and noise level/signal to noise level/signal to crosstalk level: Maintain previous setup. Terminate microphone and line level inputs with shielded resistors of 150 and 600 ohms, respectively. Set available variable gain controls such that full power amplifier output would be achieved with 40 dBm input level at a microphone input and +12 dBm at a line level input. Measure and document the specified parameters of the system overall for each microphone input channel and line level input channel. Compare with nominal signal level.

5. Total Harmonic Distortion: Maintain previous setup. Measure at reference operating level at 63 Hz, 125 Hz, 1 kHz, 10 kHz.

G. Electro/Acoustic Tests:

1. Uniformity of coverage.

2. Electronic and acoustic frequency response/one third octave equalization. Measure at ear level. Comply with applicable portions of ANSI (SMPTE) PH22.202M-1984, "B chain electro-acoustic response - control rooms and indoor theaters." Adjust to "curve X of B chain characteristic". Representative of the Owner will direct final adjustment.

3. Maximum continuous sound pressure level (in the reverberant field). Drive systems with broadband pink noise. Sustain for at least five minutes with no system damage. Measure for "A" and "C" weightings at ear level on loudspeaker axis. Turn off noise.

4. Acoustic signal to noise ratio referenced to the specified maximum continuous sound pressure level in the reverberant field. Measure for "A" and "C" weightings at ear level on loudspeaker axis with mechanical systems operating. Present comparison with previous measurement.

5. Acoustic gain before feedback. Locate acoustic source (4 inch loudspeaker/pink noise generator) two feet from system microphone. Measure at system microphone position and at most distant listener position at ear level. Present comparison.

H. System Overall:

1. Verify levels.

2. Provide permanent "wedge" type labels on all controls, as applies, to indicate correct settings after systems performance testing and adjustment procedures have been successfully completed.

I. At least 10% of the total number of zones must be tested at two different times and at two different locations within the zone during peak hours and during quiet hours. These tests must indicate that pages are at least 6dB, but no greater than 10dB above, ambient noise levels. Measured ambient noise levels must be time averaged over a period of at least one minute and are not to include announcements from the paging system.

J. Upon completion of the installation of all loudspeakers in an area, perform the following tests and record results. Correct non-conforming conditions, unless the cause is clearly outside the Work of this Section, in which case submit the apparent cause to the Owner.

1. Loudspeaker Line Impedance: At terminal cabinets at equipment rooms, measure the impedance of each loudspeaker line. Sweep from at least 20 Hz to at least 16 kHz.

2. Loudspeaker Polarity: Test the acoustic polarity of all loudspeakers using an Acoustic Polarity Tester.

3. Freedom From Buzzes, Rattles and Objectionable Distortion: Individually apply to each loudspeaker line a slow sine wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output voltage. Listen carefully for buzzes, rattles and objectionable distortion.

4. Uniformity of Coverage: Apply broadband Pink Noise. Adjust level to approximately 70-80 dBA at measurement locations. Measure in 4 kHz octave band at ear level. Adjust loudspeaker aiming and 70 Volt loudspeaker taps for uniformity of coverage.

K. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.07 CLEANING

3.08 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Contractor shall confirm specific labeling requirements with LAWA and the Design Engineer prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

3.09 TRAINING

A. General

1. By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct LAWA’s designated staff and Airline personnel in the operation, adjustment and maintenance of all products, equipment and systems.

2. The Contractor shall be required to provide all training aids, e.g., notebooks, manuals.

3. The Contractor shall provide an appropriate training area equipped with all required equipment. The location of the training area shall be coordinated with LAWA and the Design Engineer.

4. All training shall be completed a minimum of two weeks prior to system cut over. Training schedule shall be subject to LAWA and the Design Engineer’s approval.

5. Training shall be conducted by experienced personnel and supported by training aids. An adequate number and amount of training material shall be provided by the Contractor. The following is considered a minimum:

   a. Functional flow-charts, overall block diagrams, and descriptive material for all software;

   b. Schematic drawings for each of the hardware components;

   c. All procedure manuals, specification manuals, and operating manuals;

   d. As-built drawings.

6. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted. The courses shall be scheduled such that LAWA personnel can participate in all courses (no overlap).

B. Types of Training:

1. User Training: System users shall be instructed in all aspects of operations of the system. Four (4) hours of basic user training shall be provided. Additionally, four (4) hours of advanced user training shall be provided.

2. Technician Training: Eight (8) hours of maintenance training shall be provided. Training for maintenance technicians shall be provided on site, and shall include, but not be limited to, installation, operation, renovation, alteration, inspection, maintenance and

service on each system and subsystem provided, so as to enable troubleshooting and repair to the component level.

3. System Administrator Training: System Administrator Training shall be provided. System Administrator Training shall include both classroom work and on the job training and shall be provided on-site at LAX or at a location within 50 miles of LAX.

4. Classroom Training: Eight (8) hours of software training shall be provided for each system. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete software system. The course material must be presented in depth with the instructor covering detailed design, structure, and algorithms.

3.10 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule, Quality Assurance Inspections and other pertinent data will be stored in the CMMS database. Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.11 CLOSEOUT ACTIVITIES, FINAL INSPECTION AND ACCEPTANCE

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation including data input of all installed cables in LAWA management system and successful performance of the Paging System and its' components for thirty (30) day period will constitute acceptance of the system.

END OF SECTION 27 51 13

SECTION 28 13 00 – ACCESS CONTROL AND ALARM MONITORING SYSTEM (ACAMS)

PART 1 - GENERAL

1.01 SUMMARY

A. The access control and alarm monitoring system (ACAMS) specified in this section shall be an extension to the existing ACAMS currently deployed throughout the Los Angeles World Airport (LAWA).

B. Security Systems Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, software/licenses, installation, programming, configuration, testing, commissioning, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational equipment / systems shown and described in the Specifications.

C. The Security Systems Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to operations and provide complete and operational systems.

D. The Security Systems Contractor shall coordinate interfaces to existing systems that are being extended in the Project in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with LAWA.

E. This section specifies the minimum requirements for access control, door alarms, intrusion detection, and monitoring and control provision.

F. The standard access control panel deployed throughout the LAWA Airports is the General Electric (GE, now a United Technologies Corporation) *Micro/5*. LAWA ACAMS system is GE Picture Perfect Version 4.5.1. This ACAMS has links with the Airport Police Computer Aided Dispatch (CAD) and LAWA Video system for doors considered as 107 doors. Security Systems Contractor is required to ensure all required ACAM 107 doors are set-up/interfaced and tested/commissioned with CAD and the Video System.

G. The Security Systems Contractor shall coordinate and cooperate with the CAD and Video System contractor (Section 28 23 00) to set up the linkage between the two systems.

H. Access control panels and electrified locking hardware power supplies shall be located in telecommunication rooms (TR) as indicated in the drawings.

I. The electronic access card format standard shall be the HID i-Class/PIV format. Access control card readers provided must be fully compatible with this format. Note that in addition to any cabling required to make these readers operational, two (2) spare Category 6A UTP cables from each security junction box (SJB) to the telecommunication rooms shall be provided. The Security Systems Contractor shall provide space for and install an RJ-45 terminal block in the SJB, and install and test the cables as specified in 27 05 00.

J. Related documents included in the specification requirements :

1. Division 1 – General Requirements, All Sections (including but not limited to)

   Section 01 11 00 – Summary of Work

   Section 01 25 00 – Substitution Procedure

   Section 01 31 00 – Administrative Requirements

   Section 01 33 00 – Submittal

   Section 01 40 00 – Quality Requirements

   Section 01 43 00 – Quality Assurance

   Section 01 64 00 – LAWA Furnished Products

   Section 01 77 13 – Preliminary Closeout Reviews

   Section 01 77 16 – Final Closeout Review

   Section 01 78 00 – Closeout Submittals

2. Division 08 Openings Sections:

   Section 08 11 13 – Hollow Metal Doors and Frames

   Section 08 11 19 – Stainless Steel Doors and Frames

   Section 08 31 13 – Access Doors and Frames

   Section 08 33 23 – Overhead Coiling Doors

   Section 08 71 00 – Door Hardware

   Section 08 71 13 – Automatic Door Operators

3. Division 14 Conveying Equipment Section:

   Section 13 21 50 – APTA Heavy Duty Transit Type Machine Rm-Less Elevators

4. Division 26 Electrical

5. Division 27 Communications (including but not limited to):

   Section 27 05 00 - Basic Telecommunications Requirements

   Section 27 05 05 – Selective Demolition Telecommunication Systems

6. Division 28 Electronic Safety and Security

   Section 28 23 00 – Video Surveillance System (VSS)

   Section 28 31 00 – Fire Detection and Alarm

K. Products furnished (but not installed) under this section:

L. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. Abbreviations and Acronyms

1. ACAMS Access Control and Alarm Monitoring System
2. AFF Above Finish Floor
3. ANSI American National Standard Institute
4. ASCII American Standard Code for Information Interchange
5. AOA Aircraft Operations Area
6. ATP Acceptance Test Plan
7. AWG American Wire Gauge
8. BMS Balanced Magnetic Switch
9. CBP U.S. Customs and Border Protection
10. CPU Central Processing Unit
11. CCTV Closed Circuit Television
12. EMI Electromagnetic Interference
13. FAA Federal Aviation Administration
14. FAR Federal Aviation Regulation
15. IATA International Air Transport Association
16. ICAO International Civil Aviation Organization
17. ICEA Insulated Cable Engineering Association
18. IDS Intrusion Detection System
19. ISA Instrument Society of America
20. LAX IATA Symbol for the Los Angeles International Airport
21. LCC Life Cycle Costs
22. LED Light Emitting Diode
23. MHz Megahertz
24. MRT Mean Restoral Time – The mean interval between failure and restoral to operational status; includes MTTR travel time and response time.
25. MTBF Mean Time Between Failures – The mean interval that is the sum of MTTF and MRT.
26. MTTF Mean Time To Failure – The mean interval between placing a specific piece of equipment or system in service and its operational failure.
27. MTTR Mean Time To Repair – The mean interval during which the repair process is successfully performed.

28. O&M Operation and Maintenance
29. PoE Power Over Ethernet
30. PTZ Pan, Tilt, Zoom
31. QC Quality Control
32. REX Request to Exit
33. RFI Radio Frequency Interference
34. SCC Security Control Center
35. SCP Security Control Panel
36. SJB Security Junction Box
37. TBIT Tom Bradley International Terminal
38. TSA Transportation Security Administration
39. UBC Uniform Building Code
40. UPS Uninterrupted Power Supply
41. VDT Video Display Terminal
42. VSS Video Surveillance System

B. References

1. Comply with all applicable codes standards, regulations, and the most current issue of the following publications, including all amendments thereto of the issue that is current on the date of contract award. Applicable requirements of the following publications shall apply to the work under this specification as if fully written herein. Where conflicts exist between the Technical Specification and the referenced publications, local codes shall govern.

   a. American Standards Association (ASA)
   b. Institute of Electrical and Electronic Engineers (IEEE)
   c. National Fire Protection Association (NFPA)
   d. National Electrical Manufacturers Association (NEMA)
   e. Underwriters Laboratories, Inc. (UL)
   f. Federal, State and Municipal Building Codes and all other Authorities having jurisdiction
   g. National Electrical Code (NEC)
   h. Insulated Power Cable Engineers Association Specification (IPCEA)
   i. American Society for Testing Materials Specification (ASTM)
   j. Occupational Safety and Health Administration (OSHA)
   k. National Electrical Safety Code (NESC)

2. Special attention shall be made to the following specific codes, standards, and publications where applicable:
    a. ANSI B20.1 Conveyor Safety
    b. ASTM F.1468-93 Standard Practice For Evaluation
    c. Customs and Border Protection Airport Technical Design Standards for Passenger Processing Facilities, August 2006
    d. EIA 232-D Interface between Data Terminal Equipment and Data Circuit-Termination Equipment Serial Binary Data
    e. EIA RS-310-C Racks, Panel, and Associated Equipment
    f. 49 CFR 1520 Protection of Sensitive Security Information
    g. 49 CFR 1540 Civil Aviation Security General Requirements
    h. 49 CFR 1542 Airport Security
    i. 49 CFR 1544 Aircraft Operator Security
    j. 49 CFR 1546 Foreign Air Carrier Security
    k. 49 CFR 1548 Indirect Air Carrier Security. NFPA 72-D - Installations, Maintenance and Use of Proprietary Protective Signaling Systems
    l. NFPA 75 Protection of Electronic Computer Data Processing Equipment
    m. NFPA 77 Static Electricity
    n. NFPA 78 Lightning Protection Code
    o. Transportation Security Administration Recommended Security Guidelines for Airport Planning, Design and Construction, June 15, 2006
    p. UL 294 Access Control System Units
    q. UL 611 Central Station Burglar Alarm Units and Systems
    r. UL 634 Intrusion Detection Units
    s. UL 681 Installation and Classification of Mercantile and Bank Burglar Alarm Units
    t. UL 796 Electrical Printed-Wiring Boards
    u. UL 1076 Proprietary Burglar Alarm Units and Systems
    v. UL 1950 Information Technology Equipment, including Electrical Business Equipment References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.
3. In addition, the Security Systems Contractor shall comply with all applicable Security Directives as issued by the TSA.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. Action Submittals

1. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

2. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

3. Submit Manufacturers' Data:
   a. Security Control Panels.
   b. Card Reader devices.
   c. REX devices and related interfaces.
   d. Door alarm contacts and related interfaces.
   e. Alarm horns and related interfaces.
   f. Power supplies.
   g. Any other equipment installed as part of the system.

4. Product submittals shall be provided and approved prior to the commencement of installation activities of the ACAMS.

5. Submit all proposed labeling materials and nomenclature for approval.

6. Shop Drawings:
   a. Provide shop drawings that are applicable and pertain to access control and alarm system provisions.

7. Installation drawings:
   a. Floor Plans
   b. Riser Diagrams
   c. Block diagrams
   d. Door Details
   e. Point Schedules
   f. Connection of all new access control and alarm equipment with new Security Control Panels (SCPs), including block diagrams and wiring diagrams
   g. Connection of new SCPs with the existing access control CPU, including block diagrams and wiring diagrams
   h. Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding
   i. Details of surge protection device installation

j. Equipment mounting details

k. Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems

8. Coordination Drawings:

a. Indicate locations where space is limited for installation and access.

b. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.

c. Telecommunication Rooms: At least 30 days before beginning installation in each room, the Security Systems Contractor shall furnish a telecommunications room drawing showing the initial layout design and plans for the proposed mounting locations of ACAMS equipment, cable routings, and termination locations for all cable and equipment.

9. Theory of Operations

a. Description, analyses, and calculations used in sizing equipment. Describe and show how equipment will operate as a system.

10. Test and Acceptance Plans

a. Submit the following for review and approval prior to the performance of any testing:

1) Performance and Functionality Verification Test Plan (including interfaces)

2) Commissioning Test Plan

B. Project Record and Closeout Submittals

1. Project Record Documents required include:

a. Marked-up copies of Contract Drawings

b. Marked-up copies of Shop Drawings

c. Newly prepared Drawings

d. Marked-up copies of Specifications, Addenda and Change Orders

e. Marked-up Project Data submittals

f. Record Samples

g. Field records for variable and concealed conditions

h. Record information on Work that is recorded only schematically

i. As-built drawings

j. Record drawings

k. Electronic as-built and LAWA LUSAD requirements

2. As-built drawings:

a. In addition to the Project Record Drawing requirements set forth in Division 01 – General Requirements, As-built drawings shall fully document and be fully developed and provided, and shall include, but not be limited to:

1) Floor Plans.

2) Riser Diagrams.

3) Block diagrams.

4) Point-to point wiring diagrams.

5) Door Details.

6) Point Schedules.

7) Detail of connections to cameras, monitors, and workstations.

8) Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding.

9) Details of surge protection device installation.

10) Equipment mounting details.

11) Rack/Cabinet layout elevations and details, including heat and load calculations.

12) Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems.

b. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Engineer will periodically review Project Record Documents to assure compliance with this requirement.

3. Upon completion of the as built drawings, LAWA and the Design Engineer will review the as-built work with the Security Systems Contractor.

4. If the as built work is not complete, the Security Systems Contractor will be so advised and shall complete the work as required.

5. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

C. Maintenance Material Submittals

1. Submit Operations and Maintenance Manuals.

1.06 QUALITY ASSURANCE

A. Contractor Certification: The Security Systems Contractor or approved subcontractor shall be a GE/UTC certified security systems installer for the specific type of ACAMS equipment being installed. The Security Systems Contractor shall offer proof of certification by submitting a copy of certification with the Bid.

B. The Security Systems Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Engineer.

C. LAWA and the Design Engineer shall be notified by the Security Systems Contractor of any inspection(s) and LAWA and the Design Engineer may elect to participate in any inspection(s). Relevant QC information shall be input into LAWA CMMS (refer to paragraph 3.08).

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids specification requirements.

B. Under no circumstances shall LAWA be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Security Systems Contractor submits to Engineer all evidence to support the contention that the item proposed for substitution is equal to the specified item. LAWA's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Engineer is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Security Systems Contractor, or changes by the Security Systems Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Engineer is required to examine and evaluate any changes proposed by the Security Systems Contractor for the convenience of the Security Systems Contractor, then the Design Engineer's expenses in connection with such additional services shall be paid by the Security Systems Contractor and may be deducted from any moneys owed to the Security Systems Contractor.

1.08 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
2. Equipment shall meet all applicable FCC Regulations.
3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.
4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.09 DELIVERY, STORAGE AND HANDLING

1.10 FIELD/SITE CONDITIONS

A. Inspections

1. The Security Systems Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

2. The Security Systems Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

3. LAWA shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA.

B. General

1. The Security Systems Contractor shall employ the LAWA designated maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection or configuration of ACAMS or other existing systems that might be affected by this. Acceptance testing to commission the ACAMS devices into the Campus Production system shall be required to be performed.

2. Note that all programming and configuration of the Picture Perfect Software shall be done only by LAWA designated maintenance contractor, or by LAWA at its discretion. This scope of work shall include ACAMS programming and configuration required for the components and systems installed under this specification. The Security Systems Contractor shall secure the services of this specific LAWA designated maintenance contractor for this work at no cost to LAWA.
3. The Security Systems Contractor shall provide all new conduit, UTP cable, optical fiber cable, innerduct, racks, cabinets, patch panels, cover plates, outlet boxes, related hardware, distribution, termination equipment, and any other appurtenances and equipment associated specifically with ACAMS. Refer to Section 27 05 00 Basic Telecommunications.
4. The Security Systems Contractor shall obtain the approval of LAWA and the Design Engineer for the final layout of ACAMS equipment to be installed in telecommunications rooms prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation.
5. The Security Systems Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of LAWA.
6. The Security Systems Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Security Systems Contractor.
7. The Security Systems Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.
8. The Security Systems Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Security Systems Contractor shall be the single point of contact between the Security Systems Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.
9. While working in the facility, the Security Systems Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Security Systems Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment to and throughout the site.
10. The Security Systems Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Security Systems Contractor at its expense. If the Security Systems Contractor enters an area that has damage (not caused by the Contractor), the Security Systems Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.
11. Following each day’s work, the Security Systems Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

12. Deliver products to site under provisions of Division 01 - General Requirements.
13. Store and protect products under provisions of Division 01 - General Requirements.
14. Coordinate with LAWA, locations and requirements for equipment and product storage.

C. Site Conditions

1. Environmental Requirements:
   a. Comply with all manufacturers' instructions and recommendations concerning environmental factors.
2. Protection:
   a. Fragile Items:
      1) Handle any fragile items with care using protective coverings to avoid damage to sensitive instrument relays, and other devices, and to avoid contamination by dirt and debris.
   b. Weather and Construction Protection:
      1) During installation, provide adequate temporary dust and weather protection for all equipment. Reinstall covers each time any adjustments are made on the equipment.
3. Existing Conditions:
   a. Security Systems Contractor shall inspect the site and identify all existing security provisions and conditions. This includes identifying any communications and/or ancillary equipment currently existing and/or in use. It shall be the Security Systems Contractor's responsibility to identify all existing provisions to be terminated to new, existing, or relocated systems.
   b. All provisions shall be identified by the Security Systems Contractor and documented in the quality control inventory. Individual provision data such as provision type make and model, and serial number shall be obtained by the Security Systems Contractor at the time of demolition and documented in the quality control inventory.

1.11 WARRANTY

A. Warranty and Maintenance Requirements shall be in accordance with the Division 01 - General Requirements.

1. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of one (1) year from Final Acceptance.
   a. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

b. The Security Systems Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

2. Submit a copy of all manufacturer warranty information.

PART 2 - PRODUCTS

2.01 GENERAL

A. Unless otherwise specified, products for the ACAMS shall be consistent with and compatible with the established standards for LAWA ACAMS.

B. Latest technology available: Products shall be provided as specified. In the event the manufacturer(s) of specified products and materials have upgraded or replaced the specified products and materials with newer or improved technologies at the time of purchase, the newer or improved products or materials shall be provided unless they are incompatible with the rest of the ACAMS systems or so directed by LAWA (submit Request For Information if in doubt). Latest technology products and materials shall be operationally and functionally equivalent or superior to the specified products and materials. Products and materials shall be purchased by the Security Systems Contractor in a timely manner to meet construction schedules, but shall not be purchased so far advanced of the date(s) of installation that they become technologically obsolete or replaced with newer technologies.

C. Provide and install required cabling, connectors, patch cords, resister packs, terminators, and all other miscellaneous items required for a fully functional System.

D. ACAMS commissioning shall be conducted in accordance with LAWA ACAMS Commissioning Flow Chart.

E. In addition to any acceptance testing requirements specified elsewhere, the ACAMS shall be fully tested and accepted, with test results recorded individual test reports for LAWA review and acceptance. All ACAMS devices and equipment shall be tested. Test and acceptance reports shall include but not limited to:

1. Card reader controlled doors, including but not limited to:

   a Valid card read.
   b Invalid card read.
   c Valid request-to-exit.
   d Door forced open.
   e Door held open.
   f Door shunt.
   g Local alarm.

2. Alarm and monitor points.

3. ACAMS input and output interfaces.

4. ACAMS integration with VSS and cameras.

2.02 SYSTEM DESCRIPTION

A. The security related provisions for new Security Doors include access control, intrusion detection and duress/assistance alarm equipment, video surveillance cameras and recording equipment, and security system monitoring and control. All security measures are to be applied to interior and/or exterior locations as shown on the drawings. Wherever possible, unless specified elsewhere in the Specifications or Drawings, materials, equipment and installation shall conform to existing LAWA Standards for ACAMS system.

B. The access control system for LAWA is a GE Picture Perfect system. Security Control Panels (SCPs) shall be located in identified communications and electrical rooms throughout the terminal as indicated in the drawings.

C. The SCPs shall communicate to the existing GE Picture Perfect CPU and software system for monitoring and control. Communications between the GE Picture Perfect CPU shall be via the LAX data network utilizing full duplex Ethernet TCP/IP protocol.

D. Security system electrified door hardware included under this contract as specified in Section 08 71 00, Door Hardware shall be provided and installed by the door hardware Contractor. The Security Systems Contractor shall coordinate with the door hardware Contractor. It shall be the responsibility of the Security Systems Contractor to complete the low voltage electrical connections of the electrified door hardware.

E. Power supplies for electrified emergency egress panic door hardware (EPH) shall be provided and installed by the door hardware contractor, and shall be installed as indicated in the Security Door Details. The Security Systems Contractor shall provide the electrical connections between the electrified emergency egress panic door hardware and the EPH power supplies. The Security Systems Contractor shall coordinate with the door hardware contractor.

F. Doors, door frames and openings included under this contract as specified in the Division 08 specification sections shall be provided and installed by the door and door frame Contractor(s). The Security Systems Contractor shall coordinate with the door and door frame Contractor(s) for preparation of doors and frames for door position sensors, for wiring and conduit to and within frames, and for interfaces with door controllers for automatic door operators and overhead coiling doors.

G. The ACAMS integration with the VSS shall include, but not be limited to: automated PTZ camera positioning upon ACAMS alarms and events, automated camera call-up and display to VSS monitors upon ACAMS alarms and events, automatically initiate and/or adjust digital recording upon ACAMS alarms and events.

H. Two (2) spare Category 6a cables, 23 AWG, shall be installed from each ACAMS SJB to telecommunications room as indicated in the Telecommunications drawings. These cables shall be provided and installed by the telecommunications Contractor. The Security Systems Contractor shall coordinate with the telecommunications Contractor, and shall provide space in the SJB for the telecommunication Contractor to install an RJ-45 terminal block for the purpose of terminating and testing the spare Category 6a cables within the SJB.

I. Programming and configuration of GE Picture Perfect software shall be by LAWA designated ACAMS maintenance Contractor. This scope of work shall include ACAMS programming and configuration. The installing Security Systems Contractor shall secure the services of LAWA designated ACAMS maintenance Contractor for ACAMS programming and configuration at no additional cost to LAWA.

J. Contact information for LAWA designated ACAMS maintenance contractor:

Unisys Corporation

Benjamin C. Locke, Senior Contracts Manager
benjamin.locke@unisys.com
(703) 439-5270

K. All ACAMS equipment requiring building power shall be connected to building UPS or Emergency power circuits, as indicated in the drawings. The security systems Contractor shall coordinate with the electrical Contractor.

L. All equipment shall be installed in accordance with this specification. Provide and install any and all equipment necessary to provide a complete and operating system, and meet the full intent of this design and other specifications within these construction documents. Any equipment such as consumables, terminators, or any other materials or equipment needed to install this system shall be considered ancillary and be provided as a part of this project. Security Systems Contractor shall provide cable for all security systems and integration of sub-systems. Cable shall be provided in accordance with manufacturer specifications for the equipment it is terminating to.

2.03 ACAMS EQUIPMENT

A. Access Control Panel (and associated components as required):

1. GE M3000, with internal 12 VDC, 6 amp power supply (no substitutions)
2. Include GE PXN plus CPU board
3. Must be fully compatible with LAWA Picture Perfect Server Software at time of installation
4. Provide and install one (1) 12 Volt, 12 Amp Hour sealed gel type battery for each GE M3000

B. Card Reader Interface Module

1. GE 8RP model 110100501 (no substitutions)

C. Output interface module

1. Provide and install a minimum of one (1) per M3000, and as required to support outputs as indicated in the specifications and drawings
2. GE DOR model 110078001 or 110071001, no substitutions

D. Input interface module

1. Provide and install a minimum of one (1) per M3000, and as required to support inputs as indicated in the specifications and drawings
2. GE DI model 110072003 (no substitutions)

E. Wiegand Interface Unit

1. Provided and install as required to support card readers as indicated in the specifications and drawings
2. Install in SJBs located above (or near as approved by LAWA) ACAMS doors

3. GE model WIU-4 (no substitutions)

F. Power Supplies

1. Wall Mount

a) 24VDC Power

1) A minimum of one (1) 24VDC, 10 Amp Power Supply shall be provided for each GE M3000 Access control Panel, with no more than eight (8) doors (including one (1) electric lock and one (1) alarm horn per door) powered from a single wall mount 24VDC Power Supply

2) Each door shall be powered from a dedicated current protected output.

