San Diego International Airport

Design and Construction Standards

SAN DIEGO
INTERNATIONAL AIRPORT
LET'S GO.

REV: 2020.05.29

San Diego County Regional Airport Authority gratefully acknowledges the contributions of the following agencies for the development of this document:

SDIA Airport Design and Construction

SDIA Planning and Environmental Affairs

SDIA Marketing

SDIA Information and Technology Department

SDIA Aviation Security and Public Safety

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AMENDMENTS

Amendments to this document.		
EFFECTIVE DATE:	**REVISION**	**SUMMARY OF AMENDMENTS:**
Nov. 01, 2020	Chapter 04, pg. 67	Section 4.2.2.2.10.2.TOILET COMPARTMENTS - 1. Addition of Toilet Compartments Height-

CHAPTER 01:
INTRODUCTION

1.1. OVERVIEW AND BACKGROUND
1.2. PURPOSE OF THIS DOCUMENT
1.3. ACRONYMS, ABBREVIATIONS, AND DEFINITIONS
1.4. REVISIONS AND UPDATES OF DESIGN AND CONSTRUCTION STANDARDS

1.1. OVERVIEW AND BACKGROUND

San Diego International Airport (the Airport), formerly known as Lindbergh Field, is an international airport owned and operated by the San Diego County Regional Airport Authority (the Authority). The Airport covers 661 acres of land and is located three (3) miles northwest of downtown San Diego. It is the 26th busiest airport in North America in terms of passengers and it is the busiest single-runway commercial service airport in the nation. The Airport's air service continues to grow based upon demand for air travel, particularly in light of a strong economy and robust tourism industry. Over the past five years, passenger volumes at the Airport have increased by more than 34 percent; from approximately 18.1 million passengers in 2013 to approximately 24.3 million passengers in 2018.

San Diego is the largest metropolitan area in the United States that is not an airline hub or secondary hub for its top five carriers: Alaska Airlines, American Airlines, Delta Air Lines, Southwest Airlines, and United Airlines.

In addition to an extensive domestic flight network, the Airport offers nonstop international flights. British Airways provides service to the United Kingdom, Air Canada provides service to Canada. Japan Airlines provides service to Japan, Alaska Airlines and Southwest Airlines provide services to Mexico and Edelweiss provides service to

Switzerland. The Airport set a record in 2018 by serving more than one million international passengers; a 19 percent increase over 2017.

Overall, sixteen new routes were added in 2018, and all but two of the seventeen airlines serving the Airport experienced an increase in passenger traffic. Southwest added the most passengers, carrying 794,401 more in 2018 than in 2017, followed by Alaska Airlines carried an additional 456,360 passengers in 2018, and United added 306,837 passengers.

On August 7, 2019 an article was published by "The Points Guy" that ranked San Diego International Airport as the number one airport in the United States. The ratings were based on amenities provided, on-time flights, and convenience of location.

On November 13, 2017, the Airport officially signed the "Declaration". The Airports Sustainability Declaration is voluntary and nonbinding, and calls for airports to develop, implement and expand initiatives that improve the sustainability and resilience of airports and their surrounding communities. To help achieve this outcome, the Declaration promotes four key principles – collaboration, transparency, innovation and engagement – and encourages partnerships between airports on a worldwide scale. The Declaration also aligns with the seventeen action areas of the United Nations Sustainable Development Goals, which were adopted by the United States and over 190 other countries in 2015. The Airport is implementing a portfolio of policies and projects that support the Airports Sustainability Declaration and its main principles.

1.2. PURPOSE OF THIS DOCUMENT

This San Diego International Airport Design and Construction Standards serve as the primary source of the requirements for planning, layout, and execution of projects at the Airport. The contents of this document are intended to guide Consultants and Contractors in the preparation of design and construction documents for Capital Improvement projects on Airport property, and to aid Contractors as they execute and construct projects for the Authority.

In accordance with the standards and requirements of this document, it is the Authority's expectation that all projects be designed and constructed to a consistent standard of safety, quality, sustainability, efficiency, and maintainability. Consultants and Contractors should strive to minimize the impact of any project on Airport operations, and to mitigate risk to the Authority at all times.

While this document is intended for use by all entities engaged in the development of Airport-owned property, it does not cover every situation relating to a particular

project. Consultants and Contractors shall work in collaboration with the Authority's Project Manager (APM) to resolve specific issues as they arise. The APM will coordinate with required stakeholders as needs arise and will be the conduit between the Authority and the Consultants.

1.3. ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

The following acronyms, abbreviations, and definitions are used throughout this document and shall be interpreted as follows:

AC: Advisory Circular

ACAMS: Access Control and Alarm Monitoring Systems

ACC: Airport Communications Center

ACO: Access Control Office

ACS: Access Control System

ACRP: Airport Cooperative Research Program

ADA: Americans with Disabilities Act

ADC: Airport Design and Construction

ADP: Airport Development Plan

AED: Automated External Defibrillator

AFF: Above Finished Floor

AFV: Alternative Fuel Vehicle

AHJ: Authority Having Jurisdiction

AHRI: Air-Conditioning Heating and Refrigeration Institute

AHU: Air Handling Unit

Airport: San Diego International Airport

Airport Security: Aviation Security and Public Security

ALP: Airport Layout Plan

ALUP: Airport Land Use Plan

AMCA: Air Movement and Control Association

ANSI: American National Standards Institute

AOA: Air Operations Area

AODB: Airport Operations Database

AODM: Airport Operations Duty Manager

APD: Airport Police Department

APM: Authority's Project Manager

APS: Audio Paging System

ARR: Airport Rules and Regulations

ASAT: Aviation Security Awareness Training

ASC: Airport Security Coordinator

ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning

ASME: American Society of Mechanical Engineers

ASP: Airport Security Program

ATCT: Airport Traffic Control Tower

ATMs: Automated Teller Machines

ATOs: Airline Ticket Offices

Authority: San Diego Country Regional Airport Authority also referred to as SDCRAA.

AVOPS: Aviation Operations

AVSEC: Aviation Security

AWG: American Wire Gage

BAS: Building Automation System

BD+C: Building Design and Construction

BHS: Baggage Handling Systems

BICSI: Building Industry Consulting Services International

BIDS: Baggage Information Display Systems

BIM: Building Information Model/ Management

BLC: Building Level Controls

BMP: Best Management Practices

BMS: Building Management System

BOD: Basis of Design

BOH: Back-of-House

BXP: BIM Project Execution Plan

BSC: California Building Standards Commission

BSCCG: California Building Standards Commission

CAD: Computer Aided Drafting

CALGreen: California's Energy and Green Building Codes

CA MUTCD: California Manual on Uniform Traffic Control Devices; https://dot.ca.gov/programs/traffic-operations/camutcd .