3) Provide and install two (2) 12 Volt, 12 Amp Hour sealed gel type batteries for each 24VDC Power Supply.

4) Altronix AL1024ULACM, or approved equal.

2. 12VDC Power

a) Provide as required for 12 volt devices not powered by other sources

b) Provide and install two (2) 12 Volt, 12 Amp Hour sealed gel type batteries for each 12VDC Device Power Supply

c) Altronix, AL1012ULACM, or approved equal

G. Card Reader Compatibility

1. Card Readers and Card Readers with Keypads shall be compatible with Federal Information Processing Standards Publication 201 (FIPS 201)

2. Card Readers and Card Readers with Keypads shall be compatible with LAX HID issued identification and access control cards, and shall be compatible HID 13.56 MHz Contactless Smart Card technologies.

H. Card Reader

1. HID model R40 (no substitutions)

2. The firmware shall support both HID I class and PIV card formats

I. Card Reader with Keypad

1. HID model RK40 (no substitutions)

2. The firmware shall support both HID I class and PIV card formats

J. Door Position Switches (Alarm Contacts)

1. Door Position Switches shall be compatible with the door style and door materials

2. Door Position Switches shall be magnetic activated and shall be flush mounted wherever possible

3. Flush Mount

a) GE 1078/1076 Series, or approved equal

4. Surface Mount

a) Surface mounted Door Position Switches shall be high security triple-biased devices.

b) GE 2700 Series, or approved equal

K. Alarm Horns

1. Alarm Horns shall be installed as indicated in the drawings

2. Alarm Horns shall be installed at a height and in a manner consistent with existing alarms horns installed in LAWA

a) Alarm Horns shall be connected to the output interface module provided in the door's associated GE M3000 access control panel

3. Interior Alarm Horns

a) System Sensor MHW, or approved equal

4. Exterior Alarm Horns

a) Cooper Notification model MID-DC, or approved equal

L. Audio/Visual Alarm Signals

1. Audio/Visual Alarm Signals shall be installed as indicated in the drawings. Audio/Visual Alarm Signals shall be installed at a height and in a manner consistent with existing alarms horns installed in LAWA.

2. Prior to the installation of the Audio/Visual Alarm Signals the Security Systems Contractor shall coordinate with LAWA and the CBP with respect to the selection of the color of the strobe lens and the tone and level of the audible alarm signal.

3. The Security Systems Contractor shall demonstrate to LAWA and the CBP a functional Audio/Visual Alarm Signal device, including all available colored strobe lens options.

a) Safety Technology, Inc. (STI) model SA5000 with back-box kit SUB-SA504, or approved equal

M. Duress alarm buttons

1. Mushroom Style

a) Mushroom Style Duress Alarm Buttons shall be installed as indicated in the drawings

b) Unless indicated otherwise, Mushroom Style Duress Alarm Buttons shall be wall mounted 42" AFF

c) Mushroom Style Duress Alarm Buttons shall be latching when activated and require key reset

d) Mounting plate shall be stainless steel

1) Alarm Controls model KR-1-1, or approved equal

N. SJB cabinet

1. Each secure door shall have at least one SJB located on the secure side above each door through which all wiring for that door shall be routed. It shall be used for the mounting of the WIUs and also the Category 6A UTP terminations, and any other equipment as appropriate. If the door is a double door or there are multiple doors in one location, this box may be shared. Any such sharing requires prior approval by the Engineer before installation. The boxes shall conform to:

    a) 16.00” x 16.00” x 6.62”, NEMA Type 1, hinged door. Provide with back panel and keyed cylinder lock

    b) Hoffman A16N16ALP, or approved equal

O. Wire and Cable

1. Low voltage wire and cable shall be provided and installed as required
2. Wire and cable shall be selected, sized and used as appropriate for the device application in accordance with the device manufacturer’s specifications, voltage and load, and distance of the wire/cable run
3. Wire and cable runs shall be “home run”
4. Mid run splices are not permitted
5. Wire and cable shall be Belden, West Penn, Contractors Wire and Cable, or approved equal

2.04 MATERIALS

A. Color and Finish Selection:

1. In all public areas and in all other areas visible from public areas or from the exterior of the building, colors and finishes shall match the custom color and finish samples on file with LAWA. In all other areas, applicable colors and finishes shall be selected by LAWA from the manufacturer’s standard color and finish schedule. For such areas, submit manufacturer’s standard color and finish schedule(s).

2.05 UPS

A. All equipment will be powered by a UPS with a capability to support operations for at least four hours after supply power loss. All power will be obtained from emergency power sources.

2.06 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 3 - EXECUTION

3.01 GENERAL

A. Provide and install and make fully operational all components required for a fully functional system.

B. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

C. Security Systems Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein. Where undefined by codes and standards, Security Systems Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with LAWA and the Design Engineer the exact location and mounting height of all equipment in finished areas.

E. The Security Systems Contractor shall use existing conduit and surface raceway where possible and practicable. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, Engineer shall be notified before starting that part of the work. In areas with no ceilings, install only after LAWA and Design Engineer reviews and comments on arrangement and appearance.

F. Where required, the Security Systems Contractor shall be responsible for cutting, patching, coring and associated work for the system at no additional cost to LAWA. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

G. All conduit and sleeve openings used by the Security Systems Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

H. The Security Systems Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations devices to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

I. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

J. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed. The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.

2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire stop seal between sleeve and wall for drywall construction.

3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.

4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:

   a Floors – three (3) hours

   b Corridor walls – two (2) hours

   c Offices – three-quarters (0.75) hour

   d Smoke partitions – three-quarters (0.75) – one (1) hour

5. Provide fire stop pillows for existing cable tray penetrations through firewalls.

K. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

3.02 EXAMINATION

A. Inspect the jobsite and survey the conditions to be encountered during performance of the work. This shall be accomplished prior to starting the work. Failure of Security Systems Contractor to become familiar with the site conditions shall not relieve Security Systems Contractor of responsibility for full completion of the work in accordance with the contract provisions.

B. Verify that all conduit, wires, cables, security equipment are installed and ready for connection and integration with the rest of the system.

C. Examine area to be protected and verify that environmental characteristics will not affect effective communication and interfacing. Report observed problems in writing.

D. Determine that power supplies, conduit, wires, cables, connections, and equipment are ready for installation and interfacing before attempting installation.

E. Check all power and communications cabling for continuity before making connections.

F. Visually inspect each piece of equipment, determine defects, and correct.

G. Make arrangements through LAWA and inspect locations where installation work will be performed. Verify that conditions found are in accordance with drawings and are acceptable for Security Systems Contractor's installation work. Report any discrepancies in writing to

LAWA, stating suggested means of correction. As may be required, inspect existing inside and outside cable plant to determine system runs and interface conditions. Coordinate with LAWA to establish interfaces.

3.03 INSTALLATION

A. Compliance:

1. Install the equipment in accordance with the contract documents, all applicable codes and standards and the Manufacturer's written instructions. The installed system shall meet all applicable equipment and performance requirements.

B. Standardization:

1. Standardize the installation practices and material to provide uniform materials and procedures to the maximum extent possible.

C. Locations:

1. Locate pull boxes, wire-ways or other items requiring inspection, removal, or replacement conveniently and accessibly with reference to the finished facilities.

D. Electrical Service:

1. Installation of electrical service to equipment shall conform to specific UBC Codes and Standards, NFPA 70, and other applicable requirements.

E. Electrical Equipment Inspection:

1. Provide electrical equipment inspection in accordance with NEMA PB 2.1 Part VII.

F. Installation Requirements:

1. Install all system components, including furnished equipment, and appurtenances in accordance with the manufacturer's instructions, and as shown, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.
2. Install the security system equipment in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type.
3. All wiring, including low voltage wiring outside the control console, cabinets, boxes, and similar enclosures, shall be installed in rigid galvanized steel conduit conforming to UL 6 (when outdoors), or electric metallic tubing (EMT) when indoors. Minimum conduit size shall be 3/4-inch. All other electrical work shall be as specified with electrical specifications and drawings that are part of the contract document and as shown. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

4. Detailed shop drawings shall be provided as part of the submittal process. The shop drawings shall include, but not be limited to exposed conduit and devices, including hangars, brackets, back boxes and related equipment.
5. All equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall meet the requirements of ANSI C62.41. Fuses shall not be used for surge protection.
6. All inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit.
7. All cables and conductors, except fiber-optics, which serve as communications circuits from the existing access control CPU to field equipment, and between field equipment, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two wave-forms:
   a) A 10 microsecond rise time by 1000 microsecond pulse width wave-form with a peak voltage of 1500 volts and a peak current of 60 amperes.
   b) An 8 microsecond rise time by 20 microsecond pulse width wave-form with a peak voltage of 1000 volts and a peak current of 500 amperes.
8. Calibrate all equipment.
9. Inspect each component, determine obvious defects, and correct.
10. All electrical work shall be in accordance Division 26.
11. All wiring and terminations shall be performed in accordance with Division 27, Section 27 05 00 Basic Telecommunications.
12. Perform tests as recommended by manufacturer or as required to ensure the ACAMS equipment is operating properly and meets specified requirements.
13. Correct all deficiencies detected and retest affected components.
14. Record test data, tabulate, and write narrative describing tests, results, deficiencies found, corrective measures, and results of retesting. Certify that the security equipment has been tested and is ready for performance verification testing.
15. Service Loops
    a) Service loops shall be provided for all ACAMS cabling within the Telecommunication Rooms. Service loops shall be of sufficient length to facilitate relocating wall mounted ACAMS control panels and power supplies to the Security racks without splices. Service loops shall be coiled and contained in appropriately sized pull boxes.

3.04 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Security Systems Contractor shall confirm specific labeling requirements with LAWA and the Design Engineer prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. Marking:

1. Equipment Name Plates: The following requirements shall apply:

   a) General: Attach a permanent, corrosion-resistant name plate to each equipment component showing the manufacturer's name, address, serial number and equipment rating. Each name plate shall be clearly visible on the exterior of equipment. Components located within equipment enclosures shall also be provided with name plates.

   b) Location and Fastening: Provide nameplates to identify all equipment components. Provide each panel assembly with a name plate on the interior of equipment enclosures, indicating number of equipment and unit of assembly. Fasten name plates securely with slotted stainless steel screws. The use of adhesive for fastening name plates will not be permitted.

2. Control and Display Labels:

   a) Use: Each control, display and any other item of equipment that must be located, identified, read or manipulated shall be appropriately and clearly labeled to permit rapid and accurate identification of its operating state of position.

   b) Orientation: Orient labels and information thereon horizontally so that they may be read quickly and easily. Vertical orientation shall be used only where space is limited.

3. Locations: Locate labels so that there is no confusion as to which item they identify. Labels shall not obscure any other information required by the operator. Controls shall not obscure labels. The location of labels shall be consistent.

E. Use Permanent Room Numbers as indicated on the Room Finish Schedules for construction period identification of rooms and building spaces. All required shop drawings and submittals, including manuals and Project Record Drawings shall identify rooms and spaces using the Permanent Room Numbers. Permanent identification devices including signage, equipment nameplates, and panels shall use the Permanent Room Numbers.

3.05 STARTUP

A. The Security Systems Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.

2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

3. System wiring has been tested and verified as correctly connected as indicated.

4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.
6. Satisfaction of the above requirements shall not relieve the Security Systems Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.06 QUALITY CONTROL, TESTING AND ACCEPTANCE

A. Test, Commission and Acceptance

1. Conduct an Installation Test and total Acceptance Test upon completion of equipment installation. Testing shall be coordinated as necessary, to demonstrate that all interfaces have been successfully implemented.

2. Installation and Acceptance Test Procedures and Reports:

a General: Installation and acceptance tests shall be conducted in the normal operational environment to the maximum extent possible. The tests shall represent operation in the normal mode in which each system will operate. If interfaces are incomplete, provide simulation of those interfaces so that the system may be tested as a complete and stand-alone entity. Perform all equipment repair and/or adjustment that may be required during acceptance testing.

b. All ACAMS devices and equipment / systems shall be tested. Test and acceptance reports shall include, but not be limited to:

1) Card reader controlled doors, including but not limited to:
a) Valid card read
b) Invalid card read
c) Valid request-to-exit
d) Door forced open
e) Door held open
f) Door shunt
g) Local alarm

2) Alarm and monitor points

3) ACAMS input and output interfaces

4) ACAMS integration with VSS and cameras

c. Availability Tests: Installation and acceptance testing shall include conducting individual availability tests for each equipment item. Requirements for availability tests are as follows:

1) Availability shall be determined in accordance with Quality Control procedures, except for the test duration as specified herein.

2) The availability tests shall consist of the equipment being operated as a complete stand-alone entity with the exception that incomplete interfaces may be

simulated. In all other respects, the equipment shall be operated in the mode that would normally prevail.

3) The duration of each availability test, as a minimum, shall consist of a 5 day period with the availability ratios of 100% being met or exceeded over the total period.

d. System Commissioning:

1) General: Security Systems Contractor shall be responsible for ensuring that the installation and related interfaces is completed and operational at least thirty (30) days prior to scheduled beneficial occupancy. In the event the installation and related interfaces is not completed and operational by the scheduled beneficial occupancy date, Security Systems Contractor shall establish and submit a security plan to LAWA that complies with FAR Part 107.14 and related LAWA security requirements. The security plan shall be submitted to LAWA and FAA for approval. The security plan, revisions, and security measures to be deployed until such time the new security equipment is completed and operational shall be at Security Systems Contractor's expense.

2) After all installation and acceptance test requirements specified have been complied with, the equipment shall be commissioned. After commissioning has been completed, LAWA will take possession of the equipment and utilize it in accordance with the conditions described in the contract documents.

3) Prerequisites To System Commissioning:

a) Outstanding work items that may exist, such as facility interfaces, project record drawings, and/or in-process change orders, shall be documented and submitted to LAWA for review prior to start of equipment commissioning. Documentation of outstanding work items shall take the form of punch lists of critical action items lists that describe the work, the expected completion schedule, and the impact upon operation. Depending upon the nature of the outstanding work item, LAWA may grant a waiver to accomplish partial commissioning of any of the equipment. Completion of waived outstanding work items shall then be assigned to the post-commissioning operations and maintenance.

b) Preliminary testing of ACAMS devices, including but not limited to access controlled door devices, control panels and alarm monitor devices, shall be conducted and witnessed by LAWA on a separate Picture Perfect server/workstation platform prior to activation and commissioning of the ACAMS devices on the existing LAWA production Picture Perfect server. The test Picture Perfect platform shall be provided by the Security Systems Contractor.

4) Commissioning Procedure

a) The commissioning procedure shall be witnessed by LAWA. The commissioning procedure shall be conducted by Security Systems Contractor and shall consist of a detailed inspection, and physical accounting of each equipment item. An operational demonstration shall then be conducted in which the equipment shall function in the normal operational mode, and shall operate completely error-free in terms of hardware and software performance. Occurrence of any equipment failure shall terminate the demonstration. The demonstration shall restart and run for a period of time designated by LAWA after the failure has been corrected. Except for any outstanding work items as previously described, this shall complete the commissioning procedure.

3.07 CLEANING

3.08 COMPUTERIZED MAINTENANCE

A. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule and other pertinent data will be stored in the CMMS database. Security Systems Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.09 CLOSEOUT ACTIVITIES – FINAL INSPECTION AND ACCEPTANCE

A. Completion of successful installation, final tests and commissioning, receipt of the test reports and as-built documentation including data input into the CMMS and successful performance of the installed equipment / system for a thirty (30) day period will constitute Final Acceptance.

3.10 MAINTENANCE

END OF SECTION 28 13 00

SECTION 28 23 00 – VIDEO SURVEILLANCE SYSTEM (VSS) (Cameras)

PART 1 - GENERAL

1.01 SUMMARY

A. This section specifies the minimum requirements for video surveillance camera equipment. The video surveillance systems and equipment specified in this section shall be an extension to the video surveillance system (VSS) currently deployed throughout the Los Angeles World Airport (LAWA). Refer to Section 28 23 13 for Video Surveillance Storage and Recording Management System.

B. Security Systems Contractor shall include in the Bid all labor, materials, tools, plant, transportation, storage costs, installation, programming, configuration, testing, commissioning, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational equipment / systems shown and described in the Specifications.

C. The Security Systems Contractor is responsible for providing and coordinating final equipment arrangements, locations, phased activities and construction methods that minimize disruption to operations and provide complete and operational systems.

D. The standard CCTV cameras to be installed throughout the airport are by Axis® Communications Inc. These cameras communicate with the central video management system via Internet protocol (IP) Ethernet communication over the Airport multiprotocol label switching (MPLS) data network.

E. The installation of video surveillance cameras and related equipment shall include the use of both fixed and Pan/Tilt/Zoom (PTZ) color cameras.

F. LAWA Access Control and Monitoring System (ACAMS) has a linkage between alarms and video. If this functionality is selected for a location on the drawings then the Security Systems Contractor shall cooperate with the LAWA or LAWA designated ACAMS contractor (Section 28 13 00), and LAWA video maintenance contractor, to set up the linkage between the two systems and the camera.

G. Related Documents included in the Specification Requirements.

1. Division 1 – General Requirements, All Sections (including but not limited to)

   Section 01 11 00 – Summary of Work

   Section 01 25 00 – Substitution Procedure

   Section 01 31 00 – Administrative Requirements

   Section 01 33 00 – Submittal

Section 01 40 00 – Quality Requirements

Section 01 43 00 – Quality Assurance

Section 01 64 00 – Owner Furnished Products

Section 01 77 13 – Preliminary Closeout Reviews

Section 01 77 16 – Final Closeout Review

Section 01 78 00 – Closeout Submittals

2. Division 14 Conveying Equipment Section:

   Section 13 21 50 – APTA Heavy Duty Transit Type Machine Room-Less Elevators

3. Division 27 Communications (including but not limited to):

   Section 27 05 00 - Basic Telecommunications Requirements

   Section 27 21 00 – Local Area Network

4. Division 28 Electronic Safety and Security

   Section 28 13 00 – Access Control and Monitoring System (ACAMS)

   Section 28 23 13 – Video Surveillance Storage and Recording Management System

H. Products furnished (but not installed) under this section:

I. Products installed (but not furnished) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. ABBREVIATIONS AND ACRONYMS

ACAMS	Access Control and Alarm Monitoring System
AFF	Above Floor Finish
ANSI	American National Standard Institute
ASCII	American Standard Code for Information Interchange
AOA	Aircraft Operations Area
ATP	Acceptance Test Plan
AWG	American Wire Gauge
BMS	Balanced Magnetic Switch
CBP	U.S. Customs and Border Protection
CPU	Central Processing Unit
CCTV	Closed Circuit Television
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
IATA	International Air Transport Association

ICAO	International Civil Aviation Organization
ICEA	Insulated Cable Engineering Association
IDS	Intrusion Detection System
ISA	Instrument Society of America
LAX	IATA Symbol for the Los Angeles International Airport
LCC	Life Cycle Costs
LED	Light Emitting Diode
MHz	Megahertz
MRT	Mean Restoral Time – The mean interval between failure and restoral to operational status; includes MTTR travel time and response time
MTBF	Mean Time Between Failures – The mean interval that is the sum of MTTF and MRT
MTTF	Mean Time To Failure – The mean interval between placing a specific piece of equipment or system in service and its operational failure
MTTR	Mean Time To Repair – The mean interval during which the repair process is successfully performed
O&M	Operations and Maintenance
PoE	Power Over Ethernet
PTZ	Pan, Tilt, Zoom
QC	Quality Control
REX	Request to Exit
RFI	Radio Frequency Interference
SCC	Security Control Center
SCP	Security Control Panel
SJB	Security Junction Box
TBIT	Tom Bradley International Terminal
TSA	Transportation Security Administration
UBC	Uniform Building Code
UPS	Uninterrupted Power Supply
VDT	Video Display Terminal
VSS	Video Surveillance System

B. CODES, STANDARDS, REGULATIONS AND REFERENCES

1. Comply with all applicable codes standards, regulations, and the most current issue of the following publications, including all amendments thereto of the issue that is current on the date of contract award. Applicable requirements of the following publications shall apply to the work under this specification as if fully written herein. Where conflicts exist between the Technical Specification and the referenced publications, local codes shall govern.

   a. American Standards Association (ASA)

   b. Institute of Electrical and Electronic Engineers (IEEE)

   c. National Fire Protection Association (NFPA)

   d. National Electrical Manufacturers Association (NEMA)

e. Underwriters Laboratories, Inc. (UL)

f. Federal, State and Municipal Building Codes and all other Authorities having jurisdiction

g. National Electrical Code (NEC)

h. Insulated Power Cable Engineers Association Specification (IPCEA)

i. American Society for Testing Materials Specification (ASTM)

j. Occupational Safety and Health Administration (OSHA)

k. National Electrical Safety Code (NESC)

2. Special attention shall be made to the following specific codes, standards, and publications where applicable:

a. ANSI B20.1 Conveyor Safety

b. ASTM F.1468-93 Standard Practice For Evaluation

c. Customs and Border Protection Airport Technical Design Standards for Passenger Processing Facilities, August 2006

d. EIA 232-D Interface between Data Terminal Equipment and Data Circuit-Termination Equipment Serial Binary Data

e. EIA RS-310-C Racks, Panel, and Associated Equipment

f. 49 CFR 1520 Protection of Sensitive Security Information

g. 49 CFR 1540 Civil Aviation Security General Requirements

h. 49 CFR 1542 Airport Security

i. 49 CFR 1544 Aircraft Operator Security

j. 49 CFR 1546 Foreign Air Carrier Security

k. 49 CFR 1548 Indirect Air Carrier Security. NFPA 72-D - Installations, Maintenance and Use of Proprietary Protective Signaling Systems

l. NFPA 75 Protection of Electronic Computer Data Processing Equipment

m. NFPA 77 Static Electricity

n. NFPA 78 Lightning Protection Code

o. Transportation Security Administration Recommended Security Guidelines for Airport Planning, Design and Construction, June 15, 2006

p. UL 294 Access Control System Units

q. UL 611 Central Station Burglar Alarm Units and Systems

r. UL 634 Intrusion Detection Units

s. UL 681 Installation and Classification of Mercantile and Bank Burglar Alarm Units

t. UL 796 Electrical Printed-Wiring Boards

u. UL 1076 Proprietary Burglar Alarm Units and Systems

v. UL 1950 Information Technology Equipment, including Electrical Business Equipment References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

3. In addition the Security Systems Contractor shall comply with all applicable Security Directives as issued by the TSA.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Action Submittals:

1. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.

2. Submit Manufacturers' Data:
   a. Cameras
   b. Power supplies
   c. Patch panels

3. Product submittals shall be provided and approved prior to the commencement of installation activities of the VSS.

4. Submit all proposed labeling materials and nomenclature for approval.

5. Shop Drawings - Provide shop drawings that are applicable and pertain to CCTV system provisions

6. Installation drawings:
   a. Floor Plans
   b. Riser Diagrams
   c. Block diagrams
   d. Camera Details
   e. Point Schedules
   f. Connection of all new CCTV cameras with their associated junction boxes including block diagrams and wiring diagrams

g. Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding

h. Details of surge protection device installation

i. Equipment mounting details

j. Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems

7. Coordination Drawings

   a. Indicate locations where space is limited for installation and access.

   b. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.

   c. Telecommunication Rooms: At least 30 days before beginning installation in each room, the Contractor shall furnish a telecommunications room drawing showing the initial layout design and plans for the proposed mounting locations of VSS equipment, cable routings, and termination locations for all cable and equipment.

8. Theory of Operations

   a. Description, analyses, and calculations used in selecting equipment. Describe and show how equipment will operate as a system.

9. Test and Acceptance Plans

   a. Submit the following for review and approval prior to the performance of any testing:

      1) Performance and Functionality Verification Test Plan (including interfaces).

      2) Commissioning Test Plan.

C. Maintenance Manuals

1. Operation and Maintenance Manuals: Manuals including maintenance instructions and other descriptive material as received from the manufacturers shall be provided that will enable LAWA personnel to maintain equipment and test equipment. This documentation shall include descriptions, specifications, theory of operation (where applicable), layout drawings (showing component types and positions), and back-panel and assembly wiring diagrams. In addition to hardcopies, electronic copies, in a LAWA approved format, shall be provided.

2. Preventative Maintenance: Instructions shall be provided for preventive maintenance procedures that include examinations, tests, adjustments, and periodic cleaning. The manuals shall provide guidelines for isolating the causes of hardware malfunctions and for localizing faults. The manuals shall provide thorough instructions on the use of any specialized test equipment needed for hardware maintenance. In addition to hardcopies, electronic copies, in a LAWA approved format, shall be provided.

3. Maintenance Schedule: A recommended schedule for preventative, routine, and emergency maintenance indicating frequency and required response time. Preventative maintenance services during peak activity periods shall be avoided. The Security Systems Contractor shall coordinate with LAWA to define peak activity periods. The Security Systems Contractor shall submit a finalized preventative maintenance schedule for LAWA IT approval.

D. Closeout Submittals

1. Project Record Documents required include:
    a. Marked-up copies of Contract Drawings
    b. Marked-up copies of Shop Drawings
    c. Newly prepared Drawings
    d. Marked-up copies of Specifications, Addenda and Change Orders
    e. Marked-up Project Data submittals
    f. Record Samples
    g. Field records for variable and concealed conditions
    h. Record information on Work that is recorded only schematically
    i. As-built drawings
    j. Record drawings
    k. Electronic as-built and LAWA LUSAD requirements

2. As-built drawings:
    a. In addition to the Record Drawing requirements set forth in Division 01 – General Requirements, As-built drawings shall fully document and be fully developed and provided, and shall include, but not be limited to:
        1) Floor Plans
        2) Riser Diagrams
        3) Block diagrams
        4) Point-to point wiring diagrams
        5) Door Details
        6) Point Schedules
        7) Detail of connections to cameras, monitors, and workstations
        8) Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding
        9) Details of surge protection device installation

10) Equipment mounting details

11) Rack/Cabinet layout elevations and details, including heat and load calculations

12) Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems

3. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. LAWA IT will periodically review Project Record Documents to assure compliance with this requirement.

4. At every quarter, submit Project Record Documents for LAWA's records.

5. Upon completion of the as built drawings, LAWA IT / Design Engineer will review the as built work with the Security Systems Contractor.

6. If the as built work is not complete, the Security Systems Contractor will be so advised and shall complete the work as required.

7. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.06 QUALITY ASSURANCE

A. Contractor Certification: The Security Systems Contractor or approved subcontractor shall be an Axis and Pelco (as appropriate) certified security system installer for the specific type of VSS field equipment being installed. The Security Systems Contractor shall offer proof of certification by submitting a copy of certification with the Bid.

B. The Security Systems Contractor’s Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with LAWA’s and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to LAWA and the Design Engineer.

C. LAWA IT and the Design Engineer shall be notified by the Security Systems Contractor of any inspection(s) and LAWA IT and the Design Engineer may elect to participate in any inspection(s). Relevant QA information shall be input into LAWA CMMS (refer to Paragraph 3.09).

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids specification requirements.

B. Under no circumstances shall LAWA IT, or the Design Engineer be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Security Systems Contractor submits to LAWA IT all evidence to support the contention that the item proposed for substitution is equal to the specified item. LAWA's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that LAWA IT and/or the Design Engineer is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Security Systems Contractor, or changes by the Security Systems Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if LAWA IT and the Design Engineer are required to examine and evaluate any changes proposed by the Security Systems Contractor for the convenience of the Security Systems Contractor, then the Design Engineer's expenses in connection with such additional services shall be paid by the Security Systems Contractor and may be deducted from any moneys owed to the Security Systems Contractor.

D. If the deviation is not approved by LAWA IT it remains the Security Systems Contractor's responsibility to provide what is required in the Contract Documents

1.08 DELIVERY, STORAGE AND HANDLING

1.09 FIELD / SITE CONDITIONS

A. General

1. The Security Systems Contractor shall inspect the jobsite and survey the conditions to be encountered during performance of the work. This shall be accomplished prior to starting the work. Failure of the Security Systems Contractor to become familiar with the site conditions shall not relieve Security Systems Contractor of responsibility for full completion of the work in accordance with the contract provisions.

2. The Security Systems Contractor shall employ the maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection or configuration of VSS or other existing systems that might be affected by this Work.

3. Programming and configuration of the central VSS system shall be by LAWA designated CCTV maintenance contractor. This scope of work shall include CCTV programming and configuration (Refer to Section 28 23 13). The installing Security Systems Contractor shall secure the services of LAWA designated CCTV maintenance contractor for CCTV programming and configuration for this work at no additional cost to LAWA.

4. The Security Systems Contractor shall provide all new UTP cable, optical fiber cable, innerduct, racks, cabinets, patch panels, cover plates, outlet boxes, related hardware,

distribution, termination equipment, and any other appurtenances and equipment associated specifically with the VSS.

5. The Security Systems Contractor shall obtain the approval of LAWA IT for the final layout of VSS equipment to be installed in telecommunications rooms prior to the installation of any materials or equipment. Shop drawings showing proposed room layouts shall be submitted for approval before beginning installation

6. The Security Systems Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of LAWA.

7. The Security Systems Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Security Systems Contractor.

8. The Security Systems Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

9. The Security Systems Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Security Systems Contractor shall be the single point of contact between the Security Systems Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

10. While working in the facility, the Security Systems Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Security Systems Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment to and throughout the site.

11. The Security Systems Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Security Systems Contractor at its expense. If the Security Systems Contractor enters an area that has damage (not caused by the Security Systems Contractor), the Security Systems Contractor shall immediately bring this to the attention of LAWA IT so the area can be appropriately noted.

12. Following each day's work, the Security Systems Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

13. Deliver products to site under provisions of Division 01 - General Requirements.

14. Store and protect products under provisions of Division 01 - General Requirements.

15. Coordinate with LAWA IT, locations and requirements for equipment and product storage.

B. Site Conditions

1. Environmental Requirements:

a. Comply with all manufacturers' instructions and recommendations concerning environmental factors.

2. Protection:

a. Fragile Items:

1) Handle any fragile items with care using protective coverings to avoid damage to sensitive instrument relays, and other devices, and to avoid contamination by dirt and debris.

b. Weather and Construction Protection:

1) During installation, provide adequate temporary dust and weather protection for all equipment. Reinstall covers each time any adjustments are made on the equipment.

3. Existing Conditions:

a. Security Systems Contractor shall inspect the site and identify all existing security provisions and conditions. This includes identifying any communications and/or ancillary equipment currently existing and/or in use. It shall be the Security Systems Contractor's responsibility to identify all existing provisions to be terminated to new, existing, or relocated systems.

b. All provisions shall be identified by the Security Systems Contractor and documented. Individual provision data such as provision type make and model, and serial number shall be obtained by the Security Systems Contractor at the time of demolition and documented in the quality control inventory.

1.10 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

2. Equipment shall meet all applicable FCC Regulations.

3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.

4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.

5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.11 WARRANTY AND MAINTENANCE

A. Warranty and Maintenance Requirements shall be in accordance with the Division 01 - General Requirements.

B. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of two (2) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

2. The Security Systems Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

C. Submit a copy of all manufacturer warranty information.

D. Spare Parts:

1. The Security Systems Contractor shall provide to LAWA an inventory of security equipment spare parts, materials, consumables, and any other system item in order to meet the specified warranty maintenance requirements and keep the security equipment in a continuous operational mode during the warranty period. The quantity of spare parts shall equal no less that 10% of the items provided and installed under this contract.

PART 1 - PRODUCTS

2.01 GENERAL

A. Unless otherwise specified, products for the VSS shall be consistent with and compatible with the established standards for LAX VSS.

B. Latest technology available: Products shall be provided as specified. In the event the manufacturer(s) of specified products and materials have upgraded or replaced the specified products and materials with newer or improved technologies at the time of purchase, the newer or improved products or materials shall be provided unless they are incompatible with the rest of the VSS systems, or so directed by LAWA (submit Request For Information if in doubt). Latest technology products and materials shall be operationally and functionally equivalent or superior to the specified products and materials. Products and materials shall be purchased by the Security Systems Contractor in a timely manner to meet construction schedules, but shall not be purchased so far advanced of the date(s) of installation that they become technologically obsolete or replaced with newer technologies.

C. All cameras shall be IP camera technology and connect to LAWA provided communication IP switches as indicated in the specifications and drawings. The Security Systems Contractor shall be required to coordinate with LAWA. This includes, but is not limited to, MPLS assignments.

D. Where possible, all CCTV cameras shall be capable of being powered by power over Ethernet (PoE) technology. PoE power for cameras shall originate from the network switches.

E. All cameras shall use unshielded twisted pair (UTP) cable for signal transport. Camera video signals and power shall be via the same cable where possible. Cameras that require greater power than can be provided by the standard 802.3af PoE provided by LAWA network switches, shall be powered by centralized rack mounted high power PoE power injectors or centralized rack mounted CCTV power supplies where possible. In the event that a specific camera cannot be powered by PoE then a separate design proposal shall be submitted to LAWA IT for approval prior to installation.

F. If a CCTV camera is at a location which cannot conveniently be supported by an IP connection over Category 6A UTP cable, then fiber is an acceptable alternative communication mechanism. However, each such installation requires proper approval of approach and products by LAWA IT before installation.

G. Category 6A cables, 23 AWG, shall be installed from each camera back to the Telecom Room.

H. All Video related equipment requiring building power shall be connected to building UPS circuits.

I. Programming, configuration, and integration of the cameras into the VSS System shall be by LAWA designated CCTV maintenance contractor. The installing Security Systems Contractor shall secure the services of LAWA designated CCTV Maintenance contractor for CCTV programming, configuration and integration at no additional cost to LAWA.

J. Contact information for LAWA designated CCTV maintenance contractor:

Direct A/V
Lawrence M. Frontino, President
lfrontino@directavla.com
310.676.4100

K. Included in the programming and configuration shall be the assignments of the cameras to stakeholder user groups. The Security Systems Contractor shall coordinate with LAWA for the purpose of finalizing user groups, and shall include at no additional cost to the Owner up to four(4) camera assignments to site and user groups per camera.

L. Security Systems Contractor shall import drawings of the camera locations into the VSS application. Security Systems Contractor shall import AutoCAD drawings and remove all layers except the basic floor plan. Floor plans shall be such that the stakeholder can view an entire section for each level (i.e. north concourse - one drawing per level, south concourse - one drawing per level). Security Systems Contractor to work with LAWA to identify the most suitable amount of area per concourse/level that can be displayed on the monitor. Security Systems Contractor shall coordinate with LAWA IT to ensure that drawings imported provide stakeholders the ability to select cameras and view live images from the imported drawings/floor plan and that the floor plans reflect the areas effectively.

M. All equipment shall be installed in accordance with this specification. Provide and install any and all equipment necessary to provide a complete and operating system, and meet the full intent of this design and other specifications within these construction documents. Any equipment such as consumables, terminators, or any other materials or equipment needed to install this system shall be considered ancillary and be provided as a part of this project. Security Systems Contractor shall provide cable for all security systems and integration of sub-systems. Cable shall be provided in accordance with manufacturer specifications for the equipment it is terminating to.

2.02 VSS CAMERA EQUIPMENT

A. Camera Compatibility:

1. Cameras shall be compatible with LAWA's VSS System

B. PTZ Dome Cameras, Interior:

1. Mounting options shall include:

   a. Ceiling Surface Mount
   b. Ceiling Flush Mount
   c. Pendant Mount
   d. Wall / Column Mount

2. Digital Video Compression methods supported shall include:

   a. H.264

b. Motion JPEG

3. Video Resolutions shall include:

   a. 4CIF
   b. 2CIF
   c. CIF
   d. QCIF

4. Frame Rate shall be capable of no less than thirty (30) images per second for all required Digital Video Compression methods and all required Video Resolutions

5. Video Streams: A minimum of three (3) simultaneous video streams shall be supported

6. Preset Positions: A minimum of one-hundred (100) PTZ presets shall be supported

7. Pan Movement:

   a. 360° continuous pan rotation.

   b. 0.03° to 300° per second, minimum

8. Tilt Movement:
   a. 180°, minimum
   b. 0.03° to 300° per second, minimum
   c. Image shall auto-flip 180° at the bottom of the tilt travel

9. Zoom Capability: 4.7 ~ 84.6mm 18x optical zoom, minimum with 12x digital zoom minimum

10. Iris Control: Automatic with manual override

11. Auto Focus shall be supported

12. Dome: Dome color shall be “smoked” and shall induce a maximum light attenuation of 0.5 f-stop light loss

13. Axis model P5534, or approved equal

C. PTZ Dome Cameras, Exterior:

1. Mounting options shall include:

   a. Wall / Column Mount

   b. Parapet Mount

2. Day / Night Functionality: Automatic Day / Night functionality shall be supported.

3. Minimum Illumination
   a. Color: 0.5 lux at 30 IRE
   b. Black and White: 0.008 lux at 30 IRE

4. Digital Video Compression methods supported shall include:
   a. H.264
   b. Motion JPEG

5. Video Resolutions shall include:
   a. 4CIF
   b. 2CIF
   c. CIF
   d. QCIF

6. Frame Rate shall be capable of no less than thirty (30) images per second for all required Digital Video Compression methods and all required Video Resolutions.

7. Video Streams: A minimum of three (3) simultaneous video streams shall be supported.

8. Preset Positions: A minimum of one-hundred (100) PTZ presets shall be supported, with a minimum accuracy of 0.5°.

9. Pan Movement:
   a. 360° continuous pan rotation.
   b. 0.05° to 450° per second, minimum

10. Tilt Movement:
    a. 220°, minimum
    b. 0.05° to 450° per second, minimum
    c. Image shall auto-flip 180° at the bottom of the tilt travel

11. Zoom Capability: 3.4 ~ 119mm 35x optical zoom, minimum with 12x digital zoom minimum:
    a. Iris Control: Automatic with manual override
    b. Auto Focus shall be supported
    c. Electronic Image Stabilization shall be supported

12. Dome: Dome color shall be "smoked" and shall induce a maximum light attenuation of 0.5 f-stop light loss.

13. Environmental Housing: Environmental Housing shall be suited for outdoor weather exposed conditions and shall include sunshield, fan and heater.

14. Axis model Q6032-E, or approved equal.

D. Fixed CCTV Cameras, Interior:

1. Mounting options shall include:
   a. Ceiling Surface Mount
   b. Ceiling Flush Mount
   c. Wall Surface
   d. Wall / Column Mount

2. Digital Video Compression methods supported shall include:
   a. H.264
   b. Motion JPEG

3. Video Resolutions shall include:
   a. 4CIF
   b. 2CIF
   c. CIF
   d. QCIF

4. Frame Rate shall be capable of no less than thirty (30) images per second for all required Digital Video Compression methods and all required Video Resolutions.

5. Video Streams: A minimum of three (3) simultaneous video streams shall be supported.

6. Lens:
   a. Iris Control: Automatic with manual override
   b. Focus: Manual
   c. Focal Length: 2.8 ~ 10.0 mm, minimum

7. Dome: Dome color shall be “smoked” and shall induce a maximum light attenuation of 0.5 f-stop light loss.

8. Axis model P3301, or approved equal.

E. Fixed CCTV Cameras, Exterior:

1. Mounting options shall include:
   a. Ceiling Surface Mount
   b. Ceiling Flush Mount
   c. Wall Surface
   d. Wall / Column Mount

2. Day / Night Functionality: Automatic Day / Night functionality shall be supported.
   a. Minimum Illumination
      1) 6mm:
         a) Color: 0.2 lux
         b) Black and White: 0.04 lux
      2) 12mm:
         a) Color: 0.3 lux
         b) Black and White: 0.05 lux

3. Digital Video Compression methods supported shall include:
   a. H.264
   b. Motion JPEG

4. Video Resolutions shall include:

a. 4CIF
b. 2CIF
c. CIF
d. QCIF

5. Frame Rate shall be capable of no less than thirty (30) images per second for all required Digital Video Compression methods and all required Video Resolutions.

6. Video Streams: A minimum of three (3) simultaneous video streams shall be supported.

7. Lens:
   a. Iris Control: Automatic with manual override
   b. Focus: Manual

8. Focal Length: Coordinate focal length selection with the Owner or Owner's representative prior to installation:
   a. Close View: 2.5 ~ 6.0 mm, minimum
   b. Long View: 3.3 ~ 12.0 mm, minimum

9. Dome: Dome color shall be "smoked" and shall induce a maximum light attenuation of 0.5 f-stop light loss.

10. Environmental Housing: Environmental Housing shall be suited for outdoor weather exposed conditions.

11. Axis model P3343-VE, or approved equal.

F. Elevator Cameras:

1. Mounting: Elevator cameras shall be mounted in corner housings, security rated and suitable for elevator applications.

   a. Pelco EH2400, or approved equal

2. Day / Night Functionality: Automatic Day / Night functionality shall be supported.
   a. Minimum Illumination
      1) Color: 0.4 lux at 50 IRE
      2) Black and White: 0.04 lux at 50 IRE

3. Digital Video Compression methods supported shall include:
   a. H.264
   b. JPEG
   c. MPEG

4. Video Resolutions shall include:
   a. 4CIF
   b. 2CIF
   c. CIF
   d. QCIF

5. Frame Rate shall be capable of no less than thirty (30) images per second for JPEG and MPEG, and no less than ten (10) images per second for H.264.
6. Video Streams: A minimum of three (3) simultaneous video streams shall be supported.
7. Lens:
   a. Iris Control: Automatic with manual override
   b. Focus: Manual
   c. Focal Length: Vari-focal, 2.9 to 8.0 mm, with horizontal viewing angles 94° to 34°
8. General purpose input and output ports:
   a. Inputs: Two (2) alarm input shall be provided, minimum
   b. Outputs: Two (2) auxiliary relay output shall be provided, minimum
9. Sony model SNC-CS50N, or approved equal.

G. Camera Power Supplies:

1. Exterior Environmental PTZ Dome Camera Power Supply:
   a. Exterior Environmental PTZ Dome Camera Power Supply shall be fully compatible with, and fully support the power requirements of the Exterior PTZ Dome Cameras with environmental heater and blower.
   b. Power supplies for Exterior Environmental PTZ Dome Cameras may be installed adjacent to, or in close proximity to the camera(s) and may be exempt from the requirement of centralized rack mounted power supplies, but only after specific case by case approval by LAWA.
   c. The Security Systems Contractor shall coordinate with LAWA Electrical for the provisions of electrical power for Exterior Environmental PTZ Dome Cameras installed adjacent to, or in close proximity to the camera(s).
2. 802.3at PoE Power Injector: For cameras requiring 802.3at PoE power, provide and install rack mounted power injectors in the Security Rack(s) as required.
3. Provide with port configurations to support required cameras plus 25% spare capacity, with a minimum of 12 (twelve) ports per unit.
4. Shall provide 36 watts per port over two pairs.
5. PoE 802.3af backwards compatible.
6. Microsemi PowerDsine model PD-9000G, or approved equal.

H. Wire and Cable

1. Low voltage wire and cable shall be provided and installed as required.
2. Wire and cable shall be selected, sized and used as appropriate for the device application in accordance with the device manufacturer's specifications, voltage and load, and distance of the wire/cable run.
3. Wire and cable runs shall be "home run".

4. Mid run splices shall not be permitted.
5. Wire and cable shall be Belden, West Penn, Contractors Wire and Cable, or approved equal.

2.03 MOUNTING HARDWARE

A. Wherever possible use mounting hardware from the camera manufacturer. Mount Cameras at locations shown on drawings. Review each mounting arrangement with LAWA IT before procurement.

2.04 MATERIALS

A. Color and Finish Selection:

1. In all public areas and in all other areas visible from public areas or from the exterior of the building, colors and finishes shall match the custom color and finish samples on file with the Owner. In all other areas, applicable colors and finishes shall be selected by the Owner from the manufacturer's standard color and finish schedule. For such areas, submit manufacturer's standard color and finish schedule(s).

2.05 UPS

A. All equipment will be powered by a UPS with a capability to support operations for at least four hours after supply power loss. All power will be obtained from emergency power sources.

2.06 FIRESTOPPING MATERIALS

A. Fire stopping for openings through fire-rated and smoke-rated walls and floor assemblies shall be listed or classified by an approved independent testing laboratory for "Through-Penetration Fire Stop Systems." The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814.

B. Inside of all conduits, the fire stop system shall consist of dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming or backer materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

PART 2 - EXECUTION

3.01 GENERAL

A. Provide and install and make fully operational all components required for a fully functional system.

B. System installation and construction methods shall conform to LAWA requirements, requirements of the State of California and all applicable building codes.

C. Security Systems Contractor shall install equipment to meet Seismic Zone 4 requirements of the State of California and as stated herein. Where undefined by codes and standards, Security Systems Contractor shall apply a safety factor of at least 2 times the rated load to all fastenings and supports of system components.

D. All equipment locations shall be coordinated with other trades and existing conditions. Coordinate work with other trades and existing conditions to verify exact routing of all cable tray, conduit, etc. before installation. Coordinate with all the Telecommunications, Mechanical, Baggage Handling and Electrical Drawings. Verify with LAWA IT and the Design Engineer the exact location and mounting height of all equipment in finished areas, such as equipment racks and telecommunications devices.

E. The Security Systems Contractor shall use existing conduit and surface raceway where possible and practicable. All work shall be concealed above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, LAWA IT shall be notified before starting that part of the work. In areas with no ceilings, install only after LAWA IT reviews and comments on arrangement and appearance.

F. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed that may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of LAWA IT and approval received before such alterations are made.

G. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation. All TR cabinets and racks shall be mounted a minimum of 36-inches from the wall or other cabinets, equipment or power panels.

H. Where required, the Security Systems Contractor shall be responsible for cutting, patching, coring and associated work for the system at no additional cost to the Owner. Cut and drill from both sides of walls to eliminate splaying. Patch adjacent existing work disturbed by installation of new work. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

I. All conduit and sleeve openings used by the Security Systems Contractor shall be waterproofed or fireproofed in compliance with State and Local Building and Fire Codes. Strict adherence to National, State, and Local Fire Codes, particularly fire stopping will be required.

J. The Security Systems Contractor shall patch all openings remaining around and inside all conduit, sleeves and cable penetrations devices to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire stop system shall consist of a dielectric, water resistant, non-hardening, permanently pliable/re-enterable putty along with the appropriate damming materials (where required). The sealant must be capable of being removed and reinstalled and must adhere to all penetrants and common construction materials and shall be capable of allowing normal wire/cable movement without being displaced.

K. All building conduits and sleeves installed and/or used under these Specifications shall be fire stopped, or re-fire stopped, upon cable placement through such passageways.

L. Fire stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:

1. Provide materials and products listed. The system shall meet the requirements of "Fire Tests of Through-Penetration Fire Stops" designated ASTM E814. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.
2. Provide fire stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire stop seal between sleeve and wall for drywall construction.
3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire stop system. The installation shall provide an air and watertight seal.
4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:
   a. Floors – three (3) hours
   b. Corridor walls – two (2) hours
   c. Offices – three-quarters (0.75) hour
   d. Smoke partitions – three-quarters (0.75) – one (1) hour

M. Provide fire stop pillows for existing cable tray penetrations through firewalls.

N. Manufacturer's recommended installation standards must be closely followed (i.e. minimum depth of material, use of ceramic fiber and installation procedures).

3.02 EXAMINATION

A. Inspect the jobsite and survey the conditions to be encountered during performance of the work. Failure of Security Systems Contractor to become familiar with the site conditions shall not relieve Security Systems Contractor of responsibility for full completion of the work in accordance with the contract provisions.

B. Verify that all conduit, wires, cables, security equipment are installed and ready for connection and integration with the rest of the system.

C. Examine area to be protected and verify that environmental characteristics will not affect effective communication and interfacing. Report observed problems in writing.

D. Determine that power supplies, conduit, wires, cables, connections, and equipment are ready for installation and interfacing before attempting installation.

E. Check all power and communications cabling for continuity before making connections.

F. Visually inspect each piece of equipment, determine defects, and correct.

G. Inspect locations where installation work will be performed. Verify that conditions found are in accordance with drawings and are acceptable for Security Systems Contractor's installation work. Report any discrepancies in writing to LAWA IT stating suggested means of correction. As may be required, inspect existing inside and outside cable plant to determine system runs and interface conditions. Coordinate with LAWA IT to establish interfaces.

3.03 PREPARATION

3.04 INSTALLATION

A. Compliance:

1. Install the equipment in accordance with the contract documents, all applicable codes and standards and the Manufacturer's written instructions. The installed system shall meet all applicable equipment and performance requirements.

B. Standardization:

1. Standardize the installation practices and material to provide uniform materials and procedures to the maximum extent possible.

2. Locations:

   a. Locate pull boxes, wire-ways or other items requiring inspection, removal, or replacement conveniently and accessibly with reference to the finished facilities.

3. Electrical Service:

   a. Installation of electrical service to equipment shall conform to specific UBC Codes and Standards, NFPA 70, and other applicable requirements.

   b. Where possible for ceiling mounted and wall mounted CCTV install a suitable sized junction box and feed the CCTV camera via a three foot metallic flexible conduit to the mounting location. This is to ease subsequent camera repositioning. Review each mounting arrangement with LAWA IT before installation.

4. Electrical Equipment Inspection:

   a. Provide electrical equipment inspection in accordance with NEMA PB 2.1 Part VII.

5. Installation Requirements:

   a. Install all system components, including furnished equipment, and appurtenances in accordance with the manufacturer's instructions, and as shown, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

   b. Install the security system equipment in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type.

   c. All wiring, including low voltage wiring outside the control console, cabinets, boxes, and similar enclosures, shall be installed in rigid galvanized steel conduit conforming to UL 6 (when outdoors), or electric metallic tubing (EMT) when indoors. Minimum conduit size shall be 3/4-inch. All other electrical work shall be as specified with electrical specifications and drawings that are part of the contract document and as shown. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

   d. Detailed shop drawings shall be provided as part of the submittal process. The shop drawings shall include, but not be limited to exposed conduit and devices, including hangars, brackets, back boxes and related equipment.

   e. All equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall meet the requirements of ANSI C62.41. Fuses shall not be used for surge protection.

   f. All inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit.

   g. All cables and conductors, except fiber-optics, shall have surge protection circuits installed at each end. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two wave-forms:

1) A 10 microsecond rise time by 1000 microsecond pulse width wave-form with a peak voltage of 1500 volts and a peak current of 60 amperes.

2) An 8 microsecond rise time by 20 microsecond pulse width wave-form with a peak voltage of 1000 volts and a peak current of 500 amperes.

h. Calibrate all equipment.

i. Inspect each component, determine obvious defects, and correct.

j. All electrical work shall be in accordance Division 26.

k. Perform tests as recommended by manufacturer or as required to ensure the VSS equipment is operating properly and meets specified requirements.

l. Correct all deficiencies detected and retest affected components.

m. Record test data, tabulate, and write narrative describing tests, results, deficiencies found, corrective measures, and results of retesting. Certify that the security equipment has been tested and is ready for performance verification testing.

n. Service Loops: Service loops shall be provided for all VSS cabling within the Telecommunication Rooms.

o. The Security Systems Contractor shall be responsible to verify with LAWA IT the exact final location of each camera prior to installation. The Security Systems Contractor shall be responsible to coordinate with lighting, signage and other sub-contractors to avoid conflicts with intended field of view as indicated in the drawings.

3.05 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Security Systems Contractor shall confirm specific labeling requirements with LAWA IT prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. Marking:

1. Equipment Name Plates: The following requirements shall apply:

a. General: Attach a permanent, corrosion-resistant name plate to each equipment component showing the manufacturer's name, address, serial number and equipment rating. Each name plate shall be clearly visible on the exterior of equipment. Components located within equipment enclosures shall also be provided with name plates.

b. Location and Fastening: Provide nameplates to identify all equipment components. Provide each panel assembly with a name plate on the interior of equipment enclosures, indicating number of equipment and unit of assembly. Fasten name plates securely with slotted stainless steel screws. The use of adhesive for fastening name plates will not be permitted.

c. Control and Display Labels:

1) Use: Each control, display and any other item of equipment that must be located, identified, read or manipulated shall be appropriately and clearly labeled to permit rapid and accurate identification of its operating state of position.

2) Orientation: Orient labels and information thereon horizontally so that they may be read quickly and easily. Vertical orientation shall be used only where space is limited.

3) Locations: Locate labels so that there is no confusion as to which item they identify. Labels shall not obscure any other information required by the operator. Controls shall not obscure labels. The location of labels shall be consistent.

d. Use Permanent Room Numbers as indicated on the Room Finish Schedules for construction period identification of rooms and building spaces. All required shop drawings and submittals, including manuals and Project Record Drawings shall identify rooms and spaces using the Permanent Room Numbers. Permanent identification devices including signage, equipment nameplates, and panels shall use the Permanent Room Numbers.