CBC: California Building Code

CBIS: Checked Baggage Inspection Station

CBP: Customs and Border Patrol

CBRA: Checked Baggage Resolution Area

CCP: Coastal Commission Permit

CCT: Correlated Color Temperature

CCTV: Closed-Circuit Television

CDM: Concessions Design Manual

CDE: Common Data Environment

CEQA: California Environmental Quality Act

CER: Computer Equipment Room

CFC; California Fire Code

CHRC: Criminal History Records Check

CITY: City of San Diego

CLT: California Least Tern

CMS: Content Management System

CMMS: Computerized Maintenance Management System

CNG: Compressed Natural Gas

CNP: Carbon Neutrality Plan

COS: Chief of Security

CRP: Climate Resilience Plan

CTP: Clean Transportation Plan

CUP: Central Utility Plant

CUPPS: Common Use Passenger Processing System

CUSS: Common Use Service System

DAS: Distribution Antenna System

DASPS: Director, Aviation Security and Public Safety

DB: Design Build

DBB: Design Bid Build

DC: Direct Current

D+C: Sustainable Design + Construction Requirements

DCS: The SDIA Design & Construction Standards

DCSRC: The SDIA Design & Construction Standards Committee

DDC: Direct Digital Control

DPM: District Project Manager

DSD: Development Services Department

DVS: Descriptive Video Service

EDR: Elevated Departure Roadway

EGIDS: Electronic Gate Information Display System

EIA: Electronic Industries Alliance

EIR: Environmental Impact Report

EMCS: Energy Management Control System

EMT: Electrical Metal Tubing

EPO: Emergency Power Off

EPSS: Emergency Power Supply System

EV: Electric Vehicle

EVAC: Emergency Voice Alarm Communication

EVIDS: Electronic Visual Display System

ESMP: Excavated Soil Management Plan

ESNA: Engineering Society of North America

FAA: Federal Aviation Administration

FAS: Fire Alarm System

FAR: Federal Aviation Regulation

FATC: Fire Alarm Terminal Cabinet

F&B: Food and Beverage

FCPC: Full Compensation Pay Clause

FIDS: Flight Information Display System

FIS: Federal Inspection Services

FM: Facilities Maintenance

FMC: Flexible Metal Conduit

FOH: Front-of-House

FRP: Fiberglass Reinforced Panels

FSD: Fire-Smoke Dampers

GBCI: Green Building Certification Institute

GHG: Greenhouse Gas

GIDS: Gate Information Displays

GIS: Geographic Information System

GMP: Guaranteed Maximum Price

GPS: Ground Power System

GSE: Ground Support Equipment

HDM: Highway Design Manual

HPD: Harbor Police Department

HPDL: High Pressure Decorative Laminate

HVAC: Heating, Ventilation, and Air Conditioning

IBC: International Building Code

IDF: Intermediate Distribution Frame

IDS: Intrusion Detection System

IEC: International Electrotechnical Commission

IP: Internet Protocol

IESNA: Illuminated Engineering Society of North America

IPM: Integrated Pest Management

ILS: Instrument Landing System

ISI: Institute of Sustainability Infrastructure

I&TS: Information and Technology Services

JRMP: Jurisdiction Runoff Management Plan

LAN: Local Area Network

LBR: Less Bottom Rod

LCP: Local Control Panel

LDW: Less Door Width

LEED: Leadership in Energy and Environmental Design

LOA: Letter of Approval

LOD: Level of Development

LPDL: Low Pressure Decorative Laminate

MASLE: Manager, Aviation Security and Law Enforcement

MCP: Maximum Contract Price

MEP: Mechanical, Electrical, Plumbing

MERV: Minimum Efficiency Reporting Value

MLLW: Mean Lower Low Water

MPOE: Minimum Point of Entry

MPS: Master Project Schedule

MSL: Mean Sea Level

MS4s: Municipal Separate Storm Sewer Systems

NAVD: North American Vertical Datum

NCS: United States National CAD Standards

NEC: National Electric Code

NEMA: National Electrical Manufacturers Association

NEPA: National Environmental Policy Act

NFPA: National Fire Protection Association

NGVD: National Geodetic Vertical Datum

NIC: Network Interface Card

NIST: National Institute of Standards

NPDES: National Pollutant Discharge Elimination System

NOI: Notice of Intent

NOTAM: Notice to Airmen

NOV: Notice of Violation

NRTL: Nationally Recognized Testing Laboratory

NTA: Notice to Appear

NTMA: National Terrazzo and Mosaic Association

NTP: Notice to Proceed

NTSC: National Television System Committee

NVR: Network Voice Recorder

OCIP: Owner Controlled Insurance Program

OCPD: Overcurrent Protective Devices

OSHA: Occupational Safety and Health Administration

OSP: Outside Plant

OTDR: Optical Time Domain Reflectometer

PA: Public Announcement

PACS: Picture Archiving and Communication System

PBB: Passenger Boarding Bridge

PCA: Pre-conditioned Air Unit

PCD: Pre-Conditioned Air Unit

PCO: Photocatalytic Oxidation

PDD: Program Definition Document

PDP: Project Definition Package

PDS: Parallel and Distributed Systems

PDU: Power Distribution Unit

P&E: Planning and Environmental Affairs Department

PGS: Parking Guidance System

PIP: Prohibited Items Permit

PM: Project Manager

PTZ: Pan-Tilt-Zoom

PVDF: Polyvinylidene Fluoride

QA/QC: Quality Assurance / Quality Control

QMP: Quality Management Plan

RCS: Regional Communications System

Responsible Department: the designated SDIA department responsible for the content of one or more chapters or sub-chapters of the DCS, as assigned by ADC and/or the DCSRC.

RIDS: Ramp Information Display System

RFI: Request For Information

RMS: Research Management System

RON: Remain Over Night

RR: Rack Room

RTU: Roof Top Unit

SAN: San Diego International Airport, referred to as the Airport throughout this publication.

SAN-ACM: San Diego International Airport - Airport Certification Manual

SAN-ASP: San Diego International Airport - Airport Security Program

SDCRAA: San Diego County Regional Airport Authority, referred to as "Authority" throughout this publication.

SDG&E: San Diego Gas and Electric

SDI: Steel Door Institute

SDIA: San Diego International Airport

SDS: Spatial Data Standards

SDN: Software Designed Network

SEGD: Society for Experiential Graphic Designs

SIDA: Security Identification Display Area

SLC's: Single-line Circuits

SMACNA: Sheet Metal and Air Conditioning Contractors' National Association

SMP: Sustainability Management Plan

SOC: Security Operations Center

SOW: Scope of Work

SR: Server Room

SSCP: Security Screening Checkpoints

STA: Security Threat Assessment

Stakeholder: any SDIA department, individual, customer or other entity with legitimate interest in the contents and requirements as contained in the DCS.

STEP: Strategic Energy Plan

Substantive Change: any modification(s) to the contents of the DCS which materially alter the philosophy or course of action set by SDIA, or which reflect a change in federal or statutory requirements.

SWMP: Storm Water Management Plan

SWPPP: Storm Water Pollution Prevention Plan

SWRCB: California State Water Resources Control Board

SWSI: Single-width, single-inlet

TA: Tenant Advisory or Task Authorization

TBB: Telecommunications Bonding Backbone

TCACS: Trane Catalytic Air Cleaner System

TDP: Thermal Design Power

TGB: Telecommunications Grounding Busbar

TIA: Telecommunications Industry Association

TIF: Tool Inventory Verification Form

TIN: Tenant Informational Notice

TMGB: Telecommunications Main Grounding Busbar

TMG: Telecommunications Main Grounding

TMGB: Telecommunications Main Grounding Bar

TPC: Transferable Pay Clause

TR: Telecommunications Room

TSA: Transportation Security Administration

TSRs: Transportation Security Regulations

UBC: Uniform Building Code

U/G: Underground

UPS: Uninterruptable Power Supply

USCS: Unified Soil Classification System

USGBC: US Green Building Council

UTP: Unshielded Twisted Pair

UVGI: Ultraviolet Germicide Irradiation

VAV: Variable Air Volume

VDC: Virtual Device Context

VFD: Variable Frequency Devices

VLANs: Virtual Local Area Networks

VMS: Variable Messaging Signs

VoIP: Voice Over Internet Protocol

VPDS: Visual Paging Display System

WAPs: Wireless Access Points

WBS: Work Breakdown Structure

WELL: Well Building Standards

WLAN: Wireless Local Area Network

WSP: Water Stewardship Plan

ZWP: Zero Waste Plan

1.4. REVISIONS AND UPDATES OF DESIGN AND CONSTRUCTION STANDARDS

1.4.1. OBJECTIVE

The Authority has developed, published and maintains detailed Design & Construction Standards (DCS). The DCS are intended to communicate the Authority's requirements to all entities engaged in the preparation of design and construction documents for the development of Authority owned property.

The Authority's Airport Design and Construction Department (ADC) is the entity responsible for maintaining the DCS, and the following processes are established to ensure the consistent development, approval, and review of the DCS content.

1.4.2. APPLICABILITY

This Procedure is intended to apply to any and all revisions, updates, changes, corrections, additions and/or deletions to the DCS.

1.4.3. KEY ROLES, RESPONSIBILITIES & ASSIGNMENTS

1. ADC shall have primary responsibility for the administration and maintenance of the DCS.

2. The SDIA Design and Construction Standards Committee (DCSRC) shall be established by the ADC, and shall be comprised of representatives from SDIA departments that are impacted by, and have an on-going interest in, the content of the DCS. The DCSRC consists of the following representatives:

    a. ADC Representatives (recommend minimum of two);

    b. Operations Representative;

    c. Maintenance Representative;

    d. Construction Representative;

    e. City of San Diego Planning Department.

3. Responsible Departments will be delegated responsibility by ADC for one or more DCS chapter or sub-chapter. Assigned responsibilities are as shown on page 24.

4. ADC is the Responsible Department for any chapter or sub-chapter not specifically assigned to others.

1.4.4. PROCEDURE/WORK PROCESS

1. Each chapter or sub-chapter of the DCS shall be administratively assigned by ADC to a designated Authority department (Responsible Department). It is the responsibility of the designated department to ensure that the assigned content is reviewed semi-annually and maintained in a manner that is clear, concise, current, and consistent with Authority practices and requirements. Current Responsible Department assignments are identified in Section IV.C.

2. Each Responsible Department shall be responsible for preparing proposed revisions, corrections, additions and/or deletions to each assigned chapter or sub-chapter whenever the need arises, but no less frequently than semi-annually.

3. ADC may, without requiring prior approval from others, implement editorial changes to any DCS content that involves correction of typographic errors or minor changes that have no substantive effect on the document or its intent.

4. Semi-Annual Review

    a. In June and December of each year, the Responsible Department will review and confirm that the content of each assigned chapter and/or sub-chapter is:

        i. Accurate in its description of current Authority practices and requirements;

        ii. Comprehensive and inclusive of all current and relevant

information, including new or innovative practices and requirements in use at other, similar airports;

iii. Consistent with current Authority practices and policies; and

iv. Compliant with all applicable federal or statutory requirements.

v. As appropriate each Responsible Department will revise or otherwise update the content and submit to ADC for consideration.

b. On or before June 1st and December 1st of each year, each Responsible Department will provide the DCS Coordinator with a list of each DCS chapter and sub-chapter that has been reviewed, the date on which it was reviewed, and whether it remains accurate as written or if revisions are forthcoming.

c. The DCS Coordinator will maintain a log of the last date each DCS chapter and sub-chapter was reviewed.

5. New content proposed by others for addition to the DCS, or revisions to existing content, will adhere to the following process:

a. Suggestions for new content, or revision to existing content, may originate by a request from any Authority stakeholder, using the form included as Attachment 1-A, and submitted to ADC.

b. If ADC finds merit in the suggested addition or revision, it will be forwarded to the appropriate Responsible Department for action.

c. The addition or revision will be drafted by the Responsible Department, with appropriate assistance and/or input from peer groups, relative stakeholders, etc. As applicable and appropriate, Responsible Departments shall coordinate proposed additions or revisions with other Authority departments that are, or are likely to be, impacted by the new or revised language.

d. Once drafted and appropriately reviewed for clarity, conciseness and grammar/typing correctness, the new or revised content will be forwarded by the Responsible Department to ADC. Whenever appropriate or practical, new or revised content shall first be presented by the Responsible Department to any impacted stakeholder(s) for review and comment, prior to submission to ADC.

e. ADC will review each submission and provide any comments back to the Responsible Department for incorporation. Once approved by ADC, ADC will present it to the DCSRC for their consideration. At ADC's discretion this may be at the next regularly-scheduled DCSRC meeting, or at a special meeting.

f. The DCSRC will approve, reject or suggest revisions to the submission. Depending on the determination of the DCSRC, the following will then occur:

    i. When the DCSRC has suggested revisions, the submission will be returned to the Responsible Department, which is then responsible for incorporating the DCSRC's comments and resubmitting to ADC per Step 4 above;

    ii. When the DCSRC has rejected the submission, it will be returned to the Responsible Department along with written cause for rejection. At the Responsible Department's discretion, the submission may be re-written or otherwise altered and resubmitted to the ADC per Step 4 above;

    iii. When the DCSRC has approved the submission, proceed to item f.

f. Once approved by the DCSRC, the new or revised content will be submitted, in the approved format, to the DCS Coordinator for inclusion in the next published version of the DCS.

g. The DCS Coordinator shall be responsible for:

    i. Maintaining the master list of all current approved DCS content, including as applicable the current revision # and approval date for each chapter and/or sub-chapter;

    ii. Ensuring that a history of previous versions of the DCS and subsequent revisions are maintained; and

    iii. Ensuring that the digitally-published DCS is up to date at all times, and includes the most current approved version of each chapter and sub-chapter.

CHAPTER or SUB-CHAPTER	RESPONSIBLE	
	DEPT	PERSON
Chapter 01: Introduction	ADC	
Chapter 02: Existing Conditions	ADC / EA	
Chapter 03: Sustainable Design & Construction Requirements	Planning / EA	
Chapter 04: Design Requirements	ADC	
4.2.1. Structural		
4.2.2. Architectural (includes hardware)	ADC/FMD/A&TO	
4.2.2.1. Function Areas		
4.2.2.2. Passenger Amenities		
4.2.2.3. Doors, Frames and Door Hardware		
4.2.2.4. Interior Finishes and Materials		
4.2.2.5. Exterior Materials		
4.2.2.6. Equipment		
4.2.6. Fire Alarm and Fire Suppression Systems	FMD	
4.2.7. Plumbing	FMD	
4.2.8 Mechanical	FMD	
4.2.9 Electrical	FMD	
4.2.10. Telecommunications	IT/AVSEC	
Chapter 05: Guide Specifications		
5.5. Plumbing	ADC/FMD	
5.6. Mechanical	ADC/FMD	
5.7. Electrical	ADC/FMD	
5.8. Telecommunications	ADC/IT	
5.9. IT and Security	ADC/IT/AVSEC	
Chapter 06: Deliverables and Permitting Process	ADC	
Chapter 07: Drawing Requirements and Procedures	ADC	
Chapter 09: IT and Security Performance Requirements	IT/AVSEC	
Chapter 10: Aviation Security and Public Safety	AVSEC	
Chapter 11: Airport Operational Safety and Security Requirements	AVOPS	

1.4.5. MODIFICATIONS FORM

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REVISION FORM

SUGGESTED REVISION TO THE DESIGN & CONSTRUCTION STANDARDS
Proposed changes, corrections or additions to this Standard should be completed using this form and submitted to ADC for consideration. Please include a complete description of the change proposed, along with sufficient technical or other documentation to support the change or addition. All suggestions received will be reviewed and researched and a written response will be provided.

DATE:	
To: Standard Coordinator, ADC	**From:** _____
_____	_____
_____	_____

BACKGROUND/EXPLANATION:
Change _____ **Correction** _____ **Addition** _____

EXISTING STANDARD TEXT FOR WHICH A REVISION OR CORRECTION IS SUGGESTED:	
Revision # and Date: _____	**Page:** _____
Section and Sub-section: _____	**Paragraph:** _____
If needed, copy and paste the current language here: _____	

PROPOSED REVISION, CORRECTION OR ADDITION:

Rev. 01-30-2020

CHAPTER 02:
EXISTING CONDITIONS

2.1. INTRODUCTION
2.2. GEOTECHNICAL INVESTIGATION, FOUNDATIONS, AND SUBGRADE CONSTRUCTION
2.3 AIRPORT LAYOUT PLAN
2.4. ENVIRONMENTAL IMPACT REPORT

2.1. INTRODUCTION

The Authority provides design requirements prior to the start of any project at the Airport. These requirements are outlined in Section 2.2. Supplemental plans and reports are also in place to facilitate an understanding of the existing conditions at the Airport. These plans and reports are the Airport Layout Plan (ALP) and the Environmental Impact Report (EIR). Both documents should aid the Consultant in understanding the unique existing characteristics at the Airport. Sections 2.3 and 2.4 summarize these two resources.

2.2. GEOTECHNICAL INVESTIGATION, FOUNDATIONS, AND SUBGRADE CONSTRUCTION

The Consultant may be directed to perform geotechnical exploration and provide recommendations for the design of foundations and subgrade construction, seismic design criteria, and the design of systems affected by geotechnical conditions. Based on experience with previous construction on the Airport campus, the Authority anticipates the use of deep foundation systems. Deep foundations may include driven piles, rotary soil displacement piles, or other deep foundation systems, subject to the review and acceptance of the Authority. Driven piles shall be installed using sound and

vibration mitigation strategies, subject to the review and acceptance of the Authority. The strategies shall identify anticipated sound and vibration levels, to enable the Authority to ascertain whether those levels are acceptable.

Subgrade construction must be conducted so that no loss of vertical or lateral load resistance of existing foundations occurs. Foundation and subgrade construction shall be coordinated with existing and new utilities and underground construction.

The Consultant and/or Contractor shall consider construction sequencing in its designs. For example, sequencing of underground construction for utilities that will affect the design of the superstructure or foundation system must be considered and adequately addressed.

Design of subgrade construction shall consider the loadings recommended by the geotechnical engineer, including seismic earth loadings and applicable surcharge loadings from airport and construction operations.

If the geotechnical investigation indicates that the site is subject to liquefaction, the Consultant shall, at the direction of the Authority, either remove the liquefiable soils and replace them with suitable soils, or develop alternative design strategies.

The geotechnical investigation shall evaluate groundwater conditions and provide related design recommendations for the design of subgrade construction. The Consultant shall waterproof subgrade construction, to prevent water intrusion into interior spaces. Use of subgrade drainage systems is to be reviewed with the Authority. Sumps associated with a subgrade drainage system shall be connected to backup power systems. Operational and maintenance requirements shall be reviewed with the Authority. In the absence of a subgrade drainage system, design of walls and slabs for subgrade construction are to consider hydrostatic pressure associated with maximum possible water head and with adequate factor of safety against hydrostatic uplift.

The geotechnical investigation shall evaluate the potential effects of sulfates on subgrade construction and provide recommendations regarding sulfate resistance and corrosion resistance of subgrade construction.

2.3. AIRPORT LAYOUT PLAN

The Airport Layout Plan (ALP) is a graphic planning tool that depicts both existing facilities and planned development for the Airport. The ALP is a plan that shows boundaries and proposed additions to all areas owned or controlled for Airport purposes. The location and nature of existing and proposed Airport facilities and structures as well as existing and proposed non-aviation areas and improvements can be found in the ALP.

Follow this link to access the plan.

2.4. ENVIRONMENTAL IMPACT REPORT

The Environmental Impact Report (EIR) has been prepared to evaluate environmental impacts related to the construction and operation of the proposed Airport Development Plan (ADP) project.

The EIR is an objective, full-disclosure document intended to: (1) inform agency decision-makers and the general public of the direct and indirect environmental effects of a proposed project; (2) identify and evaluate alternatives to the proposed project that might lessen or avoid some or all of the identified significant impacts; and (3) identify, where necessary and feasible, mitigation measures to reduce or eliminate any identified significant adverse impacts. This EIR evaluates the potential short-term and long-term, direct, indirect, and cumulative environmental impacts associated with improvements that are proposed for construction and operation in the ADP to accommodate aviation demand at the Airport.