3.06 FIELD QUALITY CONTROL / INSPECTIONS / TEST

A. General

1. The Security Systems Contractor shall perform a detailed inspection of the site prior to submitting any technical data for approval.

2. The Security Systems Contractor shall verify that the proposed equipment and methods of installation are compatible with the existing conditions and prepare a corresponding written report of their findings.

3. LAWA IT shall be notified in writing if modifications of the existing building are required in order to accommodate the new equipment. These modifications shall be made only upon receiving written approval from LAWA IT.

B. Test, Commission and Acceptance

1. Conduct an Installation Test and total Acceptance Test upon completion of equipment installation. Testing shall be coordinated as necessary, to demonstrate that all interfaces have been successfully implemented.

2. Installation and Acceptance Test Plan and Reports:

   a Installation and acceptance tests shall be conducted in the normal operational environment to the maximum extent possible. The tests shall represent operation in the normal mode in which each system will operate. If interfaces are incomplete, provide simulation of those interfaces so that the system may be tested as a complete and stand-alone entity. Perform all equipment repair and/or adjustment that may be required during acceptance testing.

   b Security Systems Contractor shall submit a Test Plan for Installation and Acceptance Tests and Commissioning for the review and approval of LAWA IT and the Design Engineer. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

      1) Test equipment is to be identified by manufacturer and model
      2) Interconnection of test equipment and steps of operation shall be defined
      3) Expected results required to comply with specifications
      4) Record of test results with witness initials or signature and date performed
      5) Pass or fail evaluation with comments

3. Installation and acceptance tests shall be conducted in the normal operational environment to the maximum extent possible. The tests shall represent operation in the normal mode in which each system will operate. If interfaces are incomplete, provide simulation of those interfaces so that the system may be tested as a complete and stand-alone entity. Perform all equipment repair and/or adjustment that may be required during acceptance testing.

4. In addition to any acceptance testing requirements specified elsewhere, cameras shall be fully adjusted and tested to provide optimal video pictures and signals. All camera adjustments and settings available shall be utilized and adjusted. All camera adjustments and settings shall be recorded in individual camera test reports for review and acceptance.

5. The Test Plan shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

6. Documentation verification, both interconnects and functionality shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

7. The Security Systems Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.
8. Test Reports: The Security Systems Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:
   a. Commentary on test results.
   b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.
   c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.
   d. Signatures of persons who performed and witnessed the test.
9. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Security Systems Contractor at no cost to LAWA. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by LAWA IT, before any subsequent testing phase is performed.
10. Adjustment, Correction, and Completion:
    a. Correct deficiencies and retest affected components.
    b. Make necessary adjustments and modification to system after obtaining approval of LAWA IT.
    c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by LAWA IT.
11. Recording:
    a. Describe actual operational tests performed and equipment used and list personnel performing tests.
    b. Record in tabular form all test results, deficiencies, and corrective measures.
12. Termination
    a. Performance verification test shall be terminated by LAWA when:
       1) Individual components, subsystems, or the integrated system fail to perform as specified.
       2) It is determined that system is missing components or installation is not complete.
    b. Upon termination, corrective work shall be performed and performance verification test rescheduled with LAWA.

c. Retesting shall be performed by Security Systems Contractor at no additional expense.

d. Security Systems Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of LAWA IT.

13. The Security Systems Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Contractor furnished equipment, installation, or software.

14. Obtain specific approval from LAWA IT of all lens selection, camera field of view, point of focus, video quality and recording.

15. After all installation and acceptance test requirements specified have been complied with, the equipment shall be commissioned.

C. System Commissioning:

1. Video Commissioning shall be conducted in accordance with LAWA standard video commissioning policies and procedures. This will include verification of lens selection, verification of field of view, verification of image quality, verification of focus point and where required final adjustment of position of CCTV camera.

2. The Commissioning procedure shall be witnessed by LAWA. Security Systems Contractor shall provide a detailed inspection, and physical accounting of each equipment item. An operational demonstration shall then be conducted in which the equipment shall function in the normal operational mode, and shall operate completely error-free in terms of hardware and software performance. Occurrence of any equipment failure shall terminate the demonstration. The demonstration shall restart and run for a period of time designated by LAWA after the failure has been corrected.

3. Prerequisite to Commissioning: Outstanding work items that may exist, such as facility interfaces, project record drawings, and/or in-process change orders, shall be documented and submitted to LAWA for review prior to start of equipment commissioning. Documentation of outstanding work items shall take the form of punch lists of critical action items lists that describe the work, the expected completion schedule, and the impact upon operation. Depending upon the nature of the outstanding work item, LAWA IT may grant a waiver to accomplish partial commissioning of any of the equipment. Completion of waived outstanding work items shall then be assigned to the post-commissioning operations and maintenance..

4. Security Systems Contractor shall be responsible for ensuring that the installation and related interfaces are completed and operational at least thirty (30) days prior to scheduled beneficial occupancy. In the event the installation and related interfaces is not

completed and operational by the scheduled beneficial occupancy date, Security Systems Contractor shall establish and submit a security plan to LAWA that complies with 49 CFR 1542 Airport Security and 49 CFR 1544. Aircraft Operator Security as appropriates, and related LAWA security requirements. The security plan shall be submitted to LAWA and TSA for approval. The security plan, revisions, and security measures to be deployed until such time the new security equipment is completed and operational shall be at Security Systems Contractor's expense.

3.07 SYSTEM STARTUP

A. The Security Systems Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.
2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
3. System wiring has been tested and verified as correctly connected as indicated.
4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.
6. Satisfaction of the above requirements shall not relieve the Security Systems Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Security Systems Contractor work/equipment.

3.08 CLEANING

3.09 COMPUTERIZED MAINTENANCE MANAGEMENT SYSTEM

A. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule and other pertinent data will be stored in the CMMS database. Security Systems Contractor is required to input all camera, cabling, port information for all cameras installed. Security Systems Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.10 CLOSEOUT ACTIVITIES AND ACCEPTANCE

A. Completion of successful installation, final tests and commissioning, receipt of the test reports and as-built documentation including data input into the CMMS and successful performance of the installed equipment / system for a thirty (30) day period will constitute Final Acceptance.

3.11 MAINTENANCE

END OF SECTION

SECTION 28 23 13 Video Surveillance, Storage, Recording and Management Systems

PART 1 - GENERAL

1.01 SUMMARY

A. SSI - Protection of Contract Documents. All CCTV security system documents shall be considered Sensitive Security Information (SSI) and shall be handled as defined in 49 CFR, Parts 15 and 1520.

B. Hardware and Software shall be of the current model and versions that are currently implemented at LAWA.

C. Video Surveillance, Storage, Recording and Management Systems ("Video System") consist of communication systems including, but not limited to, cabling, and edge / network devices, Video Management System (VMS), Video Storage System, workstations, video/audio encoders, video decoders, video storage system, servers, cabling, connectors, software licenses, documentation, drawings, submittals, operation and maintenance, warranties.

D. Security Systems Contractor shall include in the Bid or proposal all labor, materials, tools, plant, transportation, storage costs, installation, programming, configuration, testing, commissioning, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and operational equipment / systems shown and described in the Specifications.

E. Security Systems Contractor shall ensure each new camera on Video System that interfaces with Access Control and Alarm Monitoring System. LAWA Access Control and Monitoring System (ACAMS) has a linkage between alarms and video. Security Systems Contractor shall cooperate with the ACAMS contractor (Section 28 13 00) and LAWA video maintenance contractor to set up the linkage between the two systems and the camera.

F. Communications System:

1. LAWA's network is an enterprise/service provider network that is built on MPLS (L3 VPN) technology using Cisco Cat 6500, 2800 and 3800 from a Layer 3 (L3) perspective. LAWA consists of four airports, namely, LAX, Ontario, Van Nuys and Palmdale and remote offices or trailers in each of the airport facilities. Among the four airports facilities, LAX, Ontario and Van Nuys are interconnected via three Metro Ethernet (ME) links with bandwidths of 100Mbps and 500Mbps. The remote facilities in each of the geographical locations are connected to the core/distribution devices using one of the following methods: ME, T1 or ISDN. This network (intra-campus and inter-campus) is built with equipment, path and site redundancy at the core and distribution layers. The main data center resides in LAX campus; the backup data center, Ontario campus.

2. From the L3 VPN perspective, this network segregates the user groups and the different server groups by means of VRF (Virtual Routing and Forwarding instances). The existing Verves consist of the users, common services, application servers, voice, video,

internet …. to name a few. All CE (customer edge) devices (whether L2 or L3) connect to the MPLS backbone via one of the PE (provider edge) devices that are equipped with virtual firewall modules.

3. Note: Security Systems Contractor shall perform a network load analysis to support the VMS/VSS designed system load and notify LAWA for correction of any deficiencies. Security Systems Contractor is responsible for confirming and verifying LAWA's remedies to meet Security Systems Contractor network requirements for a successful completion of the VMS/VSS project to be approved by LAWA in accordance with the System Acceptance Test Plan.

G. The Security Systems Contractor will engineer, procure, install, program, integrate, test and commission additional VSS system components needed to comprise a complete Surveillance Storage, Recording, Management System that will control, manage, display and record video streams for any new cameras.

H. Additionally the System shall provide for the following capabilities:

1. Allow the configuration of zone display/ recording or event triggering to display and record on different CIFs and frame per second based on LAWA's operational requirements to optimize the hard disk usage for recording.
2. Allow Airport Response Coordination Center (ARCC) and other LAWA identified facilities Pan, Tilt, Zoom camera controls and other controls such as audio, ring down, panic button, and system alarms, etc.
3. Provide seamless end-to-end operation by using cross-system integration to LAWA legacy systems using, but is not limited to, connector, Application Programming Interface and middleware, etc.
4. Capability to interface to Oracle Identity Management in future implementation.
5. Non-disrupt system operation for an availability of 99.99% supported by Security Systems Contractor supplied head end equipment.
6. Optimize or recommend alternatives to improve existing Airfield Operation Area (AOA) with high resolution camera views and pan, tilt and zoom controls.
7. Integrate The System to LAWA's Master Time Source for a unified time stamp for the video display/recording.
8. If applicable, include capability for displaying the video by handheld devices or Airport Police mobile data terminal using LAWA supplied wireless network.

I. Related documents included in the specification requirements:

1. Division 1 – General Requirements including but not limited to:

    Section 01 11 00 – Summary of Work

    Section 01 25 00 – Substitution Procedure

    Section 01 31 00 – Administrative Requirements

    Section 01 33 00 – Submittal

Section 01 40 00 – Quality Requirements

Section 01 43 00 – Quality Assurance

Section 01 64 00 – Owner (LAWA) Furnished Products

Section 01 77 13 – Preliminary Closeout Reviews

Section 01 77 16 – Final Closeout Review

Section 01 78 00 – Close Out Submittals

2. Section 27 05 00 – Basic Telecommunication Requirements
3. Section 27 11 00 – TR & MPOE Room Expansions
4. Section 27 21 00 – Local Area Network
5. Section 28 13 00 – Access Control and Monitoring System (ACAMS)

J. Products installed (but not furnished) under this section:

K. Products furnished (but not installed) under this section:

1.02 PRICE AND PAYMENT PROCEDURES

1.03 REFERENCES

A. ABBREVIATIONS AND ACRONYMS

ACAMS	Access Control and Alarm Monitoring System
AD	Active Directory
AEOC	Airport Emergency Operations Center
AFF	Above Floor Finish
ANSI	American National Standard Institute
AOA	Aircraft Operations Area
AOC	Airport Operations Center
API	Application Program Interface
ARCC	Airport Response Coordination Center
ASCII	American Standard Code for Information Interchange
ATP	Acceptance Test Plan
AWG	American Wire Gauge
BMS	Balanced Magnetic Switch
CAD	Computer Aided Dispatch
CATV	Cable TV

CBP	U.S. Customs and Border Protection
CCTV	Closed Circuit Television
CIFS	Common Internet File System
COP	Common Operating Picture (situational awareness)
COTS	Commercial Off the Shelf
CPU	Central Processing Unit
DVMS	Digital Video Management System
EMI	Electromagnetic Interference
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICEA	Insulated Cable Engineering Association
IDS	Intrusion Detection System
IP	Internet Protocol
ISA	Instrument Society of America
IVS	Intelligent Video Analytics System
LAWA	Los Angeles World Airports
LAX	IATA Symbol for the Los Angeles International Airport
LCC	Life Cycle Costs
LED	Light Emitting Diode
MBPS	Mega-bits per second (video stream rate)
MHz	Megahertz
MPIO	Multi-Path Input/output
MRT	Mean Restoral Time – The mean interval between failure and restoral to operational status; includes MTTR travel time and response time
MTBF	Mean Time Between Failures – The mean interval that is the sum of MTTF and MRT
MTTF	Mean Time To Failure – The mean interval between placing a specific piece of equipment or system in service and its operational failure
MTTR	Mean Time To Repair – The mean interval during which the repair process is successfully performed
NAS	Network Attached Storage
NFS	Network File System

NTP	Network Time Protocol
NTSC	National Television System Committee
O&M	Operations and Maintenance
PACS	Physical Access Control System
PLC	Programmable Logic Controller
PoE	Power Over Ethernet
PSIM	Physical Security Information Management
PTZ	Pan, Tilt, Zoom
QC	Quality Control
REX	Request to Exit
RFI	Radio Frequency Interference
RTP	Real-time Transport Protocol
SAN	Storage Area Network
SAS	Serial Attached SCSI
SCC	Security Control Center
SCP	Security Control Panel
SJB	Security Junction Box
SNMP	Simple Network Management Protocol
SSCP	Security Screening Checkpoint
SSH	Secure Shell
TBIT	Tom Bradley International Terminal
TSA	Transportation Security Administration
UBC	Uniform Building Code
UPS	Uninterrupted Power Supply
VDT	Video Display Terminal
VMD	Video Motion Detection
VMS	Video Management System
VSS	Video Surveillance System

B. CODES, STANDARDS, REGULATIONS AND REFERENCES

1. Comply with all applicable codes standards, regulations, and the most current issue of the following publications, including all amendments thereto of the issue that is current on the date of contract award. Applicable requirements of the following publications shall

apply to the work under this specification as if fully written herein. Where conflicts exist between the Technical Specification and the referenced publications, local codes shall govern.

a. American Standards Association (ASA)

b. Institute of Electrical and Electronic Engineers (IEEE)

c. National Fire Protection Association (NFPA)

d. National Electrical Manufacturers Association (NEMA)

e. Underwriters Laboratories, Inc. (UL)

f. Federal, State and Municipal Building Codes and all other Authorities having jurisdiction

g. National Electrical Code (NEC)

h. Insulated Power Cable Engineers Association Specification (IPCEA)

i. American Society for Testing Materials Specification (ASTM)

j. Occupational Safety and Health Administration (OSHA)

k. National Electrical Safety Code (NESC)

2. Special attention shall be made to the following specific codes, standards, and publications where applicable:

a. ANSI B20.1 Conveyor Safety

b. ASTM F.1468-93 Standard Practice For Evaluation

c. Customs and Border Protection Airport Technical Design Standards for Passenger Processing Facilities, August 2006

d. EIA 232-D Interface between Data Terminal Equipment and Data Circuit-Termination Equipment Serial Binary Data

e. EIA RS-310-C Racks, Panel, and Associated Equipment

f. 49 CFR 1520 Protection of Sensitive Security Information

g. 49 CFR 1540 Civil Aviation Security General Requirements

h. 49 CFR 1542 Airport Security

i. 49 CFR 1544 Aircraft Operator Security

j. 49 CFR 1546 Foreign Air Carrier Security

k. 49 CFR 1548 Indirect Air Carrier Security. NFPA 72-D - Installations, Maintenance and Use of Proprietary Protective Signaling Systems

l. NFPA 75 Protection of Electronic Computer Data Processing Equipment

m. NFPA 77 Static Electricity

n. NFPA 78 Lightning Protection Code

o. Transportation Security Administration Recommended Security Guidelines for Airport Planning, Design and Construction, June 15, 2006

p. UL 294 Access Control System Units

q. UL 611 Central Station Burglar Alarm Units and Systems

r. UL 634 Intrusion Detection Units

s. UL 681 Installation and Classification of Mercantile and Bank Burglar Alarm Units

t. UL 796 Electrical Printed-Wiring Boards

u. UL 1076 Proprietary Burglar Alarm Units and Systems

v. UL 1950 Information Technology Equipment, including Electrical Business Equipment References to codes and standards called for in the Specifications refer to the latest edition, amendments, and revisions to the codes and standards in effect on the date of these Specifications.

3. Los Angeles World Airports (LAWA) Publications – IT Infrastructure Standards of Practice.

4. In addition the Security Systems Contractor shall comply with all applicable Security Directives as issued by the TSA.

1.04 ADMINISTRATIVE REQUIREMENTS

1.05 ACTION SUBMITTALS

A. Comply with all LAWA submittal procedures given in other Sections. The following is in addition to or complementary to any requirements given elsewhere.

B. Action Submittals:

1. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.
2. Submit Manufacturers' Data for all equipment supplied under this Section.
3. Product submittals shall be provided and approved prior to the commencement of installation activities of the Video System.
4. Submit all proposed labeling materials and nomenclature for approval.
5. Shop Drawings:
   a. Provide shop drawings that are applicable and pertain to CCTV Video System provisions

   b. Provide Interface Schedules and Diagrams. These documents must clearly identify Sensors and switches which cue video cameras, as well as the number of cameras activated, video recording activation logic, video monitor switching logic, interfaces between the access control system and other subsystems, distributed processing capabilities and function.

6. Installation drawings:
   a. Floor Plans
   b. Riser Diagrams
   c. Block diagrams
   d. Connection of all new CCTV cameras with their associated junction boxes including block diagrams and wiring diagrams
   e. Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding
   f. Details of surge protection device installation
   g. Equipment mounting details
   h. Rack Installation Details
   i. Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems

7. Coordination Drawings:
   a. Indicate locations where space is limited for installation and access.
   b. Submit floor plans, elevations, and details indicating major equipment and end device locations. Indicate all floor, wall and ceiling penetrations.
   c. Telecommunication Rooms: At least 30 days before beginning installation in each room, the Security Systems Contractor shall furnish a telecommunications room drawing showing the initial layout design and plans for the proposed mounting locations of VSS equipment, cable routings, and termination locations for all cable and equipment.

8. Theory of Operations
   a. Description, analyses, and calculations used in selecting equipment. Describe and show how equipment will operate as a system.

C. Test and Acceptance Plans

1. Submit the following for review and approval prior to the performance of any testing:
   a. Performance and Functionality Verification Test Plan (including interfaces)
   b. Commissioning Test Plan

D. Closeout Submittals

1. Project Record Documents required include:
   a. Marked-up copies of Contract Drawings
   b. Marked-up copies of Shop Drawings
   c. Newly prepared Drawings
   d. Marked-up copies of Specifications, Addenda and Change Orders
   e. Marked-up Project Data submittals
   f. Record Samples

g. Field records for variable and concealed conditions
h. Record information on Work that is recorded only schematically
i. As-built drawings
j. Record drawings
k. Electronic as-built and LAWA LUSAD requirements

2. As-built drawings:
   a. In addition to the Record Drawing requirements set forth in Division 01 – General Requirements, As-built drawings shall fully document and be fully developed and provided, and shall include, but not be limited to:
      1) Floor Plans
      2) Riser Diagrams
      3) Block diagrams
      4) Point-to point wiring diagrams
      5) Door Details
      6) Point Schedules
      7) Detail of connections to cameras, monitors, and workstations
      8) Details of connections to power sources, including primary and secondary power supplies, uninterrupted power supplies, and grounding
      9) Details of surge protection device installation
      10) Equipment mounting details
      11) Rack/Cabinet layout elevations and details, including heat and load calculations
      12) Details of interconnection to data transmission media and data communication network including all hardwire and fiber optic systems

3. Post changes and modifications to the Documents as they occur. Drawings will be updated electronically and submitted to LAWA in accordance with the schedule provided for this by LAWA. Do not wait until the end of the Project. Design Engineer will periodically review Project Record Documents to assure compliance with this requirement.

4. At every quarter, submit Project Record Documents to Design Engineer for LAWA's records.

5. Upon completion of the as built drawings, LAWA and the Design Engineer will review the as built work with the Security Systems Contractor.

6. If the as built work is not complete, the Security Systems Contractor will be so advised and shall complete the work as required.

7. Project Record Drawings shall also be submitted in electronic format. Electronic drawing format shall be AutoCAD® Release 2008 or later. LAWA shall have the right and capability to manipulate all electronic file drawings and documentation.

1.06 QUALITY ASSURANCE

A. Security Systems Contractor Certification: The Security Systems Contractor or approved subcontractor shall be a NICE certified security system installer for the specific type of equipment / software being installed. The Security Systems Contractor shall offer proof of certification by submitting a copy of certification with the Bid.

B. The Security Systems Contractor's Quality Assurance Inspector shall conduct a visual inspection of all installations to verify that the installations are in accordance with LAWA's and manufacturer's specifications. Records of the inspections signed and dated by the Quality Assurance Inspector shall be provided to the Design Engineer.

C. LAWA and the Design Engineer shall be notified by the Security Systems Contractor of any inspection(s) and LAWA and the Design Engineer may elect to participate in any inspection(s). Relevant QA information shall be input into LAWA CMMS (refer to Paragraph 3.08).

1.07 SUBSTITUTION OF EQUIPMENT

A. Approval of alternate or substitute equipment or material in no way voids specification requirements.

B. Under no circumstances shall LAWA or the Design Engineer be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Security Systems Contractor submits to the Design Engineer and LAWA all evidence to support the contention that the item proposed for substitution is equal to the specified item. LAWA's decision as to the equality of substitution shall be final and without further recourse.

C. In the event that the Design Engineer is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Security Systems Contractor, or changes by the Security Systems Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Design Engineer is required to examine and evaluate any changes proposed by the Security Systems Contractor for the convenience of the Security Systems Contractor, then the Design Engineer's expenses in connection with such additional services shall be paid by the Security Systems Contractor and may be deducted from any moneys owed to the Security Systems Contractor.

1.08 DELIVERY, STORAGE AND HANDLING

1.09 FIELD/SITE CONDITIONS

A. General

1. The Security Systems Contractor shall inspect the jobsite and survey the conditions to be encountered during performance of the work. This shall be accomplished prior to starting the work. Failure of the Security Systems Contractor to become familiar with the site conditions shall not relieve Security Systems Contractor of responsibility for full completion of the work in accordance with the Contract provisions.

2. The Security Systems Contractor shall employ the maintenance contractor with whom LAWA has a maintenance contract to perform the disconnection, connection, re-connection, programming or configuration of the existing Video System or other existing systems that might be affected by this Work.

3. Programming and configuration of the VSS system shall be by LAWA designated CCTV maintenance contractor. This scope of work shall include CCTV programming and configuration. The installing Security Systems Contractor shall secure the services of LAWA designated CCTV maintenance contractor for CCTV programming and configuration for this work at no additional cost to LAWA.

4. The Security Systems Contractor shall provide all new UTP cable, optical fiber cable, innerduct, racks, cabinets, patch panels, cover plates, outlet boxes, related hardware, distribution, termination equipment, and any other appurtenances and equipment associated specifically with the Video System. Coordinate with Section 27 05 00 contractor.

5. The Security Systems Contractor shall obtain the approval of LAWA IT or Design Engineer for the final layout of the Video System equipment to be installed prior to the installation of any materials or equipment. Shop drawings showing proposed room / rack layouts shall be submitted for approval before beginning installation.

6. The Security Systems Contractor shall furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner consistent with the interests of LAWA.

7. The Security Systems Contractor shall be responsible to LAWA for the acts and omissions of its employees, subcontractors and their agents and employees, and other persons performing any of the work under a contract with the Security Systems Contractor.

8. The Security Systems Contractor shall not unreasonably encumber the site with any material or equipment. Operations shall be confined to areas permitted by law, permits, and contract documents.

9. The Security Systems Contractor shall have an experienced Project Manager on site at all times when work is in progress on any project. The individual who represents the Security Systems Contractor shall be the single point of contact between the Security Systems Contractor and LAWA, and shall be responsible for the entire project. This representative shall be able to communicate with LAWA or designated representative whenever requested throughout the life of the project.

10. While working in the facility, the Security Systems Contractor shall not block any entrances, egresses, or other passageways that are necessary for normal, safe operation. It should be noted that the Security Systems Contractor is responsible to provide any lifts, hand trucks, etc. that it will need to transport its materials and equipment to and throughout the site.

11. The Security Systems Contractor shall protect all buildings, walls, floors, and property from damage resulting from the installation. Any and all damage to property shall be repaired by the Security Systems Contractor at its expense. If the Security Systems Contractor enters an area that has damage (not caused by the Security Systems Contractor), the Security Systems Contractor shall immediately bring this to the attention of the Engineer so the area can be appropriately noted.

12. Following each day's work, the Security Systems Contractor shall clean up the areas in which it has been working and dump all trash in the appropriate designated areas.

13. Deliver products to site under provisions of Division 01 - General Requirements.

14. Store and protect products under provisions of Division 01 - General Requirements.

15. Coordinate with LAWA, locations and requirements for equipment and product storage.

B. Environmental Requirements:

1. Comply with all manufacturers' instructions and recommendations concerning environmental factors.

2. Comply with all seismic requirements.

1.10 EQUIPMENT CERTIFICATION

A. Provide materials that meet the following minimum requirements:

1. Electrical equipment and systems shall meet UL Standards (or equivalent) and requirements of the NEC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
2. Equipment shall meet all applicable FCC Regulations.
3. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material is not acceptable and will be rejected.
4. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or catalogued item of equipment. All equipment and systems must conform to the Specifications.
5. Where applicable, all materials and equipment shall bear the label and listing of Underwriters Laboratory or Factory Mutual. Application and installation of all equipment and materials shall be in accordance with such labeling and listing.

B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for the final assembled unit.

1. All components of an assembled unit need not be products of the same manufacturer.

2. Constituent parts, which are alike, shall be from a single manufacturer.
3. Components shall be compatible with each other and with the total assembly for intended service.

C. Components of equipment shall bear the manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model.

E. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

F. Maximum standardization of components shall be provided to reduce spare part requirements.

1.11 WARRANTY

A. Warranty and Maintenance Requirements shall be in accordance with the Division 01 - General Requirements.

B. Materials and workmanship shall meet or exceed industry standards and be fully guaranteed for a minimum of two (2) years from Final Acceptance.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.
2. The Security Systems Contractor shall be responsible for and make good, without expense to LAWA, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

C. Submit a copy of all manufacturer warranty information.

D. Spare Parts:

1. The Security Systems Contractor shall provide to LAWA an inventory of security equipment spare parts, materials, consumables, and any other system item in order to meet the specified warranty maintenance requirements and keep the security equipment in a continuous operational mode during the warranty period. The quantity of spare parts shall equal no less that 10% of the items provided and installed under this contract.

PART 2 - PRODUCTS

2.01 GENERAL

A. Except as may be otherwise specified herein, the equipment and materials of this Section shall be equivalent to or better than products of the following manufacturers:
   1. Video Management System – Nice Systems Inc., Rutherford, NJ
   2. Video Storage System – Hewlett-Packard Company., Palo Alto, CA
   3. Video Encoder – Axis Communications Inc., Chelmsford, MA
   4. Audio/Video Encoders – Axis Communications
   5. Audio Encoders – SiquraVideo Decoders – Nice Systems Inc., Rutherford, NJ

B. Products shall be provided as specified. In the event the manufacturer(s) of specified products and materials have upgraded or replaced the specified products and materials with newer or improved technologies at the time of purchase, the newer or improved products or materials shall be provided. Latest technology products and materials shall be operationally and functionally equivalent or superior to the specified products and materials. Products and materials shall be purchased by the Security Systems Contractor in a timely manner to meet construction schedules, but shall not be purchased so far advanced of the date(s) of installation that they become technologically obsolete or replaced with newer technologies. No discontinued products shall be used.

C. Specific requirements regarding other types of substitutions and procedures for requesting substitutions are contained in DIV 01 Specifications 01 25 00 and 01 60 00. Document each request for substitution with complete data substantiating compliance of proposed substitution with Contract Documents, including an itemized list of specification requirements and whether or not the proposed device/equipment is in compliance. By making requests for substitutions, the Security Systems Contractor:

   1. Represents that the Security Systems Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified.

   2. Represents that the Security Systems Contractor will provide the same warranty for the substitution that the Security Systems Contractor would have for the device/equipment specified.

   3. Certifies that the cost data presented is complete and includes all related costs under this Contract except the Design Engineer's redesign costs, and waives all claims for additional costs related to the substitution that subsequently become apparent.

   4. Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

2.02 VIDEO MANAGEMENT SYSTEM

A. The Video Management System shall be an expansion of the existing VMS System and shall consist of a digital, networked, computer-controlled, virtual matrix switching system designed for CCTV applications. Video Management Capabilities include but are not limited to:

1. The VMS application suite shall include applications for viewing and investigation of video, user policy setup, site setup and configurations, and an application for monitoring and providing alarms of failure or errors of any of the VMS components.

2. The VMS shall be based on open architecture software and shall allow the use of any industry computer hardware, Network hardware, and data storage equipment (non-proprietary hardware). Systems requiring the use of proprietary hardware shall not be accepted.

3. The VMS Application Suite shall be an entirely plug-and play IP based system which shall allow authorized users to monitor and playback video from multiple IP cameras and/or digitized analog cameras connected to the VMS simultaneously on the operators workstation and/or external monitors (analog and digital) on LAWA network.

4. The software installed in both servers and workstations shall be similar in Graphical User Interface, therefore, an operator shall need to learn only one interface for both control and programming of the system and functions, offering the ability to remotely configure most system components from any server or workstation.

5. The Graphical User Interface (GUI) shall provide a multi-channel display area containing access to a listing of all connected cameras, Site and terminal maps, and device tree, a navigator window, a control dialog display area, a toolbar, a display mode control area, a function area, a video display control area and other image control areas. Each area shall contain the necessary controls to operate and setup the system.

6. The VMS Application Suite shall allow authorized users to monitor, record and playback audio from audio sources connected to the VMS.

7. The VMS Application Suite shall allow authorized users to acknowledge/ reject/reset alarms.

8. The VMS Application Suite shall provide dual monitor support.
   - Channels, Groups, Alarm, Tours, Salvos and Maps shall be displayed on Monitor One
   - Video layout pages shall be displayed on Monitor Two

9. The VMS Application Suite shall have the capability to graphically display camera states on the hierarchical list, the states shown shall include indication of:

- Loss of the video signal
- Trigger activated
- User event activated
- Association with audio channel
- Recording status (recording or not recording)
- Content analytics application associated with the camera

10. The VMS Application Suite shall allow the user to monitor and playback video on a full screen, a map, or a layout page displaying up to 25 cameras.

11. The user shall have the ability to monitor and playback video on a full screen, or on a camera layout page displaying a map.

12. The VMS shall allow the user the ability to define a homepage to be displayed in the local workstation. The homepage shall include a specific layout of video panes and pre-selected cameras either in live or playback modes.

13. The VMS shall support digital zoom on the workstation or external monitors (analog or digital). The user shall be able to perform the zoom magnification up to 20 times.
    - The zoom feature shall be available on monitor and playback modes.
    - The zoom feature shall provide Digital Pan-Tilt-Zoom (PTZ) functionality, allowing the user to Pan and Tilt within the zoomed image.
14. The VMS shall have the capability to allow the viewing of a video in live and playback modes and of alarm information on PDA using Windows platform. The Security Systems Contractor shall demonstrate the capability of this function only using LAWA provided wireless network.
15. The VMS shall enable the user to select to switch to previously displayed views, where a view contains both the layout and the channels selected with that layout.
16. The VMS shall have a motion detection capability to detect if an object enters a predefined area in the camera's Field of View.
17. The VMS shall allow operator's to write (copy) archived video to CD/DVD if allowed by user rights.
18. Performance:

    a. The VSS system shall be capable of supporting at least the number of CCTV cameras being added, plus 30%, 100 workstations in concurrent use, plus concurrent video offloading capabilities.
    b. The VMS client application shall launch and display the user's defined layout within 15 seconds of starting the application.

c. Video shall be displayed at any workstation within one second of requesting a live video and five seconds for archived video stored on the VSS.

d. Video shall be displayed in real time and neither the live nor the archive players shall have any noticeable delay in presentation at any time.

e. The failover of an application server, provide user authentication and video indexing, shall be less than two seconds to a redundant server.

f. The failover of an NVR server recording video shall take no longer than 30 seconds to switch to s redundant NVR.

g. PTZ commands sent from a workstation to the cameras shall take no longer .3 seconds to reach the camera (actual performance of the camera, e.g. slewing 90°, is not included).

h. The VMS shall be able to record streams of CIF or 4CIF at 15 frames per second simultaneously.

i. The VMS shall be able to simultaneously record video streams of up to 1.2Mbps per standard PTZcamera and 500 Kbps per Fixed cameras.

j. The Security Systems Contractor shall configure the VMS to remove all pixilation and image ghosting for encoded video from the encoders.

k. Digitally zoom in and out of pre-recorded video in pause, playback or live video mode.

l. Have instant reverse and synchronized playback.

m. Allow operator to select time and date for playback and be able to retrieve the requested video in less than 10 seconds.

n. Security Systems Contractor shall add new cameras to existing maps or will create new maps to display the location of the newly installed cameras associated with the System provided under this Contract. It shall include all the same capabilities of the current System.

o. The VMS and its components shall include all the same hardware, versions, features, programming and functionality as currently configured in the existing System. This includes but is not limited to:

1) Web Server Service.

2) Level of Service mechanism to accommodate communication between the remote sites and the Head End.

3) The viewing application shall provide capability to adjust video resolution and video frame rate.

4) Workstation configuration options include (1) Best available, (2) Pre-defined Bandwidth Limits, (3) User-defined Bandwidth Limits.

5) Capability to restrict User access to system resources.

6) Have the capability to restrict users during a pre-defined period.

7) Workstations provide support for PTZ keyboards and/or Joysticks to allow authorized users to control PTZ cameras. Workstations will have ability to create new PTZ presets, call up existing PTZ presets, and to predefine a home-preset for individual cameras and a predefined timeout after which a PTZ camera will return to a home preset.

8) Viewing application includes Tour feature.

9) Viewing application includes Salvo feature.

10) Viewing application includes Page, and Tour of Pages feature.

11) All workstation play back features as currently configures.

12) Web Server Service.

13) Level of Service mechanism to accommodate communication between the rmote sites and the Head End.

14) The viewing application shall provide capability to adjust video resolution and video frame rate.

15) Workstation configuration options include (1) Best available, (2) Pre-defined Bandwidth Limits, (3) User-defined Bandwidth Limits.

16) Capability to restrict User access to system resources.

17) Have the capability to restrict users during a pre-defined period.

18) Workstations provide support for PTZ keyboards and/or Joysticks to allow authorized users to control PTZ cameras. Workstations will have ability to create new PTZ presets, call up existing PTZ presets, and to predefine a home-preset for individual cameras and a predefined timeout after which a PTZ camera will return to a home preset.

19) Support management of alarms based on Video Motion Detection and 3rd party input such as API and Dry Contacts. Contains same functionality for Alarm management, notifications, and Alarm displays on local workstations.

20) Users shall have ability to define a set of presets for each PTZ camera, including presets that may be associated with an alarm.

21) As applicable, VMS capability of performing motion detection, and camera tampering detection, along with alarming upon such detection.

22) VMS shall enable setting for adjusting visual parameters of a camera, including Smoothness, Sensitivity and brightness levels.

p. VMS shall include Video Management though the Application Management (AMS) Server. It shall run on Microsoft Operating Server using Microsoft SQL Server. It shall be deployed at each physical site/station to allow autonomous operation of the station even if the communication to the Head-End is interrupted.

This server provides for data consistency and integrity of all the VMS components. The VMS/AMS shall be configured identical to the current installed system.

q. VMS shall include Video Recording System (NVR) and Video Storage System. Additional recording capacity must be provided when cameras are added. Video and audio from all IP cameras and Encoders shall be recorded on the Video Storage System for long term storage, and on the NVR for only short term storage. Security Systems Contractor shall ensure all programming of these systems are identical to the current Systems installed at LAWA. This includes, but is not limited to:

1) The VMS shall provide both a Continuous Recording mode for uninterrupted recording and an Event Recording mode that starts recording only during alarm conditions.
2) The VMS shall be capable of recording pre-alarm and post alarm at a predefined resolution and frame rate.
3) The system shall be sized sufficiently to accommodate recording of all cameras at CIF or 4CIF, 15 fps and 30% compression rate for continuous video recording as well as event recording.
4) The system shall be capable of dual streaming to accommodate additional recording provisions that may be determined by LAWA in complying with the other stakeholder requirements.
5) The VMS NVR shall have the ability to centrally store data via IP over a LAN/WAN network to the Video Storage System (VSS).
6) The system shall support recovery from network disconnections, by transferring buffered video from the source VMS NVR to the VSS, once the network had been recovered.
7) The recovery of the video and audio buffer shall be done in parallel to the real-time transfer.
8) Only authorized users shall have the ability to search the VSS using an investigation application provided by VMS.
9) The VMS shall allow for different retention periods for tiered storage applications.
10) The video recording process shall ensure validity and authenticity of the captured images for acceptance as legal evidence in a court of law.
11) The Security Systems Contractor shall provide VMS applications for the standalone CCTV system that continues to work and record by itself in the event it is disconnected from the centralized VMS applications.
12) The NVR shall support 2 separate network interface cards (NICs).
13) The NVR shall include support for the following network segments:
14) Video collection network – the network in which video is collected, encoded and transported over an IP enabled network to the NVR.
15) Video viewing network – the network in which video is transmitted across an IP enabled network, to remote or local decoding devices, which display it on analog or digital displays.
16) The NVR at standalone and remote locations shall continue functioning autonomously should the network connectivity be interrupted to and from the Enterprise VMS location.
17) The VMS shall support video streaming from the NVR or directly from the encoding devices.

18) When streaming directly from the edge devices the workstation will receive a multicast stream directly from the encoding device for monitoring purposes. The NVR will register to the same multicast group for recording.
19) The VMS shall support multicast at SSM mode (source specific multicast). The VMS shall be able to configure different multicast addresses per recording channels.

2.03 VMS VIEWING WORKSTATIONS

A. The VMS viewing workstations and its components shall include all the same hardware, versions, features, programming and functionality as currently configured in the existing System at LAWA.

B. Workstations shall be HP Z200 Small form factor workstation or equivalent.

C. The VMS Viewing Workstations shall be HP Z200 Small form factor workstation or equivalent.

D. The VMS Viewing Workstations' specification shall meet or exceed the selected VMS vendor's minimum hardware requirements to support streaming of at least 32 concurrent video channels.

E. The VMS Viewing Workstations shall be capable of supporting multiple monitors.

F. The Viewing Workstations shall have a USB interface keyboard with joystick device enabling proportional pan/tilt, and zoom functions for PTZ cameras

G. VMS Viewing Workstation Requirements:

1. Security Systems Contractor shall be responsible for notifying LAWA of discontinuation of computer hardware and software for the workstations announced by the Manufacturer and recommend a replacement to LAWA for approval.
2. The VMS Viewing Workstations shall be provided with any equipment and software required to view/playback audio and video, and control PTZ camera.
3. At the minimum the VMS Viewing Workstations shall comply with the following specifications:
   a. Processor: Intel® Pentium® G6950 2.8 3MB/1066 DC CPU, with 2.8GHz speed, and 8MB L2 Cache.
   b. Hard drive: 250GB (7,200rpm) SATA II.
   c. Memory storage: 2.0GB 2GB (2x1GB) DDR3-1333 ECC RAM.
   d. Video card: 512 and higher Graphics with onboard processor.
   e. 16X DVD+-RW medium.
   f. Dual VGA monitor, supporting 1024x768 and 32 bit color resolution, or higher.

g. Operating systems: Windows XP Professional SP3 (XP 32 bit) or Windows Vista SP2 Business edition (Vista 32 bit) or Windows Vista SP2 Ultimate edition (Vista 32 bit).

h. At least two (2) 22-inch widescreen LCD's

i. Standard Keyboard and mouse

j. Standard PC speakers

k. Professional keyboard and/or generic joystick for PTZ camera control

2.04 VIDEO STORAGE SYSTEM

A. The Video Storage System and its components shall include all the same hardware, versions, features, programming and functionality as currently configured in the existing System at LAWA.

B. The Video Storage System consists of an online, digital networked, and computer controlled, system designed for CCTV applications. This System shall provide capabilities for short and long-term storage of video through the use of rack mounted units to be located in LAWA Datacenter.

C. Video Storage System hardware shall be HP IBRIX 9720 from Hewlett-Packard Company. Various COTS servers as may be required to run the VMS software that communicates with the storage system (to be defined by the Security Systems Contractor). Security Systems Contractor shall itemize the servers and describe their usage to support the storage system.

D. Software – must be identical as that being currently used at LAWA.

E. Configuration – must be identical to current LAWA Video Storage System configuration.

F. Performance, Scalability, Reliability and Management of the Video Storage System includes, but is not limited to:

1. Be based on Industry standard servers approved by LAWA IT to be used in LAWA's Datacenters.
2. Be based on an open appliance, leveraging an Open Source operating system with full access to root.
3. Support both Red Hat Linux and Windows operating systems.
4. Support major file protocols (CIFS/NFS) concurrently.
5. Have a high capacity single namespace of 16 Petabytes (PB).
6. Be capable to scale performance or capacity independently.
7. Provide for a minimum of 14 Months of disk based storage.
8. Be sized as required herein with capacities as per LAWA video recording requirements.
9. Be NAS based
10. Provide a non-hierarchical file system, with multi I/O writing capability of video and audio data across the storage array.
11. Support the data storage requirements of the VMS (bit rate, 4CIF, etc.)
12. Support the exporting of a single mount point across all NAS front end VMS servers (primary and redundant) of the same Common Internet File System (CIFS) share simultaneously.
13. Provide the capability for dynamic storage re-balancing by distributing files across disks.

14. Disk drives shall have a minimum size of 2 Terabytes (TB) per disk and minimum rotational speed of 7200 RPM.
15. Provide a modular, scalable and flexible platform for centralized storage supporting from TB’s to PB’s of storage.
16. Contain sufficient scalability so that the storage can grow appropriately to support higher resolution storage.
17. Have the capability for online file system expansion and shrinking.
18. Support dynamic assignment of additional nodes to a file system.
19. Provide architecture for both forward and backward compatibility.
20. Solution must have the ability to mix and match new and old technology and manage all data as one system.
21. Have the capability to add/offload data to other media types including tape drives via defined automated file migration utilities set under policy management.
22. Provide redundancy for all critical components.
23. Include dual power supplies.
24. Provide high availability (redundant) connectivity for all core servers.
25. Leverage hardware based RAID with RAID 6 double parity and hot spares.
26. System failover file services shall be less than 120 seconds.
27. Shall include proactive/preventive disk sparing.
28. Shall have non-disruptive storage retirement/refresh.
29. Shall provide Multi Path IO (MPIO) (dual paths from storage processors to disk enclosures).
30. Provide automatic NAS head failover/clustering.
31. Failover threshold must be less than 90 seconds.
32. Support partial file system offline features for disk integrity checks.
33. Provide the capability for continuous remote replication and data tiering.
34. Security Systems Contractor shall provide 20% spare disk drives
35. Provide system management capabilities through GUI, CLI, and Web Services.
36. Support Secure Shell (SSH access to the command line interface.
37. Have the ability to provide full root access for command line scripting of all GUI functionality.
38. Provide a single interface for system configuration and control to include: status monitoring, performance utilization, file system expansion, servers, and disk capacity.
39. Provide the capability for operational and performance monitoring via Simple Network Monitoring Protocol (SNMP).
40. Have the ability to provide full historical performance statistic information on all system resources.
41. Have the ability to manage multiple file systems from a single management console.
42. System allocation and reallocation must be simple, flexible and non-intrusive.
43. Support online patching of firmware and OS upgrades.
44. Provide non-disruptive upgrade capability to the storage subcomponents.
45. Include an interface which has the ability to power cycle system sub-components remotely.
46. Include a Network Time Protocol (NTP) client for time synchronization.
47. Provide security features to mitigate unauthorized access and/or modification of data and protect the confidentiality, integrity, and availability of the data.
48. Provide security features that enable access control and role based access for authorized views.

2.05 VIDEO ENCODERS

A. Video encoders and its components shall include all the same hardware, versions, features, programming and functionality as currently configured in the existing System at LAWA.

B. Video encoders shall be used to allow access to and control of existing analog cameras over IP while eliminating the need for analog monitors and VCRs. Encoders shall be available in standalone version to support 1 - 4 video channels, as well as rack mounted version supporting 16 – 84 video channels.

C. All encoders shall be rack mountable. The standalone encoders shall be installed within rack mountable Trays.

D. SUPPLIERS: Video Encoders shall be products from Axis Communications Inc., or equivalent as follows:

A/E, Tenant must obtain current ordering information from LAWA prior to specification bid	
Audio Encoders for Enterprise VMS	
Audio Encoders to Support encoding of 160 channels of Audio.	
Items/description	**Part no**
Siqura Audio Encoder Chassis	MC 10 AC-115/EB-2
Siqura Audio Encoder Module	A-80
Video Encoders for Standalone Systems	
Video Encoders to supporting encoding	
Items/description	**Part no**
AXIS Standalone Encoder (Q7404)	#291004
AXIS 6 Channel Blade (Q7406)	#289001
AXIS 1U Chassis (291 1U)	#267004
SONY 4 Channel Blade	SNT-EX154
SONY 1U Chassis	SNT-RS1U
Video Decoders for Video Wall	
Video Decoders to support monitoring capability on Video Walls. Wherever possible, decoders shall not be used. IP based video wall and audio systems shall be implemented. The IP based video wall and audio system shall be capable of accepting IP streams from IP cameras as well as audio and video encoders.	
Items/description	**Part no**

Nice Video Decoder (4 channel)	NVD 5104
VMX License	NVD-5104-VMX

1. Standalone Video Encoders with integrated audio, PTZ and I/O control shall be AXIS Q7404 or equivalent.
2. Axis Q7414 or P7224 encoders are to be used for encoding audio and video signals.
3. Multi-channel Video Encoders with integrated PTZ and I/O control shall be AXIS Q7406 or equivalent
4. Multi-channel Video Encoders to support Pelco Coaxitron protocol shall be SONY SNT-EX154
5. Multi-channel Video/Audio encoders with integrated PTZ and I/O control shall be Axis or alternatively
6. Audio only encoders shall be Siqura MC10 with A-80 audio card. or equivalent
7. In applications requiring use of SONY Video blades, SONY SNT-RS1U chassis shall be used.
8. Encoder Module Back Plane shall be AXIS Q7900 or equivalent with redundant power supplies and be capable of holding fourteen (14) multi-channel encoder modules
9. In applications requiring 4 to 18 Video channels (1 to 3 encoder blades) the Axis 291 1U chassis or equivalent shall be used.
10. The Video Encoder shall meet the MPEG-4 standard ISO/IEC 14496-10 AVC (H.264).
11. The specified unit(s) shall be manufactured in accordance with ISO 9001 / EN 29001 / 14000. They shall also be compliant with 2002/95/EG RoHS and 2002/96/EG WEEE.
12. Video Encoder shall meet the following networking standards:
    - IEEE 802.1X (Authentication)
    - IPv4 (RFC 791)
    - IPv6 (RFC 2460)
    - QoS – DiffServ (RFC 2475)

E. In addition to Video encoding capability, encoders shall also support audio, alarm activation via digital input and output, and PTZ control via built-in Serial Ports.

F. The Video encoder shall operate on an open source Linux-based platform, and shall include a built-in web server.

G. The video encoder shall be fully supported by an open and published API, which shall provide necessary information for integration of functionality into third party applications

H. For each channel, the encoder shall provide at least three individually configured simultaneous video streams at 30 frames per second (NTSC) in all resolutions up to 720x480 pixels (NTSC) in Motion JPEG and H.264. Users will not directly access the encoder. It shall provide 40% or higher compression using H.264 codec. Encoders shall be capable of running two simultaneous video streams to allow for recording and viewing at different rates. It shall not incur a delay of greater than 250ms for encoded video sent to the VMS. The Video encoder shall for each channel:

1. Use a dedicated video compression chip.
2. Provide at least 64 MB memory for pre & post alarm recording.

I. Audio – Performance: The encoder shall not incur a delay of greater than 150ms for encoded audio sent to the VMS. The encoder shall record single channel audio. Shall utilize Audio encoding AAC with max 16Hz, 64kbit/s.

J. Video: The video encoder shall, for each channel, be able to deliver at least three individually configurable full resolution full frame rate video streams over IP networks. The encoder shall at least support CIF (352x240) and D1 (720x480) resolutions. The H.264 implementation shall include support for both Constant Bit Rate (CBR) and Variable Bit Rate (VBR), and shall support both unicast and multicast over RTP. The video encoder shall provide configurable compression levels and contain embedded de-interlacing filters.

K. Audio: The Audio module shall be able to decode and encode full duplex Audio. The Module shall support the use of at least 12V phantom powered balanced microphones and be equipped with an adjustable gain. The Audio encoder shall be equipped with a built in pre-amplifier.

L. The module shall support two-way full duplex audio functionality:

   A. Input sources : External microphone and External line device

   B. Output sources: External line device

M. The module shall support the following for encoding:

   1. AAC LC at 8/16/32 kHz, 8-128 Kbit/s

   2. G.711 PCM at 8 kHz, 64 Kbit/s

   3. G.726 ADPCM at 8 kHz, 32 or 24 Kbit/s

N. The module shall support the following for decoding:

   1. G.726 ADPCM at 8 kHz, 32 or 24 Kbit/s

   2. G.711 PCM at 8 kHz, 64 Kbit/s

   3. G.711 PCM at 16 kHz, 128 Kbit/s

O. Functionality The video encoder shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software. Optional components downloaded from the video encoder for specific tasks, e.g. Active X, shall be signed by an organization providing digital trust services, such as VeriSign, Inc. Each encoder channel shall support up to 20 simultaneous unicast clients and unlimited number of clients using multicast H.264. The encoder shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server and the encoder shall use an individual IP address for each video channel. The encoder shall allow for automatic detection of the encoder based on UPnP and Bonjour when using a PC with an operating system supporting this feature.

P. The video encoder shall for each video channel shall provide the ability to control network traffic by limiting the maximum bandwidth to a selected value, and the capability to limit the frame rate per viewer to a selected value, as well as the duration of each viewing session. Support Quality of Service (QoS) shall be able to prioritize traffic.

Q. The video encoder shall provide the ability to control PTZ devices from third party manufactures via appropriate PTZ drivers for the existing cameras. Security Systems Contractor shall develop, if needed, drivers for the specified encoders to support all PTZ protocols currently being used at LAX including, but are not limited to, Pelco-P, Pelco-D, Pelco Coaxitron, Cohu, and Manchester. Provide at least 100 preset positions. Provide a guard tour functionality which allows the PTZ device to automatically move between selected presets using an individual speed and viewing time for each preset. The encoder shall be equipped with an integrated event functionality, which can be triggered by:

1. External input
2. Video Motion Detection
3. Video loss
4. Schedule
5. Camera tampering

R. Response to triggers shall include:

1. Notification, using TCP, SMTP or HTTP
2. Image upload, using FTP, SMTP or HTTP
3. Preset call up
4. Activating external output

S. Event functions shall be configurable via the web interface. The encoder shall incorporate support for at least IP, HTTP, HTTPS, SSL/TLS, TCP, ICMP, SNMPv1/v2c/v3 (MIB-II), RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, UPnP, ARP, DNS, DynDNS, SOCKS, NTP and Bonjour. The encoder shall for each video channel:

T. Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.

U. To ensure accuracy, the video encoder shall accept external time synchronization from an Network Time Protocol (NTP) server.

V. Provide the ability to apply a privacy mask to the image.

W. Allow for the overlay of a graphical image, such as a logotype, into the image.

X. Encoder Physical Interfaces: The module shall be equipped with 1-12 serial ports, supporting the serial connectivity for PTZ control. The Video encoder shall be equipped with minimum 4 (in standalone unit) and maximum of 6 (in a Blade unit) BNC connectors for analog composite video input with each channel being capable of auto sensing NTSC/PAL. SONY encoders shall be used where Pelco Coaxitron protocol is required to support PTZ functionality for a specific site. The Audio encoders shall be equipped with 4-12 pins that can either be configured as digital (alarm) inputs or digital outputs, connected through a removable terminal block. These inputs shall be capable of responding to normally open (NO) or normally closed (NC) dry contacts.

1. The module shall provide the following audio connectivity:
2. Line in/Mic in through 3.5mm jack

3. Line out through 3.5mm jack
4. Balanced microphone input through terminal block
5. Speaker out through terminal block – 0,5W RMS at 4Ω

Y. Management - The encoder shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the Video encoders' configuration. Support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II. Allow updates of the software (firmware) over the network, using FTP or HTTP. All customer-specific settings shall be stored in a non-volatile memory and shall not be lost during power cuts or soft reset. Provide a log file, containing information about all users connecting to the unit since last restart. The file shall include information about the connecting IP address and the time of connecting. Provide a connection list of all currently connected viewers. The file shall include information about the connecting IP address, time of connecting and the type of stream accessed. Be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the encoder's operational status and provide information about power, communication with receiver and encoder status. Be monitored by a watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected. The encoder chassis shall, through the multi-pin connectors, provide the video encoder with chassis id information and power supply and fan status information.