Follow this link to access the full plan outlining existing conditions at the Airport.

CHAPTER 03:
SUSTAINABLE DESIGN AND CONSTRUCTION REQUIREMENTS

3.1. INTRODUCTION
3.2. WHEN TO USE THE SUSTAINABLE DESIGN & CONSTRUCTION REQUIREMENTS
3.3. WHO SHOULD USE THE SUSTAINABLE DESIGN & CONSTRUCTION REQUIREMENTS
3.4. RELATED AUTHORITY PLANS & GOALS
3.5. REGULATORY REQUIREMENTS
3.6. NAVIGATING AIRPORT SUSTAINABLE DESIGN & CONSTRUCTION REQUIREMENTS
3.7. SUSTAINABLE DESIGN & CONSTRUCTION FOR AIRPORT BUILDING PROJECTS
3.8. SUSTAINABLE DESIGN & CONSTRUCTION FOR AIRPORT INFRASTRUCTURE PROJECTS
3.9. SUSTAINABLE DESIGN & CONSTRUCTION TECHNICAL REQUIREMENTS

3.1. INTRODUCTION

The Authority has long been committed to operating the Airport in a manner that demonstrates our sustainability leadership. Our commitment to sustainability is evident throughout our Airport management decisions, from the way we manage critical resources including energy, water and waste, to our engagement with key Airport stakeholders such as concessions and Airline tenants, to the way we design and construct Airport facilities. Our *Sustainable Design & Construction Requirements* (D+C), Chapter 3 of this document, have been developed with these overarching sustainability commitments in mind.

3.2. WHEN TO USE THE SUSTAINABLE DESIGN & CONSTRUCTION REQUIREMENTS

The D+C Requirements are intended to be a one-stop-shop for integrating sustainability into Airport design and construction projects. They have been developed so that sustainability can be integrated throughout the design and construction lifecycle from early planning, through to design and construction and project closeout/third party reporting. The Requirements seek to promote an integrated approach to design that ensures sustainability opportunities are considered and promoted early in design phase and

that engages the right stakeholders throughout the process.

The D+C Requirements also seek to standardize and promote consistency in the Authority's approach to designing and constructing Airport facilities, including Authority projects and those developed by Airport tenants by making sustainability requirements explicit in contracts with consultants or other project delivery teams.

All team members have responsibility for compliance with the Authority's sustainability policies.

3.3. USING THE SUSTAINABLE DESIGN & CONSTRUCTION REQUIREMENTS

Consultant and contractor project teams should follow an integrated design approach that brings together applicable major design disciplines to collaboratively determine how to integrate sustainability into the project. This may include input from the Authority's Planning & Environmental Affairs Department, other Authority departments, and other Authority consultants and contractors. The Authority may also engage a sustainability consultant, particularly if the Authority will ultimately be pursuing third party sustainability certification for the project. Project teams should work together in partnership to integrate sustainability thinking into all projects, whether the project comprises a building or infrastructure project. Sustainability is a primary goal of Authority projects. Contractors and consultants may be directed to lead this effort as part of their assigned tasks.

An integrated planning meeting focusing on sustainability should be set up at the project inception and at each sequential deliverable milestone, to determine sustainability goals for the project and how these goals will be met throughout project.

3.4. RELATED AUTHORITY PLANS & GOALS

The D+C Requirements are aligned with, and shall be used in conjunction with, other Authority plans and requirements.

3.4.1. SUSTAINABILITY MANAGEMENT PROGRAMS

The Sustainability Management Program is the Authority's framework for advancing and measuring its environmental sustainability progress. The Program comprises seven overarching plans including the areas of:

1. Water stewardship;
2. Strategic energy;
3. Carbon neutrality;
4. Clean transportation;

5. Zero waste;

6. Climate resilience; and

7. Biodiversity.

The Authority sets goals and stand-alone strategies for achievements that are scheduled for 2035 in each of these programmatic areas. The plans are living documents that are updated on a regular basis.

To review and download the Authority's Sustainability Management Program documents visit: SAN.ORG/GREEN.

The charts on the following pages outline the supporting plans to achieve the goals of the Authority's Environmental Affairs department:

SMP PLAN	DESCRIPTION
Water Stewardship Plan (WSP)	Establishes the Authority's vision for the stewardship of water resources and provides a framework for rethinking how we manage our water resources while we prepare to accommodate passenger growth, new airport developments, and a changing climate. Specifically, the plan addresses issues of water conservation, water quality, and flood-risk considerations. Goals: • Eliminate potable water use for non-potable processes by 2035 • Achieve zero stormwater discharge by 2035 • Strive to make all critical facilities resilient in a 100-year storm event Initiatives: • Incorporate water meters/sub-meters for all facilities • Utilize ultra-low-flow fixtures • Use Xeriscaping and resilient irrigation practices for all landscaped areas • Incorporate dual plumbing for reuse of captured stormwater for non-potable uses • Incorporate condensate water reuse from gate-supplied pre-conditioned air • Incorporate a dual piping system to reuse captured stormwater for irrigation uses
Strategic Energy Plan (STEP)	Establishes the Authority's approach in the provision of cost-effective, energy resilience strategies that are environmentally responsible and fully aligned with airport operations and development. It addresses key issues of energy efficiency and conservation including on-site energy generation and storage, enhanced monitoring of key energy metrics, and mechanisms through which to actively engage the broad spectrum of airport stakeholders. Goals: • Achieve 100% renewable energy by 2035 • Achieve 30% reduction in energy cost per passenger by 2035 • Make energy systems resilient to 24-hour outage Initiatives: • Include performance-based energy targets (BTUs/sf) and energy modeling for all new facilities and major renovations to minimize Life Cycle Cost, maximize occupant comfort, and strive for Net Zero design • Resurface dark rooftops with cool roof treatment to reduce heat island effect • Provide for energy sub-monitoring and active energy management based upon tenant lease lines and major systems energy consumption • Perform commissioning for all new facilities and plan for ongoing commissioning • Design energy distribution infrastructure for redundancy to service disruptions • Incorporate lighting controls • Ensure that new facilities are solar photovoltaic ready • Plan for installation of on-site chilled water energy generation and storage capacity, when applicable

SMP PLAN	DESCRIPTION
Carbon Neutrality Plan (CNP)	Establishes the strategy for managing air quality and greenhouse gas (GHG) emissions over which the Authority has control and provides a framework for the airport to achieve carbon neutrality under the ACI Airport Carbon Accreditation program. Goals: • 80% reduction of Airport Authority-controlled GHG emissions by 2035 • 30% reduction in Airport-wide emissions by 2035 • 100% of stationary combustion equipment converted to electric or alternative energy sources by 2035 Initiatives: • Evaluate and consider needed infrastructure and/or distribution channels to support biofuel usage • Use hydrant fueling for Terminal 1 replacement and Terminal 2 retrofits, as applicable
Clean Transportation Plan (CTP)	Provides the Authority's strategy and plan for managing various ground transportation issues. Covers all ground transportation emission sources, including all vehicles and equipment accessing and operating at the airport, whether owned and operated by the Authority or by third parties. Goals: • 100% conversion of Authority and non-Authority owned vehicles and equipment to zero emissions by 2035. • 50% of parking designated Alternative Fuel Vehicle (AFV) or EV-ready by 2035. Initiatives: • Provide storage space and support infrastructure for bicycle use in commuting and operations • Provide enhanced airside infrastructure at gates (e.g., charging for electric Ground Support Equipment [eGSE]) • Accommodate Compressed Natural Gas (CNG) fueling, where applicable • Require that construction vehicles go through a Tier compliant and retrofit program (e.g., retrofit all pre-Tier, Tier 1, and Tier 2 construction vehicles) • Utilize low- and zero-emitting equipment during construction and remodeling activities, whenever possible • Bus construction workers into the construction site from consolidated vehicle parking/staging areas to reduce security checkpoint delays and emissions from individual riders and vehicle idling • Require contractors to demonstrate that vehicles have installed low emission engines, particulate filters and diesel oxidation catalysts on construction vehicles • Propose construction methods and techniques that require limited use of vehicles (eligible for preferred scoring during selection process) • During construction or remodeling process, use off-peak delivery schedules and/or delivery consolidation centers designated by the Airport, whenever feasible • Educate all construction and remodeling personnel about the Airport anti-idling plan and related enforcement policies • Provide EV charging infrastructure for Airport Authority vehicles and equipment