Z. Security - The video encoder shall for each video channel: Support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams. Restrict access to the built-in web server by usernames and passwords at three different levels. Support for restricting access to pre-defined IP addresses only (IP address filtering). Support IEEE 802.1X authentication. The SMTP implementation shall include support for SMTP authentication.

AA. Encoder Chassis - General: The encoder chassis shall comply with all the requirements mentioned in above sections. The encoder chassis shall be manufactured with an all metal casing. The rack mounted chassis shall be designed for installation in standard EIA 19" racks. The encoder chassis shall operate in a temperature range of 0°C to +45°C (32°F to +113°F) and a humidity range of 20–80% RH (non-condensing).

BB. Standalone Encoder: The Standalone encoder shall be used in applications requiring 2-4 channels within the same location where installation of rack mount encoder is not recommended. The encoder shall be equipped with four analog video inputs, one channel of audio and a 1000BASE-T Gigabit Ethernet interface. The encoder shall be equipped with one RS422/485 port per channel providing the ability to control third part PTZ and dome cameras and two I/O ports per channel, configurable as in- or output.

CC. Low Density Rack Mounted Chassis: The Low Density chassis shall be used in applications requiring 5-18 channels to the maximum of 72 video channels within the same location. The encoder chassis shall be equipped with an embedded universal power supply. The encoder chassis shall be equipped with a standard IEC connector for power 100 – 240 VAC, 50/60 Hz, max 80W.

DD. The encoder chassis shall provide three available card slots for video server blades. The encoder chassis shall provide embedded passive network switch functionality, and be equipped with a 1000BaseT Gigabit Ethernet port. The encoders chassis shall provide hot-swap of video server blades, whereby blades may be removed and/or inserted without the need to power off/restart the rack. The encoder chassis shall be equipped with three multi-pin connectors, providing connectivity for video server blades. The encoder chassis shall be equipped with one 1000BaseT Gigabit Ethernet-port, using a standard RJ-45 socket and shall support auto sensing of network speed. The encoder chassis shall, for each card slot, be equipped with a removable terminal block providing connectivity to I/O functions and serial data from the video server blade.

EE. High Density Rack Mounted Chassis: The high Density chassis shall be used in applications where more than 72 video channels need to be encoded in a same location. The encoder chassis shall provide 2 redundant hot-swap power supplies, whereby power may be removed and/or inserted without affecting operation of the rack. Each power supply shall be equipped with a standard IEC connector for power; 100 – 240 VAC, 50/60 Hz, max 480W.

FF. The encoder chassis shall provide hot-swap of 3 replaceable fan cassettes, whereby cassettes may be removed and/or inserted without affecting operation of the rack. The encoder chassis shall provide hot-swap of video server blades, whereby blades may be removed and/or inserted without the needs to power off/restart the rack. The encoder chassis shall provide 14 available card slots for blades. The encoder chassis shall, for each card slot, be equipped with a removable terminal block providing connectivity to I/O functions and serial data from/to the blade. The encoder chassis shall be equipped with multi-pin connectors, providing required connectivity between rack and blades. The encoder shall be equipped with four 1000BASE-T Gigabit Ethernet ports, using standard RJ-45 sockets and shall support auto sensing of network. The encoder chassis shall provide the ability to daisy-chain network functionality to use 1, 2, 3 or 4 Gigabit network ports selectable via dipswitches. The encoder chassis shall, for each card slot, be equipped with a removable terminal block providing connectivity to I/O functions on the blade (one per slot), configurable as digital (alarm) inputs or digital outputs. These inputs can be configured to respond to normally open (NO) or normally closed (NC) dry contacts. The encoder chassis shall, for each card slot, be equipped with a removable terminal block providing connectivity to serial data from/to the blade (one per port).

2.06 VIDEO DECODERS

A. Video decoder shall be used to convert the network digitized video and audio streams back to analog signals which can then be connected to regular analog monitors, and video walls within command center. The decoder shall be TV sets(such as LCD), analog monitors, and video walls within command center. The decoder shall be, designed for commercial/industrial 24/7/365 use and based upon standard components and proven technology using open and published protocols.

B. Supplier: The Video Decoder shall be NICE NVD-5004 or equivalent The Decoder shall be rack mountable or alternatively installed within rack mountable trays. The decoder shall be equipped with one video output, providing analog and digital signals, one channel of audio. The unit shall be designed to decode Motion JPEG, MPEG-4, and H.264 video sources in resolutions up to 720X480 pixels (NTSC) at 30 frames per second. The decoder shall be equipped with a serial port, providing ability to send serial data to the encoding side. The unit shall be powered through power over Ethernet according to IEEE802.3af, class 3; 8-20 VDC, max 9W.

C. VIDEO: Video Decoder shall be able to deliver digital video with resolutions up to 1280x720 pixels (HDTV 720p), depending on the quality of the originally encoded video. The unit shall allow for scaling of video to at least 1280x720 pixels for optimized quality on LCD monitor.

D. AUDIO: The video decoder shall support simplex audio via external line devices. The Video decoder shall support:

1. AAC LC
2. G.711 PCM
3. G.726 ADPCM

E. Performance: Video Decoder shall be able to deliver digital video with resolutions up to 1280x720 pixels (HDTV 720p), depending on the quality of the originally encoded video. The unit shall allow for scaling of video to at least 1280x720 pixels for optimized quality on LCD monitor.

F. Functionality: The video decoder shall be able to connect to at least 200 different video encoders or network cameras as defined when configuring the unit. Remote sources shall be addressed using either IP address or a DNS-name. The decoder shall provide the ability to manually or automatically, using a selected dwell time, toggle between defined remote sources. It shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software. Optional components downloaded from the decoder for specific tasks, e.g. Active X, shall be signed by an organization providing digital trust services, such as VeriSign, Inc. The unit shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server. The decoder shall allow for automatic detection of the video decoder based on UPnP and Bonjour when using a PC with an operating system supporting this feature. The decoder shall provide support for both IPv4 and IPv6. The decoder shall be equipped with one DVI-I connector for digital and analog video output plus one RCA connector for analog composite video output , with one RS-485/422 serial port and one pin that can be used to manually select/jump between defied and available video sources and with one 3.5 mm jack for line output.

G. Management: The decoder shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the Video encoders' configuration. It shall allow updates of the software (firmware) over the network, using FTP or HTTP. The decoder shall support use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II. All customer-specific settings shall be stored in a non-volatile memory and shall not be lost during power cuts or soft reset. The Unit shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the encoder's operational status and provide information about power, communication with receiver and encoder status. Be monitored by a watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.

2.07 NETWORK SWITCHES

A. The Network Architecture shall include provisions for segregating Viewing Segment (local and remote workstations) from Collection Segment (Edge devices including IP Cameras and

Encoders) , Recording Segment (NVRs and Storage system), and Management Segment (AMS and Domain Servers). Network hardware and configuration shall be of the same hardware, software, versions, features, programming and functionality as currently configured in the existing CCTV Network Architecture at LAWA. Network shall deliver high performance by placing network switches in 3 different hierarchical Access, Distribution, and Core layers.

B. The Security Systems Contractor shall provision Access Control and filtering at the Distribution Layer.

C. The resource utilization of Network Switches shall be configured such that it will not exceed 50% of the rated bandwidth of any device when piping streaming data.

D. The Security Systems Contractor shall select and install appropriate network switches from amongst LAWA provided list of approved networking equipment for CCTV.

E. The Security Systems Contractor shall collaborate with LAWA to determine the correct configuration and shall configure the switch for connectivity to LAWA network.

2.08 WIRE AND CABLE

A. Low voltage wire and cable shall be provided and installed as required, except as otherwise indicated in the drawings and specifications. Wire and cable shall be selected and used as appropriate for the device application in accordance with the device manufacturer's specifications, voltage and load, and distance of the wire/cable run. Wire and cable runs shall be "home run". Mid run splices shall not be permitted. Wire and cable shall be Belden, West Penn, Contractors Wire and Cable, or approved equal.

2.09 SYSTEM SECURITY

A. System Security shall be identical to hardware, software, versions, features, programming, functionality, auditing, virus protection and detection as currently provided in the existing CCTV Video System at LAWA.

B. Security requirements in this section apply to all components and subcomponents of the Video System. All security configurations shall be in accordance with established LAWA security policies, and the Contractor shall collaborate with LAWA to utilize existing LAWA security management devices. The Security Systems Contractor shall apply communications security techniques to the extent necessary to deny information to unauthorized personnel and to effectively defend the system against interception, traffic analysis and deception.

C. The Security Systems Contractor shall provide IT Security that incorporates intrusion prevention through filtering methods to reduce the possibility of malicious traffic entering the system from external resources.

D. The Security Systems Contractor shall provide IT Security that enforces a policy that requires workstations and personal computers to invoke a password-protected screen saver after a system administrator-configurable period of user inactivity.

E. The Security Systems Contractor shall design each system component with an audit capability that performs an administrator-configurable notification action upon detection of a potential security violation.

F. The Network based access control list (ACL) shall be used to control access between secure network and other Airport resources. The Security Systems Contractor shall ensure ports, protocols, and services that are not required are denied at the network level and disabled at the system level.

PART 3 - EXECUTION

3.01 GENERAL

A. LAWA's overarching security strategy calls for the protection of people, property, aircraft, and efficient continuity of vital operations. This strategy requires implementation of a Video System intended to enhance the ability of LAWA and affiliated agency personnel to effectively deter, detect, delay, prevent, alert, protect, respond, and recover from any situation, threat, or incident involving passengers, employees, tenants, operations, aircrafts, and critical infrastructure in an effort to ensure their safety and security and enhance the existing operational capabilities.

B. The Security Systems Contractor shall design, procure, install, configure, test and commission the new system components, provide seamless integration with other existing security systems, and test all system components. The Security Systems Contractor shall provide training to LAWA end users and system administrators.

C. During the deployment phase the Security Systems Contractor shall provide Warranty and Operations and Maintenance support. Upon system acceptance by LAWA, the Security Systems Contractor shall ensure LAWA CCTV Maintenance Provider will maintain the new devices and software for a minimum of 2-years from date of acceptance at no additional cost to LAWA.

D. The Security Systems Contractor shall be responsible for management and performance of its subcontractors, ensuring that all tasks are completed on time.

E. To complete the scope of this project, the Security Systems Contractor or approved subcontractor shall be a certified on the installation and configuration of the Video System and its subsystems. The Security Systems Contractor shall provide a manufacturer's certification of not less than fifteen (15) years for the voice and data cabling. The Security Systems Contractor shall offer proof of certification by submitting a copy of certification with the proposal.

F. The Security Systems Contractor shall assess the deadline for project activities and furnish an adequate supply of technicians and materials at all times, and shall perform the work in the most appropriate, expeditious, and economical manner to meet the deadline to avoid delay to the project.

G. The Security Systems Contractor shall provide all services and equipment (overheads, administrative supports, office spaces, parking, labor, hardware, software, etc.,) necessary to design, develop, implement, integrate, and test a complete digital, networkable, retrievable, Video System as defined in this specification.

3.02 EXAMINATION – SITE CONDITIONS

3.03 PREPARATION

A. Security Systems Contractor shall comply with all manufacturers' instructions and recommendations concerning environmental factors.

B. Fragile Items - Security Systems Contractor shall handle any fragile items with care using protective coverings to avoid damage to sensitive instrument relays, and other devices, and to avoid contamination by dirt and debris.

C. Electrostatic charge protection - Security Systems Contractor shall, during installation, provide adequate mechanisms to ensure proper grounding to avoid damage to equipment.

D. Security Systems Contractor shall inspect the site and identify all existing security provisions and conditions. This includes identifying any communications and/or ancillary equipment currently existing and/or in use. It shall be the Security Systems Contractor's responsibility to identify all existing provisions to be terminated to new, existing, or relocated systems.

E. The Security Systems Contractor shall provide LAWA with electrical load calculations for all Servers and devices along with uninterrupted power supply (UPS) requirements for every facility where new equipment shall be installed.

F. Power Schedule shall include the following information which is required by LAWA to ensure each facility can accommodate the new electrical power requirements of the new equipment being installed:

   1. Combined Power in Amps
   2. Combined Power in Watts
   3. Combined VA Rating
   4. AC Voltage requirement
   5. Power Receptacle requirements (single or three phase)
   6. Number of Power Receptacles required per Rack
   7. Combined power Receptacle requirement

G. The Security Systems Contractor shall ensure that adequate environmental controls have been installed within each installation site. The Security Systems Contractor shall provide LAWA with a complete calculation of the British thermal Units (Btu's) generated showing; Thermal Btu/hour of each server or device. And combined Btu/hour for all the new equipment to be installed. The Security Systems Contractor shall ensure that adequate controls are in place to maintain:

H. Operating Temperature: 5°-to-35°C (40°-to-95°F).

I. Operating Humidity: 20%-to-80% (non-condensing).

J. Non-operating Temperature: -40°-to-70°C (-40°-to-158°F).

K. Equipment Racks: Within 15 days after award of the Contract, the Security Systems Contractor shall provide LAWA with exact number of racks needed to accommodate new servers and devices within Data Center. LAWA shall allocate enough space to install VMS/VSS racks in a secure location providing network connectivity between the different segments of the network connecting the Video System equipment.

L. Communications : Although LAWA will be responsible for provisioning, facilitating, and configuring the Security Network Infrastructure within its Communication System, the Security Systems Contractor shall be responsible to provide detailed information including but not limited to the location and number of the required network switches, Port density, Routing Protocols, Access Control Lists (ACL), Network Performance requirements, Device Schedules, and description of how these switches are to be connected. The Security Systems Contractor shall design a “process control network” specific to the Security Systems. This shall be configured as a dedicated VLAN on LAWA enterprise network infrastructure isolating it from existing LAWA “Business Network”.

M. The Security Systems Contractor shall provide all of the connectivity requirements between the project locations, security workstations and head end devices, within 15 days from contract Notice to Proceed (NTP).

N. The Security Systems Contractor shall provide LAWA with detailed Single-Line diagrams showing the signal flow path between all the networking devices in the VMS/VSS design.

O. The Security Systems Contractor is responsible to provide network connectivity between the security devices within each facility such as Standalone locations, Telecom building and/or Data Center. LAWA will provide network connectivity between the facilities.

P. The Security Systems Contractor shall provide interconnectivity requirements between new Video System components and existing systems to accommodate sharing of the security information (Video, Audio, Alarm) and resources (camera controls). This connectivity shall include but not limited to providing access between Video System infrastructure and different Command and Control Centers at the LAX airport such as AOC, AEOC, TBIT Terminal Operations Center, ARCC, and/or any other monitoring location identified by LAWA.

Q. The Security Systems Contractor shall provide network connectivity requirements between workstations, Edge devices, VMS, and VSS equipment throughout LAWA Campus. This connectivity is included but not limited to:

R. Network connectivity between Access Layer switches attached to the new and existing edge devices at Standalone locations, Telecom building, Admin West building, Badge building, TBIT and associated the Video System Distribution Later Switches in the Data Center and/or Physical location of AMS/NVR servers.

S. Network connectivity between the Distribution Layer Switches at the Data Center and Access Layer switches attached to the Security Workstations located in Standalone locations, Telecom building, Admin West building, Admin East building, Badge building, TBIT, other terminal buildings, and/or other locations identified by LAWA.

T. The Security Systems Contractor shall provide LAWA with design requirements for configuring multicast protocol for the security systems.

U. The Security Systems Contractor shall provide requirements to obtain and assign Static IP addresses from LAWA IT for all Servers, Workstations, encoders, and networking devices.

V. Video/Audio Encoders - Installation and Configuration processes for all existing and new encoders shall be standardized. Following tasks shall be accomplished to achieve standardization across all video/audio encoders.

1. Review existing design and validate, recommending adjustments to design as needed
2. Devise standardized configuration
3. Plan for correcting existing configurations

4. Establish processes for installing and/or configuring encoders to meet specification

W. VMS - Review existing design concepts and validate. Provide an OEM Certified Engineer to support/perform installation and configuration planning with LAWA. Establish processes for installing and configuring VMS to meet specifications.

X. Video Storage System - Review existing design concepts and validate. Provide an OEM Certified Engineer to support/perform Installation and configuration planning with LAWA. Establish processes for installing and configuring VSS to meet specifications.

Y. Security Systems Contractor shall conduct site walks and provide a list of observed deficiencies to LAWA for site improvement to add power, HVAC, Grounding, etc. prior to installation.

Z. Decommissioning and removal of existing legacy system components, including but not limited to, VCRs. All recovered equipment shall be turned over to LAWA.

AA. Provide calculations for new equipment installed under this project (power to equipment racks and UPS upgrade to be provided by LAWA/others).

BB. HVAC: Provide calculations for heat dissipated from existing and new equipment to determine any additional HVAC requirements for equipment rooms. Any mechanical enhancements are not included in this project.

CC. The Security Systems Contractor shall be responsible for the interface design and implementation with all internal and external interfaces, and shall plan for these activities

DD. The Security Systems Contractor shall implement a way to record the audio from various microphones and associate it with a primary security camera so that synchronized video and audio are available for playback.

EE. PTZ – The Security Systems Contractor shall ensure that the Video System meets the response time for alarms. When the VMS is notified of an alarm it will pop-up the fixed camera or positions a PTZ camera within one second.

FF. The Security Systems Contractor shall ensure that PTZ commands sent to camera from the VMS will perform as quickly as PTZ commands from the current PTZ keyboards. The camera shall receive the command within 250ms from the VMS.

GG. VMS to CAD - The Security Systems Contractor shall review the interface requirements for VMS to CAD, and plan the design/development activities necessary to create the required interfaces.

HH. ACAMS Integration for Alarms – when new cameras are installed to view specific doors, the Security Systems Contractor shall design and implement an interface to the ACAMS system. The interface shall accept alarms via a TCP/IP sockets interface. The VMS shall forward the alarm to CAD using the same TCP/IP sockets interface that CAD and ACAMS use today.

3.04 INSTALLATION

3.05 IDENTIFICATION AND LABELING

A. All cables and patch cables shall have a permanent label attached at both ends.

B. The Security Systems Security Systems Contractor shall confirm specific labeling requirements with LAWA IT prior to cable installation or termination.

C. All indoor cable and patch cable labels shall be pre-printed using BRADY TLS 2200 printer or equivalent and shall be placed loose on the patch cable near the connector end without heat shrinking labels. Labels shall use a three line format with the origination patch panel and port on the first line, the destination patch panel and port on the second line and the system or other descriptive information on the third line.

D. Marking:

1. Equipment Name Plates: The following requirements shall apply:

a. General: Attach a permanent, corrosion-resistant name plate to each equipment component showing the manufacturer's name, address, serial number and equipment rating. Each name plate shall be clearly visible on the exterior of equipment. Components located within equipment enclosures shall also be provided with name plates.

b. Location and Fastening: Provide nameplates to identify all equipment components. Provide each panel assembly with a name plate on the interior of equipment enclosures, indicating number of equipment and unit of assembly. Fasten name plates securely with slotted stainless steel screws. The use of adhesive for fastening name plates will not be permitted.

c. Control and Display Labels:

1) Use: Each control, display and any other item of equipment that must be located, identified, read or manipulated shall be appropriately and clearly labeled to permit rapid and accurate identification of its operating state of position.

2) Orientation: Orient labels and information thereon horizontally so that they may be read quickly and easily. Vertical orientation shall be used only where space is limited.

3) Locations: Locate labels so that there is no confusion as to which item they identify. Labels shall not obscure any other information required by the operator. Controls shall not obscure labels. The location of labels shall be consistent.

d. Use Permanent Room Numbers as indicated on the Room Finish Schedules for construction period identification of rooms and building spaces. All required shop drawings and submittals, including manuals and Project Record Drawings shall identify rooms and spaces using the Permanent Room Numbers. Permanent identification devices including signage, equipment nameplates, and panels shall use the Permanent Room Numbers.

3.06 QUALITY CONTROL / SYSTEM TESTING AND COMMISSIONING

A. General: Installation and acceptance tests shall be conducted in the normal operational environment to the maximum extent possible. The tests shall represent operation in the normal mode in which each system will operate. If interfaces are incomplete, provide simulation of those interfaces so that the system may be tested as a complete and stand-alone entity. Perform all equipment repair and/or adjustment that may be required during acceptance testing.

B. In addition to any acceptance testing requirements specified elsewhere, the Video System shall be fully tested and accepted, with test results recorded individual test reports for review and acceptance. All Video devices and equipment shall be tested.

C. In addition to any acceptance testing requirements specified elsewhere, cameras shall be fully adjusted and tested to provide optimal video pictures and signals. All camera adjustments and settings available shall be utilized and adjusted. All camera adjustments and settings shall be recorded in individual camera test reports for review and acceptance.

D. Phases of Testing

1. On-Site Performance Verification Testing
2. On-Site Commissioning Testing

E. Test, Commission and Acceptance

1. Conduct an Installation Test and total Acceptance Test upon completion of equipment installation. Testing shall be coordinated as necessary, to demonstrate that all interfaces have been successfully implemented.
2. Installation and Acceptance Test Plan and Reports:

a Installation and acceptance tests shall be conducted in the normal operational environment to the maximum extent possible. The tests shall represent operation in the normal mode in which each system will operate. If interfaces are incomplete, provide simulation of those interfaces so that the system may be tested as a complete and stand-alone entity. Perform all equipment repair and/or adjustment that may be required during acceptance testing.

b Security Systems Contractor shall submit a Test Plan for Installation and Acceptance Tests and Commissioning for the review and approval of LAWA IT and the Design Engineer. The test plan for each phase shall detail the objectives of all tests. The tests shall clearly demonstrate that the system and its components fully comply with the requirements specified herein. The test plan shall be provided at least forty-five (45) days prior to the scheduled start of each test. Test plans shall contain at a minimum:

1) Test equipment is to be identified by manufacturer and model
2) Interconnection of test equipment and steps of operation shall be defined
3) Expected results required to comply with specifications
4) Record of test results with witness initials or signature and date performed
5) Pass or fail evaluation with comments

3. Installation and acceptance tests shall be conducted in the normal operational environment to the maximum extent possible. The tests shall represent operation in the normal mode in which each system will operate. If interfaces are incomplete, provide simulation of those interfaces so that the system may be tested as a complete and stand-alone entity. Perform all equipment repair and/or adjustment that may be required during acceptance testing.

4. In addition to any acceptance testing requirements specified elsewhere, cameras shall be fully adjusted and tested to provide optimal video pictures and signals. All camera adjustments and settings available shall be utilized and adjusted. All camera adjustments and settings shall be recorded in individual camera test reports for review and acceptance.

5. The Test Plan shall provide conformity to all specification requirements. Satisfactory completion of the test procedure is necessary as a condition of system acceptance.

6. Documentation verification, both interconnects and functionality, shall be part of the test. Where documentation is not in accordance with the installed system interconnect and operating procedures, the system shall not be considered accepted until the system and documentation correlate.

7. The Security Systems Contractor shall cooperate with and provide LAWA representative(s) the opportunity(s) to participate in any or all of the tests.

8. Test Reports: The Security Systems Contractor shall submit for each test, a test report document that shall certify successful completion of that test. Submit for review and acceptance within seven (7) days following each test. The test report shall contain, at a minimum:

   a. Commentary on test results.

   b. A listing and discussion of all discrepancies between expected and actual results and of all failures encountered during the test and their resolution.

   c. Complete copy of test procedures and test data sheets with annotations showing dates, times, initials, and any other annotations entered during execution of the test.

   d. Signatures of persons who performed and witnessed the test.

9. Test Resolution: Any discrepancies or problems discovered during these tests shall be corrected by the Security Systems Contractor at no cost to LAWA. The problems identified in each phase shall be corrected and the percentage of the entire system re-tested determined by LAWA IT, before any subsequent testing phase is performed.

10. Adjustment, Correction, and Completion:

    a. Correct deficiencies and retest affected components.

    b. Make necessary adjustments and modification to system after obtaining approval of LAWA IT.

    c. Completion: Performance verification test shall be complete when testing or retesting of each component has produced a positive result and has been approved in writing by LAWA IT.

11. Recording:

a. Describe actual operational tests performed and equipment used and list personnel performing tests.

b. Record in tabular form all test results, deficiencies, and corrective measures.

12. Termination

a. Performance verification test shall be terminated by LAWA when:

1) Individual components, subsystems, or the integrated system fail to perform as specified.

2) It is determined that system is missing components or installation is not complete.

b. Upon termination, corrective work shall be performed and performance verification test rescheduled with LAWA.

c. Retesting shall be performed by Security Systems Contractor at no additional expense.

d. Security Systems Contractor shall continue to perform corrective actions and retest until system passes all tests to satisfaction of LAWA IT.

13. The Security Systems Contractor will not be responsible for failures caused by:

a. Outage of main power in excess of backup power capability provided that automatic initiation of all backup sources was accomplished and automatic shutdowns and restarts of systems performed as specified.

b. Failure of any LAWA furnished power, communications, and control circuits provided failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing LAWA equipment provided failure was not due to Security Systems Contractor furnished equipment, installation, or software.

14. Obtain specific approval from LAWA IT of all lens selection, camera field of view, point of focus, video quality and recording.

15. After all installation and acceptance test requirements specified have been complied with, the equipment shall be commissioned.

C. System Commissioning:

1. Video Commissioning shall be conducted in accordance with LAWA standard video commissioning policies and procedures. This will include verification of lens selection, verification of field of view, verification of image quality, verification of focus point and where required final adjustment of position of CCTV camera.

2. The Commissioning procedure shall be witnessed by LAWA. Security Systems Contractor shall provide a detailed inspection, and physical accounting of each equipment item. An operational demonstration shall then be conducted in which the equipment shall function in the normal operational mode, and shall operate completely error-free in terms of hardware and software performance. Occurrence of any equipment failure shall

terminate the demonstration. The demonstration shall restart and run for a period of time designated by LAWA after the failure has been corrected.

2. Prerequisite to Commissioning: Outstanding work items that may exist, such as facility interfaces, project record drawings, and/or in-process change orders, shall be documented and submitted to LAWA for review prior to start of equipment commissioning. Documentation of outstanding work items shall take the form of punch lists of critical action items lists that describe the work, the expected completion schedule, and the impact upon operation. Depending upon the nature of the outstanding work item, LAWA IT may grant a waiver to accomplish partial commissioning of any of the equipment. Completion of waived outstanding work items shall then be assigned to the post-commissioning operations and maintenance.

3. Security Systems Contractor shall be responsible for ensuring that the installation and related interfaces are completed and operational at least thirty (30) days prior to scheduled beneficial occupancy. In the event the installation and related interfaces is not completed and operational by the scheduled beneficial occupancy date, Security Systems Contractor shall establish and submit a security plan to LAWA that complies with 49 CFR 1542 Airport Security and 49 CFR 1544. Aircraft Operator Security as appropriates, and related LAWA security requirements. The security plan shall be submitted to LAWA and TSA for approval. The security plan, revisions, and security measures to be deployed until such time the new security equipment is completed and operational shall be at Security Systems Contractor's expense.

3.07 SYSTEM STARTUP

A. The Security Systems Contractor shall not apply power to the system until after:

1. System and components have been installed and inspected in accordance with the manufacturer's installation instructions.
2. A visual inspection of the system components has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
3. System wiring has been tested and verified as correctly connected as indicated.
4. All system grounding and transient protection systems have been verified as properly installed and connected, as indicated.
5. Power supplies to be connected to the system and equipment have been verified as the correct voltage, phasing, and frequency as indicated.
6. Satisfaction of the above requirements shall not relieve the Security Systems Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Security Systems Contractor work/equipment.

3.08 CLEANING

3.09 COMPUTERIZED MAINTENANCE

A. Information regarding all equipment including model, nomenclature, serial number, function, location, recommended preventative maintenance schedule and other pertinent data will be stored in the CMMS database. Security Systems Contractor is required to input all information such as cabling and port information for the devices installed. Security Systems Contractor shall include in their Bid the cost for collecting and inputting this data for all systems and equipment provided by this Contract into this database.

3.10 CLOSEOUT ACTIVITIES

A. Completion of successful installation, final tests and commissioning, receipt of the test reports and as-built documentation including data input into the CMMS and successful performance of the installed equipment / system for a thirty (30) day period will constitute Final Acceptance.

3.11 MAINTENANCE

END OF SECTION 28 23 13

SECTION 28 31 00-FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. This performance specification provides the minimum requirements for the Life Safety System. The work provided shall include, but not limited to furnishing all permits, equipment, materials, delivery, labor, documentation, testing and services necessary to design and furnish and install a complete, operational system Fire Alarm System.

B. At the time of bid, all exceptions taken to these Specifications, all variances from these Specification and all substitutions of operating capabilities or equipment called for in these Specification shall be listed in writing and forwarded to the Designer. Any such exception, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment.

C. The contractor must prepare the appropriate fire alarm system design and shall submit all the required drawings, equipment specifications, riser diagrams, worst case voltage drop calculations, battery calculations, mounting details and equipment to the city of Los Angeles Fire Department for review and obtain the permit under a deferred approval.

D. Contractor is responsible for verifying existing fire alarm devices located within the terminal and providing connection to main fire alarm system for a complete working system.

1.2 REFERENCES

A. All work and materials shall conform to all applicable Federal, State and local codes and regulations governing the installation.

B. Fire alarm system, equipment, installation, and wiring materials and methods used shall comply with the following codes and standards:

1. System components proposed in this specification shall be UL listed for its intended use.
2. California State Fire Marshal Listed Components
3. Los Angeles Building Code
4. California Fire Code
5. Los Angeles Fire Code
6. California Mechanical Code
7. California Electrical Code
8. NFPA 72 - National Fire Alarm Code®, As amended by CA code
9. NFPA 13 – Standards for the installation of fire sprinkler systems
10. NFPA 14 - Standards for the installation of fire standpipes and hose systems
11. NFPA 415 Standards for airport terminal building fueling, ramp drainage and loading walkways, 2008 edition.
12. Los Angeles Zoning Code - Chapter 1 LA Municipal Code
13. State of California title 24 energy code

14. State of California elevator code
15. Americans with Disabilities Act (ADA)

1.3 CONTRACTOR QUALIFICATIONS

A. All work in this Section shall be performed (furnished, installed and connected) by a qualified fire alarm contractor. The fire alarm contractor shall provide the following documentation to show compliance with the contractor qualifications within 14 days after notice of award of contractor.

1. Contractor's License: A copy of the contractor's valid State of California License. The contractor must be licensed in the state of project location and have been incorporated in the business in that state for a minimum of 5 years.
2. Proof of Experience: Proof that the fire alarm contractor has successfully installed similar system fire detection, evacuation voice and visual signaling control components on a previous project of comparable size and complexity. Provide a statement summarizing any pending litigation involving an officer or principal of /or the company, the nature of the litigation and what effect the litigation may carry as it relates to this work in the worst case scenario. Non-disclosure of this item, if later discovered, may result, at the LAWA's discretion, in the contractor bearing all costs and any cost related to associated delays in the progress of the work.
3. Insurance Certificates: Copy of fire alarm contractor's current liability insurance and state industrial insurance certificates in conformance with the contract document.
4. Service Capability: The fire alarm contractor shall have in-house Engineering, installation and service personnel with a maintenance office within 50 miles of the project location
5. Authorization Letters: Letters from the fire alarm equipment manufacturer stating that the fire alarm contractor is a Factory Authorized Distributor, and is trained and certified for the equipment proposed on this project and is licensed to purchase and install the software required to provide the specified functions.
6. Certifications:

   a. Provide a copy of the National Institute for Certification in Technologies (NICET) Technician Level 3 Certificate for the employee actively involved in this project.
   b. Documentation that the fire alarm contractor has on staff personnel factory-trained and certified for the equipment proposed for this project.

7. The Contractor shall be an EST Authorized Strategic Partner or contracted with LAWA's fire alarm maintenance contractor to install EST3 equipment. Proof of authorization shall be required.

1.4 SCOPE OF WORK

A. New EST3 fire control panel to add to existing EST3 network and FireWorks Graphical User Interface at CUP shall be installed. All new fire alarm equipment and devices shall be a product of GE, EST Life Safety & Communications.

B. The system supplied under this specification shall be a microprocessor-based direct wired, multi-priority peer-to-peer networked system. The system shall utilize independently addressed, microprocessor-based smoke detectors, heat detectors, and modules as described in this specification. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer.

C. The Contractor shall obtain and pay for all permits and related fees including any fees for after hours testing and expedited plan check.

D. The Contractor will be responsible for providing all required professional Engineering stamps/certification and all required contractors license requirements, which are required by the AHJ.

E. The fire alarm systems shall be operational at all times unless an approved Fire Watch is in place. The system shall not be left out of service during weekends. The contractor shall be responsible for notifying the General Contractor 48 hours in advance of any fire watch in areas that will not be protected by the fire alarm system.

F. Provide and be responsible for fire-watch as required by the AHJ.

G. A factory trained technician shall be on site to supervise the installation.

H. The Contractor shall be responsible to contract with the Existing LAWA Maintenance Contractor to program the Fire Works system at the Central Utilities Plant and to integrate with the existing EST3 system. The Contractor shall ensure current programming efforts are coordinated with other work and contractors.

I. The fire alarm scope of work shall consist of the following minimum requirements.

1. Control Panels and Annunciators

a. Fire Control Panels

1) A new EST3 fire alarm control panel shall be provided. New panels will be connected to main EST3 panel located at new fire control room. Additional related remote data gathering panels shall be provided at these locations as needed.
2) All FACP, remote data gathering panels and annunciators shall complete the "network" between all areas of the building(s) allowing for common monitoring and control.
3) A new matrix graphic annunciator will be provided in the new fire control room as part of the project depicting the final terminal layout. The contractor will be responsible for providing new LED's at the Matrix annunciator as follows:

a) Horizontal rows of LED's for each alarm zone (floor) arranged vertically in columns by Pull Station, Area Smoke/Heat Detector, Elevator Lobby Smoke Detector, Duct Smoke Detector, Elevator Shaft Smoke/Heat Detector, Sprinkler Water Flow, Sprinkler Valve Tamper Switch and Special Extinguishing System Zones.

b) Emergency Generator Run & Fail.
c) Fire/Booster Pump Run & Fail.
d) Common Trouble and Power LED's.
e) Lamp Test Push Button.

2. Initiating Devices

a. All initiating devices shall be new addressable devices. Any conventional initiating devices utilized shall have individual addressable monitor modules provided for each conventional device for unique addressing and annunciation.
b. Smoke detectors shall be added as follows:

1) All Mechanical, Electrical, Telephone, Elevator, Transformer, Generator or similar room.
2) At each elevator lobby.
3) Magnetically held open or automatic-closing doors.
4) Roll doors and/or one-hour fire-resistive occupancy separations.
5) Elevator Shafts if required per code.
6) Storage areas.
7) Smoke and combination Smoke/Fire Dampers.

a) Duct smoke detectors not required for dampers where the entire space served by the smoke damper is protected by a system of area smoke detectors.

8) Above each fire alarm control panel or booster power supply.
9) Beam pockets shall be covered as needed in order to meet current code requirements.
10) Provide and install new smoke detectors in rooms designated with pre-action systems. Smoke detectors shall be compatible with pre-action panel designated in the sprinkler specification.

c. Manual pull stations shall be added as follows:

1) At all exits from the building.
2) At every exit from every level
3) At each elevator lobby if required by AHJ.
4) Additional manual pull stations shall be provided so that the travel distance to the nearest manual pull station will not be in excess of (200 ft) measured horizontally on the same floor.
5) A conventional weatherproof Pull Station shall be provided with an individual addressable module per pull station for any exterior locations.

d. Duct Detectors shall be added as follows:

1) Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 944 L/sec (2000 ft3/min)
2) At each story prior to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 7080 L/sec (15,000 ft3/min) and serving more than one story.

a) Return system smoke detectors shall not be required where the entire space served by the air distribution system is protected by a system of area smoke detectors.

3) Smoke detectors shall not be required for fan units whose sole function is to remove air from the inside of the building to the outside of the building.
4) Smoke and combination Smoke/Fire Dampers.

a) Duct smoke detectors not required for dampers where the entire space served by the smoke damper is protected by a system of area smoke detectors.

5) Remote LED’s w/ test stations shall be provided for all duct detectors located above ceilings or out of sight.

e. Heat Detectors shall be added as follows:

1) Elevator Machine Rooms
2) Elevator Shafts if required per code.
3) All Kitchens with cooking and heating equipment.
4) Trash Rooms

f. Sprinkler tamper and waterflow switches shall be individually monitored as follows:

1) Provide one (1) supervisory module circuit for each sprinkler valve supervisory and waterflow switch.
2) Tamper switches in fire pump room only may be grouped together as allowed per coded.

g. Vesda LaserPlus Detector shall be provided per plans as required.

3. Notifications Appliances

a. All notification appliances shall be new.
b. Speakers shall be added as follow:

1) Shall be added throughout public and private spaces to achieve 15db above ambient as needed to maintain intelligibility in all areas during paging and meet current code requirements.
2) Elevator Cabs and Stairwells for Paging Only.
3) Elevator Lobbies
4) Corridors
5) Rooms and tenant spaces exceeding 1,000 square feet.
6) Public Restrooms for intelligibility during paging.

c. Strobes shall be added as follows:

1) Restrooms and Similar Uses: Public, Staff, locker rooms and dressing rooms.
2) Corridor System and Similar Uses: Public, Staff and Service Corridors, Vestibules and Passageways.

3) Occupied Rooms where Ambient Noise Impairs Hearing of the Fire Alarm and Similar Uses: Mechanical equipment rooms, Generator rooms.
4) Lobbies and Similar Uses
5) Rooms used for sleeping and Similar Uses: Sleeping rooms and suites for persons with hearing impairments.

   a) Strobes that are required in sleeping areas shall be located within 16' of pillow and have a minimum intensity of 110cd. For strobes located less than 24" from ceiling the minimum intensity shall be 117cd.

6) Any other area for common use.
7) Additional strobes shall be added in ADA rooms as needed.
8) Sized Per ADA coverage and NFPA72
9) Combination Audible/Visual appliances may be used as needed.
10) Areas having more than 2 strobes in the field of view shall be synchronized

   a) Booster Power Supplies shall be distributed throughout the facility to provide the power necessary for all indicating devices. Power Supplies shall be initiated by Synchronized Signal Modules. Synchronization by means of a common pair of wires chaining power supplies shall not an acceptable means of synchronization between units.
   b) Fan and Damper control as follows.

4. Transmit signal to the building automation system per zone for smoke control operation of all fans and dampers identified in the smoke control sequence of operation. All other dampers and fans shall be non-managed and shutdown or closed by the fire alarm system.
5. Interface and provide fan shutdown control for all non-managed fans not identified in the smoke control sequence of operation. An addressable control relay shall be provided for each unit.
6. Interface and provide non-managed smoke damper shutdown for all dampers not identified in the smoke control sequence of operation. Provide addressable control relays at each electrical panel where smoke dampers are powered.
7. Other device/controls shall be added as follows.

   a. Primary, Alternate elevator recall and shunt trip shall be required for each elevator.
   b. The fire alarm panel shall monitor individual Fire Pump and Emergency Generator "Run" & "Fail" status for each unit. Run & Fail Status shall report as Monitor points.
   c. Interface with any door lock\card accesses release circuits. An addressable control relay shall be provided at each lock location obstructing the emergency exit path. Stairwell door locks may have one common control.
   d. Provide and Interface with magnetic door holder release circuits. Provide addressable control relays as required.
   e. Magnetic door holders shall be provided as part of this section at elevator lobby doors and all cross-corridor doors and as required per code.
   f. Fireman's phone jack shall be provided at all elevators, stairwells and elevator control rooms.

1.5 SEQUENCE OF OPERATIONS

A. General Alarm Operation: Upon alarm activation of any area smoke detector, duct smoke detector, heat detector, manual pull station, sprinkler waterflow, Vesda Detector, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel, annunciator or command center.
2. The LCD Display shall indicate all applicable information associated with the alarm condition including zone, device type, device location and time/date.
3. All system activity/events shall be documented on the system printer.
4. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
5. The following notification signals and actions shall occur simultaneously:

    a. An evacuation message shall be sounded on fire floors (zones). The signal shall be a slow whoop tone.
    b. Activate visual strobes on the fire floors (zones). The visual strobe shall stop operating when the "Alarm Silence" is pressed.

6. Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.
7. Transmit a signal to the building automation system to activate the automatic smoke control sequences.
8. If a fire originates in any place other than in the communication rooms, all HVAC units will shut down, except the DX units serving the telecom rooms. If a fire originates within the communication rooms, the associated DX units will shut down.
9. All stairwell/exit doors shall unlock throughout the building.
10. All self-closing fire/smoke doors held open shall be released.
11. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
12. EST Fireworks

    a. Display the address of the alarm or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
    b. Display color graphical representation of the area in which the alarm or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
    c. Display a set of written operator instructions for each point.
    d. Log operator's comments for each event to history with time and date.
    e. Log all events and operator actions to history for future review.

13. Smoke evacuation louvers shall open.

B. Elevator Lobby / Equipment Room Detectors: Upon alarm activation of any elevator lobby smoke detector or equipment room detector the following functions shall automatically occur:

1. Perform general alarm sequence above.
2. Elevator Lobby smoke detectors shall recall the elevators to primary floor
3. Elevator Lobby smoke detectors located on the primary recall floor shall recall the elevator the alternate floor.
4. Equipment room smoke detectors shall recall the elevator to the primary floor.
5. Activation of the Equipment room heat detector shall initiate the shunt trip in the associated elevator equipment room.

C. Supervisory Operation: Upon supervisory activation of any sprinkler valve supervisory switch, fire pump off-normal, clean agent fire suppression system trouble, Vesda Detector, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel, annunciator or command center.
2. The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.
3. All system activity/events shall be documented on the system printer.
4. Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.
5. Transmit signal to the central station with point identification.
6. EST Fireworks

   a. Display the address of the supervisory or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the even list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
   b. Display color graphical representation of the area in which the supervisory or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
   c. Display a set of written operator instructions for each point.
   d. Log operator's comments for each event to history with time and date.
   e. Log all events and operator actions to history for future review.

D. Trouble Operation: Upon activation of a trouble condition or signal from any device on the system, the following functions shall automatically occur:

1. The internal audible device shall sound at the control panel, annunciator or command center.
2. The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.
3. All system activity/events shall be documented on the system printer.
4. Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.
5. Transmit signal to the central station with point identification.
6. EST Fireworks

a. Display the address of the trouble or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
b. Display color graphical representation of the area in which the trouble or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
c. Display a set of written operator instructions for each point.
d. Log operator's comments for each event to history with time and date.
e. Log all events and operator actions to history for future review.

E. Monitor Activation: Upon activation of any device connected to a monitor circuit (fire pump/emergency generator status, Vesda Detector), the following functions shall automatically occur:

1. The LCD display shall indicate all applicable information associated with the status condition including; zone, device type, device location and time/date.
2. All system activity/events shall be documented on the system printer.
3. Any remote or local annunciator LCD/LED's associated with the status zone shall be illuminated.
4. EST Fireworks

a. Display the address of the monitor or off normal point with type and description and time of the event in a prioritized color-coded event list. Highlighting an event in the event list shall automatically cause the other three quadrants (described below) to display information relating to the highlighted event.
b. Display color graphical representation of the area in which the monitor or off normal device is located. It shall be possible for the operator to manually zoom down to any portion of a vector-based graphic without aliening, artifacting, or pixilation of the image. Preset zoom levels shall not be considered equal.
c. Display a set of written operator instructions for each point.
d. Log operator's comments for each event to history with time and date.
e. Log all events and operator actions to history for future review.

5. Smoke evacuation louvers shall open.

1.6 SYSTEM DESIGN PARAMETERS

A. Standby power

1. The standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for twenty four (24) hours and capable of operating the system for five (5) minutes of evacuation alarm on all devices, operating at maximum load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.

B. Voltage Drop

1. The point-to-point Ohm's Law voltage drop calculations of all alarm system circuits shall no exceed 10%.

C. Spare Capacity

1. The system shall be Engineered to accommodate 20% spare capacity on each individual loop, and 20% spare on system power supplies.

D. Circuiting Guidelines

1. Initiating Device Circuits

a. Where necessary, conventional initiating device circuits (i.e. waterflow switches, valve supervisory switches, fire pump functions, etc.) shall be Class B (Style "A" or "B").

2. Notification Appliance Circuits

a. All notification appliance circuits shall be Class B (Style "Y"). The notification circuits shall be power limited. Non-power limited circuits are not acceptable.

3. Signaling Line Circuits: Addressable Analog Devices

a. The signaling line circuit connecting to addressable/analog devices including, detectors, monitor modules, control modules, isolation modules, intrusion detection modules and notification circuit modules shall be Class B (style 4).
b. Each addressable analog loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices.

4. Signaling Line Circuits: Data & Audio for FACP & Annunciator Network

a. The signaling line circuit connecting network panel/nodes, annunciators, command centers, shall be Class A (style 7). The media shall be copper except where fiber optic cable is required.

1.7 SUBMITTALS

A. General

1. It is the responsibility of the contractor to meet the entire intent and functional performance required in these specifications.
2. The proposed equipment shall be subject to the approval of LAWA.
3. Approved submittals shall only allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications.

B. Equipment Submittal

1. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which will also indicate the manufacturer's

part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.

2. Provide manufacturer's ORIGINAL printed data sheets with the printed logo or trademark of the manufacturer for all equipment. Photocopied and/or illegible product data sheets shall not be acceptable.
3. Indicated in the documentation will be the type, size, rating, style, and catalog number for all items proposed to meet the system performance detailed in this specification.
4. CSFM listing sheet for each component
5. Installer's NICET 3 Certification
6. Letter or Certificate from the fire alarm manufacturer stating that the fire alarm contractor is an authorized EST Strategic Partner of the specified product.
7. Submit a copy of the system supplier's training certification for the specified product issued by the manufacturer of the integrated life safety system.
8. Equipment submittals and other documentation shall be incorporated bound with the above information indexed and tabbed for quick reference.

C. Shop Drawings

1. A complete set of shop drawings shall be supplied. The shop drawings shall be reproduced electronically in digital format. This package shall include but not be limited to:

    a. All drawings and diagrams shall include the contractor's title block, complete with drawing title, contractor's name, address, date including revisions, and preparer's and reviewer's initials
    b. Complete system bill of material with peripheral device backbox size information, part numbers, device mounting height information
    c. Detailed system operational description. Any Specification differences and deviations shall be clearly noted and marked.
    d. A riser diagram that individually depicts all control panels, annunciators, addressable devices and notification appliances. Field addressable devices and notification appliances may be grouped together by specific type per loop or circuit if allowed by AHJ.
    e. Complete 1/8" = 1'-0 scale floor plan drawing locating all system devices and elevation of all equipment at the Fire Command Station. Floor plans shall indicate accurate locations for all control and peripheral devices as well as raceway size and routing, junction boxes, and conductor size, and quantity in each raceway. All notification appliances shall be provided with a candela rating and circuit address that corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8" scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.
    f. All drawings shall be reviewed and signed off by an individual having a minimum of a NICET 3 certification in fire protection Engineering technology, subfield of fire alarm systems.
    g. Control panel wiring and interconnection schematics. The drawing(s) shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data-gathering

panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service and location of the control enclosure.

h. Any additional requirements if required by AHJ for approval.

i. Complete calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements. Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws.

j. System (Load & Battery) calculations shall be provided for each system power supply, each notification appliance circuit and each auxiliary control circuit that draws power from any system power supply.

1.8 OPERATING AND MAINTAINANCE MANUALS

A. The manual shall contain a detailed narrative description of the system Architecture, inputs, notification signaling, auxiliary functions, annunciation, sequence of operations, expansion capability, application considerations and limitations.

B. Manufacturer's data sheets and installation manuals/instructions for all equipment supplied.

C. Minimum two (2) copies of the closeout documents shall be delivered to LAWA's representative at the time of system acceptance.

D. Provide the name, address and telephone of the authorized factory representative.

E. A filled out Record of Completion similar to those provided in NFPA 72.

1.9 AS-BUILT PROJECT DRAWINGS AND DATA

A. Drawings consisting of: a scaled plan of each building showing the placement of each individual item of the Integrated Life Safety System equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.

B. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the Designer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.

C. All drawings shall be provided in standard .DXF or AutoCAD format.

1.10 WARRANTY

A. The contractor shall warranty all materials, installation and workmanship for one (1) year.

B. A copy of the manufacturer's warranty shall be provided with closeout documentation and included with the operation and installation manuals.

C. The System Supplier shall maintain a service organization with adequate spare parts stock within 50 miles of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the LAWA notifying the contractor.

1.11 EXTRA MATERIALS

A. Provide10% of each type of manual stations (minimum of one for each type).

B. Provide six keys of each type.

C. Provide10% of each type of smoke and heat detector (minimum of one for each type).

D. Provide10% of each type of audible and visual indicating appliances (minimum of one for each type).

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. GE Security: EST Fire & Life Safety – EST3 to match existing system and network.

B. The Contractor shall be an EST Authorized Strategic Partner or contracted with LAWA’s fire alarm maintenance contractor to install EST3 equipment. Proof of authorization shall be required.

2.2 GENERAL

A. All equipment and components shall be the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approval agency for use as part of a protected premises (fire alarm) system.

B. The contractor shall provide, from the acceptable manufacturer's current product lines, equipment and components, which comply, with the requirements of these specifications. Equipment or components, which do not provide the performance and features, required by these specifications are not acceptable, regardless of manufacturer.

C. All System components shall be the cataloged products of a single supplier. All products shall be UL listed by the manufacturer for their intended purpose.

D. All control panel assemblies and connected field appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as to ensure that a fully functioning system is designed and installed.

2.3 FIRE ALARM CONTROL PANEL

A. General, EST3.

1. The fire alarm control panel or panels and all system devices (Audible-Visuals, Visuals, pull stations, smoke and heat detectors, etc. shall be GE Security (EST). All under one label “UL/UOJZ listed and approved” for the use of fire alarm systems in this area of the United States of America.
2. The operating controls shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified.
3. The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 64 network nodes. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, LCD/LED annunciation nodes, and workstations. Each node is an equal, active functional node of the network, which is capable of making all local decisions and generating network tasks to other nodes in the event of node failure or communications failure between a nodes. When utilizing a network and multiple wiring faults occur, the network shall re-configure into many sub-networks and continue to respond to alarm events from every panel that can transmit and receive network messages.
4. The Main Controller Module shall control and monitor all local or remote peripherals. It shall support a large 168 character LCD, power supply, remote LCD and zone display annunciators, printers, and support communication interface standard protocol (CSI) devices such as color computer annunciators and color graphic displays.
5. Each controller shall contain a RS232 printer/programming port for programming locally via an IBM PC. When operational, each controller shall support a printer through the RS232 port and be capable of message routing.
6. The programmer shall be able to download all network and firmware applications from the configuration computer to all the network panels from a single location on the system.
7. The panels shall have the ability to add an operator interface control/display at each node that shall annunciate, command and control system functions.
8. The system shall store all basic system functionality and job specific data in non-volatile memory. All site specific and operating data shall survive a complete power failure intact. Passwords shall protect any changes to system operations.
9. The control panel shall contain a standby power supply that automatically supplies electrical energy to the system upon primary power supply failure. The system shall include a charging circuit to automatically maintain the electrical charge of the battery.

B. Signaling Line Circuits

1. The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 125 detectors and 125 remote modules per addressable Signaling line Circuit (SLC). The CPU shall support up to 10 SLC's per panel for a total system capacity of 2500 Intelligent Addressable points. The system shall be designed with peer-to-peer networking capability for enhanced survivability, with support for up to 64 nodes, each with up to 2500 points and an overall capacity of 160,000 points.
2. The system shall provide electronic addressing of analog/addressable devices.
3. The system shall have built-in automatic system programming to automatically address and map all system devices attached to the main controller.
4. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of “same type” devices without the need of addressing and impose the “location” parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is mapped and defined into the system.

5. The system shall have a UL Listed Detector Sensitivity test feature, which will be a function of the smoke detectors and performed automatically every 4 hours.

C. Integrated Digital Audio

1. The system shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media.
2. All audio messages and live pages shall originate at the one-way audio control unit.
3. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control.
4. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits.
5. The one-way emergency audio control shall provide control switches to direct paging messages as follows:

   a. "All Call" to direct the page message to all areas in the facility, overriding all other messages and tones.
   b. "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.
   c. "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.
   d. "Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.
   e. "Page by Phone" switch to select the firefighters telephone system as the source for paging.

6. Audio Amplifiers (Multi-Channel)

   a. Provide as minimum one twenty (20) watt audio amplifier per paging zone.
   b. The system software shall be capable of selecting the required audio source signal for amplification.
   c. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000 Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition.
   d. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring.
   e. Each amplifier shall include a dedicated, selectable 25/70 Vrms output.
   f. Each amplifier shall also include a notification appliance circuit rated at 24Vdc @ 3.5A for connection of visible (strobe) appliances. This circuit shall be fully programmable and it shall be possible to define the circuit for the support of audible, visible, or ancillary devices.