SMP PLAN	DESCRIPTION
Clean Transportation Plan (CTP) (continued)	• Provide dedicated motorcycle parking area and spaces to avoid use of vehicle spaces • Provide parking and relevant infrastructure for electric and alternative fuel vehicles such as CNG (including shuttles, taxis/ridesharing services, personal vehicles) • Provide parking guidance systems in new parking structures
Zero Waste Plan (ZWP)	Serves as the Authority's strategy and plan for managing various waste issues and covers all waste generated at the Airport. The ZWP provides an organized framework for eliminating or reducing waste generation and responsibly managing materials that we do produce. The Authority sees zero waste as addressing five primary focus areas, including sustainable materials management, infrastructure and development, training and education, metrics and reporting, and leadership and influence. Goals: • Achieve 90%+ diversion from landfill ("zero waste") by 2035 • Reduce the amount of material discarded per employee and passenger by 10% by 2035 Initiatives: • Allocate space and locate storage and collection areas for various waste streams, including organics and recyclables, in strategic locations throughout public and employee spaces • Accommodate space for reusable plates/cutlery and other waste-reducing strategies in tenant spaces • Design facilities to reduce pre-consumer organic waste from tenant spaces (e.g., kitchen food waste) and post-consumer organic waste • Plumb checkpoint liquid containment units ("dump sinks") to sanitary sewer, where applicable • Provide hydration/water refill stations in public areas (including near checkpoints) • Design to reduce restroom paper towel use (e.g., sink-integrated air dryers) • Recycle green waste collected from landscaping activities into mulch and compost • Ensure that any materials or waste generated during remodeling or construction projects, meet or exceed Authority thresholds for zero waste goals, practices and reporting • Ensure that all plans for new projects incorporate storage areas for landfill, recycling, and food waste • Maximize opportunities to reuse/repurpose modular buildings and cubicle parts • Purchase products that maximize recyclability and recycled content, reduce toxicity, and conserve natural resources, raw materials, and energy (e.g., minimize or eliminate use of single-use plastic products)

SMP PLAN	DESCRIPTION
Climate Resilience Plan (CRP)	Provides the Authority's strategy for achieving uninterrupted business continuity in future climate conditions. The Authority is proactively working toward long-term solutions that would allow for improvements in areas related to climate resilience that go beyond complying with existing regulations. This Plan builds upon existing initiatives ranging from improving storm drainage capacity in low-lying areas to collaborating with regional stakeholders to explore large-scale coastal flood protection strategies. Goals: • 100% of new capital projects are screened for climate resilience by 2020 Initiatives: • Evaluate climate resilience credits for projects pursuing third-party rating systems (e.g., LEED, Envision, or RELi), where applicable • Require projects to complete alternatives analysis that considers climate resilience of different types of materials (such as asphalt versus concrete), where applicable
Biodiversity Plan	Establishes the Authority's vision for the stewardship of plants and wildlife. Provides a framework for how we manage onsite habitat for the endangered California Least Tern (CLT), reduce the use of biocides through our Integrated Pest Management (IPM) program, and identify robust drought-tolerant plant species for our campus-wide xeriscape landscape program. Goals: • 100% bird deterrents on all new structures, solar panels, light and other poles, and any other structure that creates an area for birds to perch, loaf, roost, or nest by 2025 • 100% of all new landscaped areas include native plant species by 2025 Initiatives: • Consider optimal locations for native species planting. • Create native planting palette to attract specific types of native pollinators (e.g., butterflies) • Adhere to the list of preferred native species for designers and contractors that is consistent with applicable regulations. • Work with the Airport Authority to review projects during the design and plan check phase to ensure incorporation of IPM best practices • Work with the Airport Authority for plan check and construction inspection with a focus on proper installation of pest exclusion methods and bird deterrents • Participate in weekly construction meetings to ensure work activities occur in an environmentally friendly manner with a focus on CLT protection measures
	To review and download the Sustainability Management Program Documents go to SAN.ORG/GREEN

3.5. REGULATORY REQUIREMENTS

Regulations at the federal, state, and local levels, including the FAA—define the baseline environmental and sustainability performance requirements of Airport projects. These requirements, related to waste, biodiversity, energy, water, stormwater, transportation, and air quality, are the starting point of environmental performance at the Airport. Regulatory requirements include, but are not limited to, those shown in Table 3.5.1.:

Table 3.5.1: Regulatory Requirements Affecting Environmental and Sustainability Projects

Regulatory Policies & Documents	Strategic Energy	Water Stewardship	Zero Waste	Clean Transportation	Climate Resilience	Biodiversity
2009 Memorandum of Understanding with the California Attorney General	●			●		
California Air Resources Board Ambient Air Quality Standards and State Implementation Plans for San Diego County	●			●		
California Building Standards Code (Title 24 of the California Code of Regulations, or "CALGreen")	●	●	●			
California Clean Air Act	●			●		
California Coastal Act				●		
California Coastal Commission Sea Level Rise Policy Guidance (2018)		●			●	
California Endangered Species Act						●
California Global Warming Solutions Act of 2006 (AB 32), including additional targets set in SB 32 / SB 350 / EO B-30-15	●			●		
California Mandatory Commercial Organics Recycling Law of 2014 (AB 1826)			●			
California Mandatory Commercial Recycling Law of 2011 (AB 341)			●			

Table 3.5.1: Regulatory Requirements Affecting Environmental and Sustainability Projects (continued)

Regulatory Policies & Documents (cont.)	Strategic Energy	Water Stewardship	Zero Waste	Clean Transportation	Climate Resilience	Biodiversity
California Regional Water Quality Control Board - San Diego Regional MS4 Permit		●				
California State Water Resources Control Board - Construction General Permit - Industrial General Permit		●				
California Sustainable Communities Act (SB 375)	●					
Clean Water Act, Section 402, National Pollutant Discharge Elimination System (NPDES) Program		●				
FAA Airport Certification Manual - SDIA Wildlife Hazard Management Plan						●
FAA Modernization and Reform Act of 2012 requiring "a plan for recycling and minimizing the generation of airport solid waste"			●			
Federal Clean Air Act	●			●		
Federal Endangered Species Act						●
Mobility 2030 (Transportation Plan for the San Diego Region)				●		
Safeguarding California: Reducing Climate Risk (2014)	●	●			●	●

3.5.1. STORMWATER

3.5.1.1. CONSTRUCTION-RELATED DISCHARGES

The California State Water Resources Control Board ("SWRCB") adopted a statewide General Permit as the regulatory mechanism to address stormwater discharges associated with the majority of construction activity in the state. Under the state Construction General Permit, SWRCB Order No. 2010-0014-DWQ, NPDES No. CAS000002 (as may later be amended, reissued, or replaced), construction activity that results in soil disturbances of at least one acre must obtain coverage through compliance with the requirements of the

Construction General Permit. Compliance involves applying for coverage through a Notice of Intent (NOI) certified by the project owner and submitted to the SWRCB, along with other required information such as a site-specific Storm Water Pollution Prevention Plan (SWPPP) to minimize pollution from construction activities, and conducting periodic site inspections and reporting. The SWPPP has two major objectives:

1. To help identify the sources of sediment and other pollutants that affect the quality of stormwater discharges and;

2. To describe and ensure the implementation of best management practices (BMPs) to reduce or eliminate sediment and other pollutants in stormwater as well as non-stormwater discharges.

3.5.1.2. MUNICIPAL SEPARATE STORM SEWER SYSTEMS (MS4) DISCHARGES

The NPDES program also regulates stormwater discharges from municipal separate storm sewer systems ("MS4s") owned/operated by municipal agencies and other public entities. The San Diego Regional Water Quality Control Board (Regional Board) issued Order No. R9-2013 -001, NPDES Permit No. CAS0109266 (as may later be amended, reissued, or replaced), to regulate MS4 stormwater discharges from the watersheds within the San Diego Region (the Municipal Permit) and named the Authority as one of 21 Copermittees.

3.5.1.3. AUTHORITY STORM WATER MANAGEMENT PLAN (SWMP)

In 2015, the Authority updated the Airport Storm Water Management Plan (SWMP) to fulfill the Jurisdictional Runoff Management Plan (JRMP) requirements of the Municipal Permit. Similar to the SWPPP required by the Construction General Permit, the JRMP outlines the sources of pollutants across the entire airport site that can impact the quality of stormwater discharges. The JRMP also describes the BMPs that are required for use in eliminating or reducing pollutants in stormwater discharges, as well as non-stormwater discharges, resulting from operation of the Airport, including all construction activities.

The SWMP is updated regularly and can be accessed at SAN.ORG/GREEN.

The Airport SWMP addresses numerous topics, including development and construction:

1. Development Component Chapter 06 of this document addresses the Development Planning Component for New Development and Redevelopment requirements of the Municipal Permit. It discusses the Authority's development and

environmental review processes and the requirements for the incorporation of post-construction stormwater treatment controls and BMPs into those processes and procedures.

2. Construction Component, Chapter 06 of this document addresses the Construction Component requirements of the Municipal Permit, including the description of approval processes, inventory and prioritization of all construction activities, implementation of construction BMPs, and inspection and enforcement.

3. Appendices – The appendices to the SWMP contain supporting information such as Authority regulations, detailed BMP information, and the Authority's BMP Design Manual, which outlines the requirements and processes for documenting post-construction stormwater BMPs applicable to new development and redevelopment.