D. DACT

1. The system shall provide off premise communications capability (DACT) for transmitting system events to multiple Central Monitoring Station (CMS) receivers.
2. The system shall capable of providing the CMS(s) with point identification of system events using Contact ID or SIA DCS protocols.

3. In the event of a panel CPU failure during a fire alarm condition, the DACT degrade mode shall transmit a general fire alarm signal to the CMS.

E. User Interfere

1. Main Control & Display

a. The main display shall be a large 168 character LCD with normal, alarm, trouble, supervisory, disabled point and ground fault indicators.
b. The interface shall show the first and most recent highest priority system events without any operator intervention. All system events shall be directed to one of four message queues. Messages of different types shall never intermixed to eliminate operator confusion. A "Details" switch shall provide additional information about any device highlighted by the operator.
c. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.
d. The internal audible signal shall have different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
e. The annunciator shall contain the following controls:

1) System Reset Switch with Indicator
2) System Alarm Silence Switch with Indicator
3) System Panel Silence Switch with Indicator
4) Programmable Switch with Indicator
5) Details Switch
6) System Message Queue Scroll Switches.
7) 10-Digit Keypad to Enable/Disable System and Functions.

f. An authorized operator shall have the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
g. An authorized operator shall be capable of performing test functions within the installed system.

2. Additional Annunciation & Control

a. The system shall be capable to receive, monitor, and annunciate signals from individual devices and circuits installed throughout the building.
b. Each zone, stairwell and elevator bank shall have a control switch to initiate paging. Each paging switch shall have an associated Green LED (zone indicating circuit on) and Yellow LED (zone indicating circuit trouble).
c. Manufacturers' standard control switches shall be acceptable if they provide the required operation, including performance, supervision and position indication. If the manufacturers' standard switches do not comply with these requirements, fabrication of custom manual controls acceptable to the LAWA is required.

F. Internal Modular Power Supply

1. System power supply(s) shall provide multiple power limited 24 VDC output circuits as required by the panel.
2. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions.
3. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.
4. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciate as battery trouble and identify the specific power supply affected.
5. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.
6. All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 72 - The AC power circuit shall be installed in conduit raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

G. Reports

1. The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD, and shall be capable of being printed on any system printer.
2. The system shall provide a report that gives a sensitivity listing of all detectors that have less than 75% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.
3. The system shall provide a report that gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given analog/addressable device loop within any given panel.
4. The system shall provide a report that gives a chronological listing of up to the last 1740 system events.
5. The system shall provide a listing of all of the firmware revision listings for all of the installed network components in the system.

2.4 ANNUNCIATORS

A. General

1. The system shall have the capacity to support 64 network annunciators or EST3 network panel nodes.

B. Remote LCD Annunciator, 3ANN.

1. Remote LCD annunciators shall display each and every point in the system and be sized with the same number of characters as in the main FACP display. Annunciators not capable of displaying each point will not be considered equal. Grouping points to “zones” will not be acceptable.

2. Network alphanumeric annunciators shall be located throughout the facility as indicated on the plans and in the fire safety director's office. This annunciator shall be an Integral part of the Peer to Peer Network for survivability. Systems that require a “host” Network Node to control remote annunciators shall not be considered acceptable.
3. Each annunciator shall contain a supervised, back lit, liquid crystal with a minimum of 8 line with 21 characters per line. Where required, the annunciator shall include additional zonal annunciation and manual control without additional enclosures. The annunciator shall support full ability to serve as the operating interface to the system and shall include the following features;

   a. Matched appearance with other system displays
   b. Each LCD Display on each node (cabinet) in the system shall be configurable to show the status of any or all of the following functions anywhere in the system:

      1) Alarm
      2) Supervisory
      3) Trouble
      4) Monitor

4. Each annunciator must be capable of supporting custom messages as well as system event annunciation. It must be possible to filter unwanted annunciation of trouble, alarm or supervisory functions on a by point or by geographic area. The annunciators shall be mounted in stand-alone enclosures or integrated into the network panels as indicated on the plans.

C. Graphic Annunciator, ENVOY.

1. The annunciator shall depict the graphical diagrams or matrix lamps as required per the contract drawings and AHJ.
2. It shall operate on nominal 24 Vdc and is battery backed up.
3. All annunciator switches shall be system input points and shall be capable of controlling any system output or function.
4. The graphic annunciator shall be UL, ULC and CSFM Listed.
5. The graphic shall be backlit using high intensity LEDs.
6. The unit shall be semi-flush or surface mounted to match existing.
7. The main graphic door shall be tamper resistant and equipped with a key lock.
8. It shall be possible to update the graphic image in the field without replacing the entire graphic.

2.5 EXISTING COMMAND CENTER , FIREWORKS

A. Overview

1. The existing Fireworks command center currently functions as the center point for all operational and administration functions required for the systems provided within the specification. The graphical workstation provides command control and monitoring of the systems provided by this specification. Individual point annunciation shall be provided. Grouping of initiating devices into zones shall not meet the intent of the specification.

2. The existing Fireworks command center shall be modified to show the final TBIT graphic configuration. Custom graphics shall be created or existing graphics modified to show the final site plan of the facility followed by photo building profile and every level of building floor plan map. Additional floor plan sections within a level shall be provided to allow for each initiating device to be clearly shown on a detailed floor plan map

2.6 INTELLIGENT ADDRESSABLE DETECTORS

A. General

1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.
3. The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.
4. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.75 seconds. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable.
5. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGAPRO Signature Program/Service Tool.
6. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status.
7. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.
8. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to

program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

9. Each detector microprocessor shall contain an environmental compensation algorithm, which identifies and sets ambient “Environmental Thresholds” approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long-term and 4 hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the “learned” base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.
10. The intelligent analog detectors shall be suitable for mounting on any Signature Series detector mounting base.
11. The Fire alarm system shall have the ability to set individual smoke detectors for alarm verification. Detector in the alarm verification mode shall indicate, by point in a text format at the main control and at the remote LCD annunciators.

B. Photoelectric Smoke Detector, SIGA-PS.

1. Provide intelligent photoelectric smoke detectors SIGA-PS. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings.
2. The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications.
3. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes.
4. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:

    a. Temperature: 32oF to 120oF (0oC to 49oC)
    b. Humidity: 0-93% RH, non-condensing
    c. Installation Attitude: no limit

C. Fixed Temp/Rate of Rise Heat Detector, SIGA-HRS.

1. Provide intelligent combination fixed temperature/rate-of-rise heat detectors SIGA-HRS. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
2. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable.
3. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135 degrees F (57 degrees C) and a rate-of-rise alarm point of 15 degrees F (9 degrees C) per minute.

4. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.

D. Standard Detector Bases, SIGA-SB/SIGA-SB4

1. Provide standard detector mounting bases SIGA-SB suitable for mounting on North American 1gang, 3½” or 4” octagon box and 4” square box. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements:

a. Removal of the respective detector shall not affect communications with other detectors.
b. Terminal connections shall be made on the room side of the base. Bases, which must be removed to gain access to the terminals, shall not be acceptable.
c. The base shall be capable of supporting one (1) Signature Series SIGA-LED Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

E. Relay Detector Bases, SIGA-RB / SIGA-RB4

1. Provide standard detector mounting bases SIGA-RB suitable for mounting on North American 1gang, 3½” or 4” octagon box and 4” square box. The base shall support all Signature Series detector types and have the following minimum requirements:

a. Removal of the respective detector shall not affect communications with other detectors.
b. Terminal connections shall be made on the room side of the base. Bases, which must be removed to gain access to the terminals, shall not be acceptable.
c. The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
d. The position of the contact shall be supervised.
e. The relay shall automatically de-energize when a detector is removed.
f. The operation of the relay base shall be controlled by its respective detector processor. Detectors operating standalone mode shall operate the relay upon changing to alarm state. Relay bases not controlled by the detector microprocessor shall not be acceptable.
g. Form "C" Relay contacts shall have a minimum rating of 1 amp @ 30 Vdc and be listed for pilot duty.

F. Duct Detector, SIGA-SD

1. Provide intelligent addressable photoelectric duct smoke detectors SIGA-SD. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop.

2. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 0.79% to 2.46%. The duct detector shall be suitable for operation in the following environment:

   a. Temperature: -20oF to 158oF (-29oC to 70oC)
   b. Humidity: 0-93% RH, non-condensing
   c. Air velocity: 100 to 4000 ft/min

3. Provide an air exhaust tube and an air sampling inlet tube, which extends into the duct air stream up to ten feet. The sampling tube can be installed with or without the cover in place and can be rotated in 45 degree increments to ensure proper alignment with the duct airflow.
4. Status LEDs shall remain visible through a clear assembly cover.
5. The unit shall contain a magnet-activated test switch.
6. One integral form C auxiliary alarm relay shall be provided. The relay contact shall be capable of being individually programmed from the control panel. The contact shall be rated for 2.0A at 30VDC
7. Provide Key-activated Remote Test station w/ integral remote alarm indicator SD-TRK where detectors must be accessed by ladder. (CSFM 7300-1657:226)

G. Vesda LaserPlus Detector shall be provided.

2.7 CONVENTIONAL INITIATING DEVICES

A. General

1. All initiating devices shall be UL Listed for Fire Protective Service.
2. All initiating devices shall be of the same manufacturer as the Fire Alarm Control Panel specified to assure absolute compatibility between the devices and the control panels, and to assure that the application of the initiating devices is done in accordance with the single manufacturer’s instructions.

B. Weatherproof Pull Stations, MPSR1-S45W-GE

1. Provide single action, single stage MPSR series fire alarm stations with terminals for wire connections rated for outdoor use.
2. Key reset shall be provided with keys identical to those required for the specified fire alarm panels, booster power supplies and other locked fire alarm cabinets.
3. Finish the station in red plated surface to inhibit corrosion.
4. Compatible factory weatherproof box w/ gasket shall be provided in all locations.
5. Pull Stations shall be individually monitored by addressable monitor module.

C. Projected Beam Smoke Detector, EC-50R/100R

1. The projected beam type smoke detector shall be a 4-wire 12/24 Vdc device used with UL listed separately supplied 4-wire control panels only.
2. The unit shall be listed to UL 268 and shall consist of an integrated transmitter and receiver.
3. The detector shall operate between a range of 15 and 330 ft.

4. The temperature range of the beam shall be -22 °F to 131 °F.
5. The beam detector shall feature automatic gain control, which will compensate for gradual signal deterioration caused by dirt accumulation on the lenses.
6. The unit shall include a wall mounting bracket.
7. Testing shall be carried out using a calibrated test filter.
8. Provide wall mounted, EC-LLT, test station at ground level. Test stations shall include Power and Alarm LEDs with a key activated test switch on a single gang plate. (CSFM 7260-1657:234)
9. The unit shall be individually monitored for alarm trouble by addressable monitor module.

2.8 INTELLIGENT ADDRESSABLE MODULES

A. General

1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.
2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary.
3. It shall be possible to address each Intelligent Signature Series module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:

    a. Temperature: 32oF to 120oF (0oC to 49oC)
    b. Humidity: 0-93% RH, non condensing

B. Single Input Module, SIGA-CT1

1. Provide intelligent single input modules SIGA-CT1 for monitoring of PIV's, Fan Status, Tamper Switches, Flow Switches, Generator & Fire Pump Status, Preaction System Alarm or Trouble or any other dry contact required to be monitored.
2. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation.

3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.
4. The single input module shall support the following circuit types:

    a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
    b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
    c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
    d. Normally-Open Active Latching (Supervisory, Tamper Switches)

C. Dual Input Module, SIGA-CT2

1. Provide intelligent dual input modules SIGA-CT2 for monitoring of sets of PIV's, Fan/Damper Status, Tamper Switches, Flow Switches, Generator & Fire Pump Status, Preaction System Alarm or Trouble or any other sets of dry contacts required to be monitored.
2. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.
4. The dual input module shall support the following circuit types:

    a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
    b. Normally-Open Alarm Delayed Latching (Waterflow Switches)
    c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
    d. Normally-Open Active Latching (Supervisory, Tamper Switches)

D. Signal Module, SIGA-CC1

1. Provide intelligent single input signal modules SIGA-CC1 for activation of booster power supplies, audible/visual circuits, speaker circuits or for monitoring and communication of phone jacks.
2. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes.
4. The single input signal module shall support the following operations:

    a. Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
    b. Telephone Power Selector with Ring Tone (Fire Fighter's Telephone)

5. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone".

E. Synchronized Signal Module, SIGA-CC1S

1. Provide intelligent single input signal modules SIGA-CC1S for activation of booster power supplies and/or audible/visual circuits that require synchronization.

2. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation.
3. The module shall be suitable for mounting on North American 2 ½” (64mm) deep 2-gang boxes and 1 ½” (38mm) deep 4” square boxes with 2-gang covers, or European 100mm square boxes.
4. The single input signal module shall support the following operations:

   a. Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)
   b. Telephone Power Selector with Ring Tone (Fire Fighter’s Telephone)

5. Provides UL1971 auto-sync output for synchronizing multiple notification appliance circuits

F. Control Relay Module, SIGA-CR

1. Provide intelligent control relay modules SIGA-CR for activation and/or shutdown of fans, dampers, door holder circuits, door locks, shunt trip, elevator recall or any other fail safe system requiring control or activation.
2. The Control Relay Module shall provide one form “R” dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown.
3. The control relay shall be rated for pilot duty and releasing systems.
4. The position of the relay contact shall be confirmed by the system firmware.
5. The control relay module shall be suitable for mounting on North American 2 ½” (64mm) deep 1gang boxes and 1 ½” (38mm) deep 4” square boxes with 1-gang covers.

G. Manual Pull Station, SIGA-270

1. Provide intelligent single action, single stage fire alarm stations SIGA-270. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver “PULL IN CASE OF FIRE” English lettering.
2. The manual station shall be suitable for mounting on North American 2 ½” (64mm) deep 1-gang boxes and 1 ½” (38mm) deep 4” square boxes with 1-gang covers.
3. Provide compatible surface mount red box, 276B-RSB, at all surface mount locations. Standard electrical boxes are not acceptable.

2.9 NOTIFICATION APPLIANCES

A. General

1. All appliances shall be UL Listed for Fire Protective Service.
2. All strobe appliances or combination appliances with strobes shall be capable of providing the “Equivalent Facilitation” which is allowed under the Americans with Disabilities Act accessibly guidelines (ADA (AG)), and shall be UL 1971.
3. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels,

and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.

4. Any appliances, which do not meet the above requirements, and are submitted, for use must show written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended.

B. Wall Strobes, Genesis G1 Series

1. Strobes shall provide synchronized flash outputs. The light output shall be an even "FullLight" pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the Chime and meet the intent of UL Private Mode signaling.
3. The strobe shall have selectable 15, 30, 75 or 110 cd settings.
4. It shall be possible to change the strobe setting without removing the device from the wall
5. The strobe shall be a low profile design, finished in neutral white and shall not protrude more than 1" off the wall. In-out screw terminals shall be provided for wiring.
6. The strobe shall be suitable for wall mounting and shall mount in a standard North American 1gang box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

C. Ceiling Strobes, Genesis GC Series

1. Strobes shall provide synchronized flash outputs. The light output shall be an even "FullLight" pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the Chime and meet the intent of UL Private Mode signaling.
3. The standard ceiling strobe shall have selectable 15, 30, 75 or 95 cd settings.
4. The high output ceiling strobe shall have selectable 95, 115, 150 or 177 cd settings.
5. It shall be possible to change the strobe setting without removing the device from the ceiling.
6. The strobe shall be a low profile design, finished in neutral white and shall not protrude more than 1.6" off the ceiling. In-out screw terminals shall be provided for wiring.
7. The strobe shall be suitable for ceiling mounting and shall mount in a standard 4" square 2 1/8" (54 mm) deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

D. Weatherproof Wall or Ceiling Strobes, Integrity CS405 Series

1. In and out screw terminals shall be provided for wiring.
2. Strobes shall provide synchronized flash.
3. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 60cd, or 110cd devices
4. Strobes shall mount in a North American 1-gang box. For weatherproof application provide weatherproof wall boxes for mounting.

E. Wall Speakers, Genesis G4 Series

1. It shall be a low profile design, finished in neutral white and shall not protrude more than 1” off the wall. In-out screw terminals shall be provided for wiring.
2. The low profile speaker shall not extend more than 1" (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.
3. Wattage setting shall be visible with the cover installed.
4. It shall be suitable for wall mounting and shall mount in a standard North American 4" x 2 1/8" square electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

F. Wall Speaker-Strobes, Genesis G4 Series

1. Strobes shall provide synchronized flash outputs. The light output shall be an even “FullLight” pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the horn and meet the intent of UL Private Mode signaling.
3. The strobe shall have selectable 15, 30, 75 or 110 cd settings.
4. The high output strobe shall have selectable 95, 115, 150 or 177 cd settings.
5. It shall be possible to change the strobe setting without removing the device from the wall
6. It shall be a low profile design, finished in neutral white and shall not protrude more than 1” off the wall. In-out screw terminals shall be provided for wiring.
7. The low profile speaker shall not extend more than 1" (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.
8. Wattage setting shall be visible with the cover installed.
9. It shall be suitable for wall mounting and shall mount in a standard North American 4" x 2 1/8" square electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

G. Ceiling Speaker-Strobes, Genesis GC Series

1. Strobes shall provide synchronized flash outputs. The light output shall be an even “FullLight” pattern with no hot spots. Strobes using specular reflectors are not acceptable.
2. It shall be possible to flash the strobe at a temporal flash rate to match the horn and meet the intent of UL Private Mode signaling.
3. The standard ceiling strobe shall have selectable 15, 30, 75 or 95 cd settings.
4. The high output strobe shall have selectable 95, 115, 150 or 177 cd settings.
5. It shall be possible to change the strobe setting without removing the device from the ceiling
6. The low profile speaker shall provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464.
7. Wattage and Candela setting shall be visible with the cover installed.

8. It shall be a low profile design, finished in neutral white and shall not protrude more than 1.6” off the ceiling. In-out screw terminals shall be provided for wiring.
9. The strobe shall be suitable for ceiling mounting and shall mount in a standard flush mounted 4" square 2 1/8" (54 mm) deep electrical box. All mounting hardware shall be captive and there shall be no mounting screws visible after the device is installed.

H. Wall Weatherproof Speakers, Integrity 757 Series

1. Provide 4" surface weatherproof re-entrant speakers at the locations as required.
2. Speakers shall provide 2w, 4w, 8w, and 15w power taps for use with 25V or 70V systems.
3. The re-entrant speakers shall utilize a high efficiency compression drivers. Cone type drivers are not acceptable.
4. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480.

I. Weatherproof boxes (EST 757A-WB) shall be provided for outdoor mounting.

2.10 ACCESSORY EQUIPMENT

A. Multi-Voltage Control Relays, MR Series

1. General

a. Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc.
b. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac.
c. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac.
d. A red LED shall indicate the relay is energized.
e. A metal enclosure shall be provided.

2. MR-100 Series

a. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac.

3. MR-200 Series

a. Relay contact ratings shall be DPDT and rated for 10 amperes at 115 Vac.

B. Electromagnetic Door Holders, EST 1500 Series, CSFM 3550-1501:137

1. General - Electromagnetic door holders submitted for use must have written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended.
2. Wall Mounted, 1504/1505/1508/1509 Series

a. Provide flush, semi-flush or surface wall mounted electromagnetic door holder/releases selectable to 24 Vac/dc or 120 Vac as directed by the Consulting Designer. Finish shall be brushed zinc.

C. Remote Booster Power Supplies, BPS6A/BPS10A, CSFM 7300-1657:229

1. Unit shall be a self contained with 24Vdc power supply and batteries housed in its own locked enclosure. Keys provided shall be identical to the keys provided for all other fire alarm equipment provided.
2. Power supply shall be available in both 10 Amp or 6.5 Amp models and 110 Vac or 220Vac.
3. On board LED indicators for each resident NAC, battery supervision, ground fault and AC power.
4. The power supply shall provide four (4) independent 3Amp NACs. Each circuit can be configurable as an auxiliary output.
5. Configurable for any one of three signaling rates: 120SPM; 3-3-3 temporal; or, continuous.
6. Two independent and configurable inputs switch selectable to allow correlation of the two (2) inputs and the four (4) outputs.
7. NACs shall be configurable for either four Class B or two Class A circuits.
8. The unit shall be compatible with SIGA-CC1S for synchronization of multiple power supplies without inter-connect wiring.
9. Brackets shall be provided inside the enclosure to allow mounting the signaling modules. All signaling modules shall be listed to be located inside the booster power supply enclosure.
10. A selectable dip switch shall enable built in synchronization for horns and strobes which may be used to synchronize downstream devices, as well as other boosters and their connected devices.

2.11 CONDUCTORS

A. The requirement of this section apply to all system conductors, including all signaling line, initiating device, notification appliance, auxiliary function, remote signaling, AC and DC power and grounding/shield drain circuits, and any other wiring installed by the Contractor pursuant to the requirements of these Specifications.

B. All circuits shall be rated power limited in accordance with NEC Article 760.

C. Installed in conduit or enclosed raceway.

D. All new system conductors shall be of the type(s) specified herein.

1. All initiating circuit, signaling line circuit, AC power conductors, shield drain conductors and grounding conductors, shall be solid copper, stranded or bunch tinned (bonded) stranded copper.
2. All signaling line circuits, including all addressable initiating device circuits shall be 18 AWG minimum multi-conductor jacketed twisted cable or as per manufacturer's requirements.

3. All non-addressable initiating device circuits, 24 VDC auxiliary function circuits shall be 18 AWG minimum or per manufacturer's requirements.
4. All notification appliance circuit conductors shall be solid copper or bunch tinned (bonded) stranded copper. Where stranded conductors are utilized, a maximum of 7 strands shall be permitted for No. 16 and No. 18 conductors, and a maximum of 19 strands shall be permitted for No. 14 and larger conductors.
5. All audible notification appliance circuits shall be 14 AWG THHN minimum twisted pairs or per manufacturer's requirements.
6. All visual notification appliance circuits shall be 14 AWG minimum THHN twisted pairs or per manufacturer's requirements.
7. All wiring shall be color-coded throughout, to National Electrical Code standards.

2.12 CONDUIT RACEWAY

A. All systems and system components listed to UL864 Control Units for Fire Protective Signaling System maybe installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System(s)or system components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.

B. The requirements of this section apply to all system conduits, raceways, electrical enclosures, junction boxes, pull boxes and device back boxes.

C. All system conduits shall be of the sizes and types specified.

D. All system conduits shall be EMT, 3/4 -inch minimum, except for flexible metallic conduit used for whips to devices only, maximum length 6 feet, 3/4-inch diameter, minimum.

E. All system conduits, which are installed in areas, which may be subject to physical damage or weather, shall be IMC or rigid steel, 3/4 -inch minimum.

F. Conduits shall be sized according to the conductors contained therein. Cross sectional area percentage fill for system conduits shall not exceed 40%.

G. Existing conduit raceway system may be re-used where possible.

H. All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical or by fire damage, and so as not to interfere with existing building systems, facilities or equipment, and to facilitate service and minimize maintenance.

I. All conduits, except flexible conduit whips to devices, shall be solidly attached to building structural members, ceiling slabs or permanent walls. Conduits shall not be attached to existing conduit, duct work, cable trays, other ceiling equipment, drop ceiling hangers/grids or partition walls, except where necessary to connect to initiating, notification, or auxiliary function devices.

J. All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back boxes shall be readily accessible for inspection, testing, service and maintenance.

K. All penetration of floor slabs and firewalls shall be sleeved (1” conduit minimum) fire stopped in accordance with all local fire codes.

L. All junction box covers shall be painted red.

PART 3 - INSTALLATION

3.1 INSTALLATION CONDITIONS

A. All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation.

B. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer’s wiring diagram.

C. The Contractor shall be responsible to contract with the Existing LAWA Maintenance Contractor to program the Fire Works system at the Central Utilities Plant and to integrate with the existing EST3 system. The Contractor shall ensure current programming efforts are coordinated with other work and contractors.

3.2 INSTALLATION REQUIREMENTS

A. Concrete floors shall be X-rayed prior to core drilling.

B. All pull stations shall be mounted 48 inches above the finished floor, as measured on handle.

C. Pull stations currently mounted at the incorrect height shall be lowered accordingly when replaced.

D. All manual pull stations shall be flush mounted. Surface mounted pull stations shall be identified and requested prior to submittal. They shall only be allowed if approved by the Designer prior to installation. All surface mount pull station shall be provided w/ manufacturers listed back box.

E. All new audio/visual devices shall be mounted at a minimum of 80 inches and no more than 96 inches above the finished floor, as measured on strobe center. Devices shall be mounted no less than 6 inches from the ceiling.

F. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.

G. No area smoke or heat detector shall be mounted within 12 inches of any wall.

H. All fire alarm devices shall be accessible for periodic maintenance. Should a device location not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Designer. Failure to bring such issues to the attention of the Project Designer shall be the exclusive liability of the installing Electrical Contractor.

I. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer.

J. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.

K. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.

L. Power-limited/Non-power-limited NEC wiring standards SHALL BE OBSERVED.

M. Auxiliary relays shall be appropriately labeled on the exterior to indicate “FIRE ALARM SYSTEM” and their specific function (i.e. FAN S-1 SHUTDOWN) to match existing.

3.3 TEST & INSPECTION

A. All fire alarm testing shall be in accordance with NFPA 72.

B. The system shall be pre-tested and documented prior to the final inspection by the AHJ. The LAWA shall be notified of the pretest 48 hours in advance and shall witness this test if desired.

C. The pre-test shall include the following:

1. All intelligent analog addressable devices shall be tested for current address, sensitivity, and user defined message.
2. All wiring shall be tested for continuity, shorts, and grounds before the system is activated.
3. Proper operation and execution of all it's sequences

D. Perform a magnahellic test on all new duct smoke detectors to verify proper installation. Provide a copy of all measurements to LAWA.

E. At the final test and inspection, a factory-trained representative of the system manufacturer shall demonstrate to the LAWA, his representative, and the local fire inspector all its sequence of operations and any additional tests required by the AHJ. In the event the system does not operate properly, the test may be terminated. Corrections shall be made and the testing procedure shall be repeated until it is acceptable to LAWA and the fire inspector.

3.4 TRAINING

A. The System Supplier shall schedule and present a minimum of (2) 4 hour segments of documented formalized instruction for the building, detailing the proper operation of the installed System. One training segment shall be available at the completion of the project. The second training segment may be required within the warranty period. Training shall be for a minimum of 10 personnel.

B. The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.

C. The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

D. Instruction shall be made available to the Local Municipal Fire Department if requested by the Local Authority Having Jurisdiction.

END OF SECTION 28 31 00