3.5.1.4. BMP DESIGN MANUAL

The BMP Design Manual guides the project proponents through the selection, design, and incorporation of storm water BMPs or storm water treatment control/ management facilities that must be implemented to obtain approval of project plans. The Authority BMP Design Manual is included as Appendix C of the Airport SWMP and is available on the Airport's website at SAN.ORG/GREEN.

The requirements of the MS4 Permit, and thus the Authority BMP Design Manual, dictate a hierarchical approach to designing and implementing post-construction stormwater treatment controls from the project site. The approach requires that 100 percent of the pollutants contained in the volume of storm water runoff produced from a 24-hour 85th percentile storm event be retained on site. Onsite pollutant retention should, unless found to be technically infeasible, be accomplished using stormwater capture and reuse or infiltration. Only if these methods are found technically infeasible, as agreed upon by the Authority, may the project team consider biofiltration and other flow-through stormwater treatment controls.

There are several issues in the Authority BMP Design Manual that are jurisdiction-specific, including the inapplicability of hydromodification management requirements since the entirety of the Authority jurisdiction discharges to San Diego Bay through storm drains (as opposed to natural creeks or channels), and therefore, meets the MS4 Permit exemption for hydromodification requirements. Additionally, in regard to infiltration, the Model BMP Design Manual noted that requirements relative to the depth to groundwater can be reduced at the discretion of the approval agency if the underlying groundwater basin does not support beneficial uses and the groundwater quality is maintained. The

Authority BMP Design Manual states that groundwater at the Airport does not support beneficial uses (Water Quality Control Plan for the San Diego Basin, 1994/1995 as amended), and that therefore, the Authority may approve of infiltrations BMPS where the vertical distance from the base of the infiltration BMP to the seasonal high groundwater mark may be less than 10 feet, provided groundwater quality is maintained.

3.5.1.5 THE AIRPORT STORMWATER CAPTURE AND REUSE SYSTEM

The Authority has investigated and evaluated stormwater capture and reuse since 2016 as documented in the 2016 Airport Water Stewardship Plan, the 2017 Airport Phase II Strategic Stormwater Master Plan, and the 2018 Strategic Stormwater Master Plan. There are multiple benefits to stormwater capture and reuse at the Airport. Capture and reuse also allows the Authority to meet numerous regulatory requirements related to stormwater discharges and enables the Authority to meet water stewardship goals, including the development of other water sources to help offset the amount of potable water being used for non-potable purposes at the Airport. Stormwater capture and reuse is one of the post-construction stormwater treatment controls available to new developments and redevelopments as detailed the Authority BMP Design Manual.

The 2018 Strategic Stormwater Master Plan includes hydrology and hydraulic modeling of existing conditions at The Airport and presents the design progression of the Airport Stormwater Capture and Reuse System. The 2018 Strategic Stormwater Master Plan identifies necessary modifications to existing storm drains to develop the Airport Stormwater Capture and Reuse System. The Airport Stormwater Capture and Reuse System is currently conceived as a large-scale multi-phase project intended to capture stormwater from approximately 200 acres of the airport.

The Airport Stormwater Capture and Reuse System currently envision the construction of two underground storage tanks with approximately 3 and 3.4 million gallons of storage, respectively, and underground infiltration areas that will temporarily store approximately 3 million gallons of stormwater, while simultaneously allowing the stormwater to infiltrate into the ground. At final build-out, the total storage capacity of the Airport Stormwater Capture and Reuse System would be approximately 9.4 million gallons and allow for the capture and reuse or infiltration of approximately 43 million gallons of stormwater per year.

All future developments at the Airport shall be evaluated in light of the Airport Stormwater Capture and Reuse System and incorporated into the system to the extent possible, with the intent to capture

stormwater as much from the 661-acre airport as practicable.

For a copy of the Stormwater Master Drainage Plan, please contact the Airport Design & Construction Department or the Planning & Environmental Affairs Department.

3.5.1.6. ALTERNATIVE COMPLIANCE PROGRAM FOR DEVELOPMENT / WATER QUALITY CREDIT SYSTEM

The stormwater Municipal Permit allowed the Authority to request Regional Board approval of an "applicant-implemented alternative compliance program" for new development and redevelopment projects, wherein the only projects in the program are those owned by the Authority. Such an alternative compliance program created a "credit system" which allows for the banking, tracking, and trading of water quality credits and debits between Authority projects. The credits generated by one Authority project can be applied to another Authority project. The Authority BMP Design Manual provides information on the alternative compliance program that might be applicable to the post-construction stormwater treatment control requirements for development and redevelopment projects. The Authority BMP Design Manual outlines the methods that the Authority uses to bank, track, and trade water quality credits. The Alternative Compliance Program is managed by the Planning & Environmental Affairs Department.

3.5.1.7. OVER-IRRIGATION PROHIBITION

In compliance with the Regional MS4 Permit (AKA the "Municipal Stormwater Permit"), the Authority prohibits over-irrigation discharges into storm drains and encourages contractors to prevent and report over-irrigation. If a contractor spots over-irrigation on Airport premises, please contact the Authority with the incident location by calling 619-400-2710 or filling out an over-irrigation contact us form at: https://san.org/Travel-Info/Contact-Us

3.5.1.8. EXCAVATED SOIL MANAGEMENT PLAN

An Excavated Soil Management Plan (ESMP) was prepared for the Authority to provide contractors with guidance and procedures to appropriately handle and dispose of potentially impacted soil, groundwater, and/or sediments in the storm water systems during future construction activities at the Airport in accordance with Hazardous Waste Operations and Emergency Response regulations, other applicable rules and regulations, and best management practices. The ESMP also informs contractors of locations that may have residual chemical concentrations from historical operations. A copy of the latest version of the ESMP to be provided at a future date.

3.6. NAVIGATING AIRPORT SUSTAINABLE DESIGN & CONSTRUCTION REQUIREMENTS

The Authority provides multiple pathways for integrating sustainability in Airport projects, including certification to different rating systems, such as Leadership in Energy and Environmental Design (LEED), Parksmart and Envision. The D+C Requirements are intended to streamline the various sustainability requirements that exist within Authority procedures and processes, including LEED certification requirements and compliance with CALGreen, and voluntary initiatives such as Parksmart and Envision certification. An overview of LEED, Envision and Parksmart is provided in Figure 3.6.a.. Additional information is provided later in this document.

The type of project will dictate which pathway consultants shall follow, as defined in the following decision process shown in Figure 3.6.b. All projects, regardless of project type, shall refer to this document.

Figure 3.6.a. SUSTAINABLE PROGRAM PATHWAYS

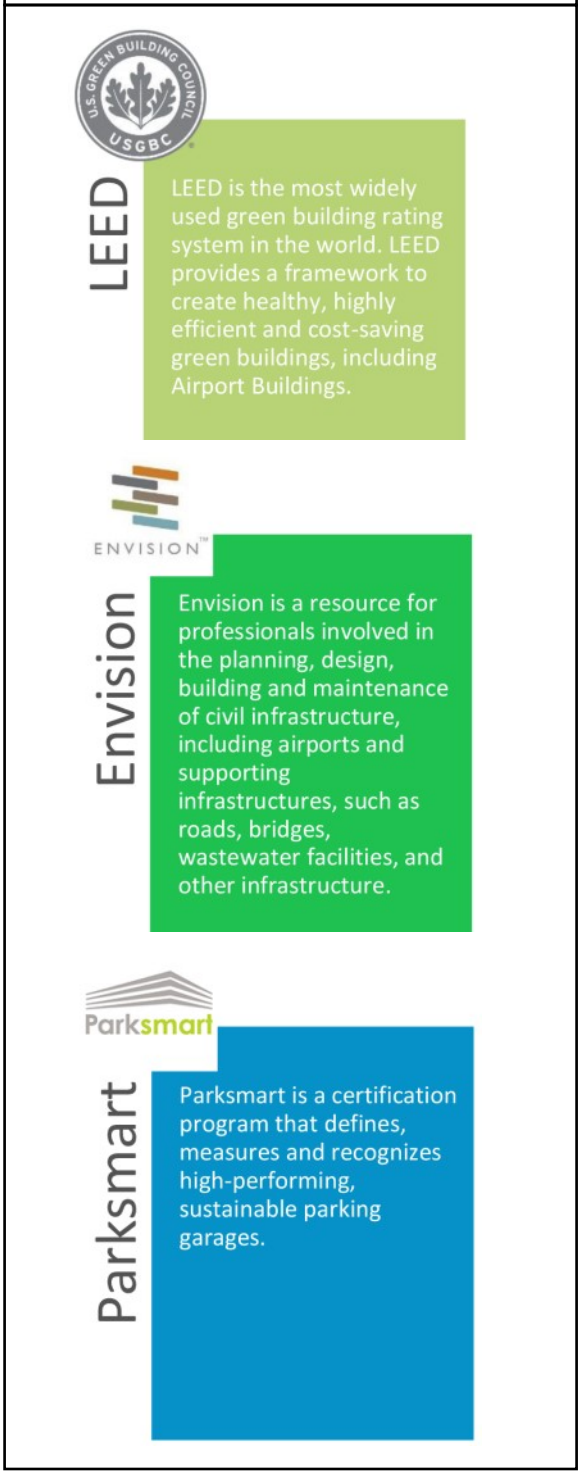


Figure 3.6.b.: SUSTAINABILITY REQUIREMENTS FOR DESIGN & CONSTRUCTION PROJECTS

Project Type Number	Concessions Design Manual	LEED Silver Certification	Envision Certification	Parksmart Certification	Sustainable Design & Construction Guidelines
New building or major renovation* projects greater than 10,000 SF**		●			●
New building or major renovation* projects less than 10,000 SF	○				●
Minor renovation projects	○				●
Civil infrastructure greater than $2M			●		●
Civil infrastructure less than $2M			○		●
Parking structures				●	●

* Major renovation projects are defined as those whose scopes include renovation of primary building systems such as electrical, mechanical, plumbing, and glazing systems.

** This also applies to commercial and retail interior spaces, in which case the LEED Interior Design and Construction rating system would be applicable.

○ Certain projects may be subject to the Concessions Design Manual.

○ Infrastructure projects less than $2M should use the Envision checklist to guide the sustainability efforts early in the project planning; these projects are not required to obtain Envision certification.

3.6.1. BUILDING HEALTH & WELLNESS CONSIDERATIONS

The Well Building Standards (WELL) and Fitwel are performance-based rating systems for measuring, certifying and monitoring features of the built environment that impact human health and wellbeing. Although it is not the intent of the Authority to pursue certification, design teams should consider pursuing specific requirements or certain applicable credits.

For administrative buildings and office space, project teams should consider incorporating the following design principles:

1. Promote daily physical activity and movement through the design of the circulation network;
2. Discourage prolonged sitting and sedentary behaviors by providing active workstations;
3. Provide a dedicated quiet room accessible to all regular occupants that can be used in private;
4. Support occupant well-being by incorporating the natural environment through interior and exterior design; and
5. Provide an outdoor space amenity accessible from a building entrance to all regular occupants.

For terminal spaces, consider incorporating the following design principles:

1. Support occupant well-being by incorporating the natural environment through interior and exterior design;
2. Provide a sufficient number of dedicated lactation rooms or stations accessible to all regular occupants;
3. Require a healthy food and beverage standard at least as rigorous as the Fitwel Food Services Standard in leasing agreements with food service providers; and
4. Provide a permanent dedicated display in a location accessible to all regular occupants advertising amenities within a 1/2 mile or 800 meter walking route of the building.

3.7. SUSTAINABLE DESIGN & CONSTRUCTION FOR AIRPORT BUILDING PROJECTS

Project teams shall follow the requirements outlined below for Airport building projects, in accordance with project size.

3.7.1. NEW BUILDING AND MAJOR RENOVATION PROJECTS 10,000 SQUARE FEET OR LARGER

The Authority's Sustainability Policy requires that all new building and major

renovation projects totaling greater than 10,000 square feet, whether Authority-or Tenant-owned, achieve LEED Silver certification.

Major renovation projects are defined as those whose scopes include renovation of primary building systems such as electrical, mechanical, plumbing, and glazing systems. LEED is a holistic sustainability rating system that covers sustainability considerations across multiple dimensions. It comprises a series of credits divided into the following categories:

1. Location and Transportation
2. Sustainable Sites
3. Water Efficiency
4. Energy and Atmosphere
5. Materials and Resources
6. Indoor Environmental Quality
7. Innovation
8. Regional Priority

3.7.2. LEED MASTER SITE PROGRAM

The LEED Master Site program was developed for projects that are located on a shared site under the control of a single entity (e.g., a corporate or educational campus, government installation, commercial development, or airport). It is intended to encourage a holistic approach to project management, define site-wide documentation requirements and capture economies of scale in the certification process, and address the unique challenges and opportunities inherent in shared site projects. The Authority is working to streamline the LEED certification process for Airport projects through the development of the Airport Master Site Program.

The Authority has applied to the Green Building Certification Institute (GBCI), the entity that provides LEED certification, to receive preapproval for certain prerequisites and credits for use with any associated LEED project in the Airport Master Site. The Authority has submitted documentation for these credits in the Master Site program, and individual projects within the Airport Master Site boundary can earn these Consultant Teams do not need to document these credits for their LEED project, unless there are deviations from the Master Site Program documentation that have already been submitted. To claim Master Site credits, projects must register individually (or as a group). Projects under the Master Site program go through the typical review process for individual projects but receive a discount in the registration fee collected by GBCI.

As shown in Figure 3.7.a., the Authority has been awarded the following prerequisites and credits: Cooling Tower Water Use,

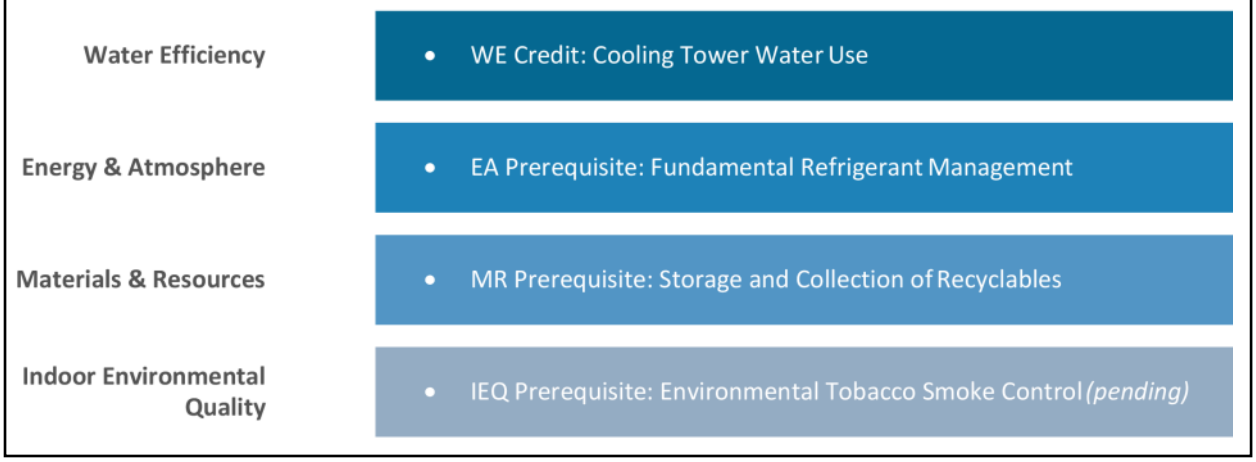
Fundamental Refrigerant Management, and Storage and Collection of Recyclables.

Future projects pursuing LEED certification under LEED v4 for New Construction and Major Renovation can pursue certification through the Airport's Master Site Program. To claim earned Campus Credits, register individual or group projects under the Airport Master Site Program. Projects shall be registered using a similar naming convention as the Master Site (e.g., San Diego International Airport Project X). To access the Airport Master Site in LEED Online, the LEED Online Project Administrator must designate each individual LEED Online Project Manager in the LEED Online Airport Master Site Program (using the "Project Manager" authority level).

3.7.3. LINKING A LEED PROJECT TO THE AIRPORT MASTER SITE

1. Login to your LEED Online account.
2. On the righthand side of the page, click on "Campuses."
3. From the provided list, click on San Diego International Airport campus project, ID 1000104162.
4. Click on "Master Sites" from the bar directly under the Campus name.
5. Click on "San Diego International Airport" from the Master Sites list.
6. Click on "Projects" from the bar underneath the Master Site name.
7. Click "Add Project."
8. Download the Excel Template and complete the required fields:

Figure 3.7.a.: SAN LEED—CAMPUS CREDITS CURRENTLY AWARDED



a. SAN Campus Project ID: 1000039695

b. Master Site Project ID: 1000104154

c. Campus Administrator email: breed@san.org

9. Once the excel sheet has been completed, click "Upload Excel Template," locate your document and select "Continue." You will be prompted to confirm your project detail and select "Proceed" to continue. If you need to revise any of the information, click on the "X" in the righthand corner and repeat Step 9.

10. Once the project information has been uploaded, you will be directed to the payment page. Complete the required information and payment details.

11. Once the project has been registered you will need to assemble the project team from the Master Site page. In addition to the design and construction team, confirm with the Airport Project Manager other stakeholders to be added to the team.

12. Assign Master Site credits at the project level. On the credits page, look for the term 'Project Credit' in the center column. If you see this term next to a credit item it means that documentation completed under the Airport Master Site Program may apply to your project. To utilize the Master Site Program documentation for the credit, hover over "Project Credit," then click on the Master Site tag under the 'Project Credit' label.

13. When using the preapproved Master Site Program prerequisites and credits, provide a narrative under the "Special Circumstances" directing the LEED reviewer to refer the Master Site application. Any project specific conditions that deviate from the Master Site Credit compliance path, must be documented under the individual project. For project specific variations, the LEED Campus Credit prerequisite or credit should not be referenced, and project specific documentation must be provided for that credit.

14. All other credits shall be documented as a typical LEED Online credits. Also note any additional requirements which are mandatory for LEED certification.

3.7.4. ADDITIONAL LEED RESOURCES

The USGBC website provides additional resources to help project teams pursuing LEED certification. The USGBC maintains a credit library for all LEED credits:

https://www.usgbc.org/credits This library provides guidance, worksheets and references for teams to follow.

3.7.5. CALIFORNIA'S ENERGY CODE AND GREEN BUILDING STANDARDS CODE

In order to significantly streamline fundamental LEED requirements, the US Green Building Council has approved a new approach to reviewing nonresidential LEED projects built in California. As announced in the summer of 2017, USGBC has preapproved certain prerequisites and credits for projects built to California's energy and green building codes (CALGreen). Eligible projects (defined below) can utilize code compliance for a batch of Alternative Compliance Pathways on LEED v4 projects. Eligible prerequisites and credits for the California Alternative Compliance Pathways are shown in Figure 3.7.b..

Eligibility for specific credit Alternative Compliance Pathways may differ by project type and scope. See the California LEED Alternative Compliance Pathways Guidance document https://www.usgbc.org/sites/default/files/California-LEED%20ACPs%20Guidance%20Doc%20Nov-2017.pdf for step-by-step instructions. To utilize the Alternative Compliance Pathways, project teams can preregister by filling out the USGBC survey at https://usgbc.wufoo.com/forms/m13erk317lairw/ To be eligible for the California Alternative Compliance Pathways, projects must meet the following conditions:

1. Project is subject to and meets all minimum requirements of the 2016 California Code of Regulations, Title 24, Part 6 and Part 11 (Energy Code & CALGreen code) and any associated updates;

2. Project is or was permitted after January 1, 2016 and has been issued a permit number by the Authority Having Jurisdiction;

3. Project is a nonresidential building under the authority of the California Building Standards Commission (BSC) or other appropriate jurisdictional agency;

4. CALGreen code requirements for the project are at least equivalent to the mandatory measures as adopted by the California Building Standards Commission (as defined in Title 24, Part 11, section 103, "BSCCG"); and

5. Project is registered under a LEED Building Design + Construction (BD+C) v4 Rating Systems.

Figure 3.7.b.: ELIGIBLE PREREQUISITES AND CREDITS FOR THE CALIFORNIA ALTERNATIVE COMPLIANCE PATHWAYS

Sustainable Sites	• Prerequisite: Construction Activity Pollution Prevention • Credit: Light Pollution Reduction (1 point, Option 1)
Water Efficiency	• Prerequisite: Outdoor Water Use Reduction • Prerequisite: Indoor Water Use Reduction • Prerequisite: Building-Level Water Metering • Credit: Outdoor Water Use Reduction (1 point, Option 2) • Credit: Indoor Water Use Reduction (1 point)
Energy & Atmosphere	• Prerequisite: Fundamental Commissioning & Verification • Prerequisite: Minimum Energy Performance • Prerequisite: Building-Level Energy Metering • Prerequisite: Fundamental Refrigerant Management • Credit: Optimize Energy Performance (1 point, Option 1)
Materials & Resources	• Prerequisite: Storage and Collection of Recyclables • Prerequisite: Construction & Demolition Waste Management Planning • Credit: Construction & Demolition Waste Management (1 point, Option 1)
Indoor Environmental Quality	• Prerequisite: Minimum Indoor Air Quality Performance • Prerequisite: Environmental Tobacco Smoke Control • Credit Construction Indoor Air Quality Management Plan (1 point)

3.7.6. NEW BUILDINGS AND MAJOR RENOVATION PROJECTS SMALLER THAN 10,000 SQUARE FEET

For smaller buildings and renovation projects consultants should refer to this document (specifically Chapters 4 and 6) to integrate sustainability into their projects. The sustainability requirements laid out in this document are aligned with LEED.

3.7.7. MINOR RENOVATION PROJECTS

Minor renovation projects should adhere to the Concessions Manual and/or the Design and Construction Standards following the D+C Requirements to integrate sustainability into their projects. The sustainability requirements laid out in this document are aligned with LEED requirements.

3.8. SUSTAINABLE DESIGN & CONSTRUCTION FOR AIRPORT INFRASTRUCTURE PROJECTS

Recognizing the diversity of project types that are constructed at the Airport, the Authority promotes the use of other third party rating systems that are applicable to projects that are not eligible for LEED certification, namely Parksmart and Envision.

3.8.1. AIRPORT INFRASTRUCTURE GREATER THAN $2M IN DESIGN AND CONSTRUCTION COSTS

Project teams developing infrastructure projects with design and construction costs exceeding $2M are required to achieve Envision silver certification.

Envision is a rating system that evaluates, grades and gives recognition to infrastructure projects, including airport projects including but not limited to roadways, energy, water distribution and management infrastructure, etc. This rating system is administered through the Institute of Sustainability Infrastructure (ISI). Envision comprises 64 credits across five categories:

1. Quality of Life: Promoting community engagement and wellbeing;
2. Leadership: Encouraging collaboration, improved sustainability management and planning;
3. Resources Allocation: Addressing energy, materials and water stewardship;
4. Natural World: Promoting effective project siting, protecting of land and water, and biodiversity; and
5. Climate: Addressing emissions and resilience.

For more information on Envision, refer to ISI's website: https://sustainableinfrastructure.org/

For more information on Parksmart, refer to their website: https://parksmart.gbci.org/

3.8.2. PARKING STRUCTURES

Project teams developing parking structures are required to achieve Parksmart Silver Certification. Parksmart is a voluntary rating system that complements LEED and other certifications and has a narrow focus on parking infrastructure. Parksmart comprises 48 credits over four categories including:

1. Management
2. Programs
3. Technology and Structure Design
4. Innovation

Certification is open to both new and existing structured parking facilities of all types including airports. Projects can be standalone, or a part of a mixed-use building. Projects have five years to complete certification and may submit measures all at once, or work toward certification over time. For more information on Parksmart, refer to their website: https://parksmart.gbci.org/

3.8.3. OTHER INFRASTRUCTURES LESS THAN $2M IN DESIGN AND CONSTRUCTION COSTS

Project teams developing infrastructure projects with design and construction costing less than $2M are required to utilize the Envision project checklist but are not required to pursue certification.

See above information about the Envision rating system.

3.9. SUSTAINABLE DESIGN & CONSTRUCTION TECHNICAL REQUIREMENTS

As detailed throughout this Chapter, the Authority has developed multiple plans and programs to enhance the sustainability performance of Airport capital projects and operations. Each of these plans includes recommendations that are applicable to design and construction projects, and the D+C Requirements are intended to summarize the highest priority recommendations from the Authority's relevant planning documents. Project teams should incorporate these considerations into their projects as applicable given the scope of the project.

Links to the plans can be found at:

www.san.org/green

CHAPTER 04: DESIGN REQUIREMENTS

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4.1. INTRODUCTION AND GOALS

The employees of the Airport maintain the highest operational standards throughout all functional activities and constructed facilities. It is the continual goal of the Airport to establish and maintain an atmosphere that enhances customer satisfaction, improves the appearance of the terminals, and increases operational and economic performance of the Airport's facilities.

The intent of this document is not to replace the technical specifications. Rather it is the intent for the technical specifications to be written utilizing these guidelines as a base.

The content within this Chapter establishes the requirements for functional, durable, maintainable, sustainable and life cycle products at the Airport. The objectives for this Chapter are:

1. To support the integration and streamlining of existing facilities asset management applications in order to improve business operations from project inception to decommissioning and disposal, through enhanced functionality and streamlining of existing processes;

2. To enhance the currently planned Terminal Development Program by providing insight into the products and

systems that the Authority considers acceptable in form and function; and

3. To focus the design and decision-making processes on multi-dimensional sustainability concepts; and in support of that effort, to provide guidance in the implementation of new and renovation works so that they are in alignment with the Authority's established policy on sustainability.

The Authority has embraced the complex challenges faced by an airport engaged in being environmentally responsible, as evidenced by the adoption of their Sustainable Design and Construction Guidelines. Information pertaining to the Authority's sustainability efforts at the Airport can be found in Chapter 3 of this document.

The architectural and engineering design community, whenever working in a consulting capacity for the Authority, must achieve the intent of these criteria throughout all phases of any project, regardless of its size or scope.

Practices and projects shall comply with the standards set forth in this document.

This document is a "living" standard that is routinely revised based upon identified changes in technologies, improvements made by manufacturers, and lessons learned through project execution and operations and maintenance activities.

4.1.1. SOLE SOURCE PRODUCTS

If the Authority requires that a product exactly match other products in use, then that is a "sole source" product. Internal Authority approval for that sole source is required prior to the release of the specifications. Those sole source products are listed in Appendix 4.6 and Appendix 5.14.

It is required by Public Contract Code §3400 and Authority Board Policy 5.01 that a specification listing a sole source product must state a reason that is allowed by that section.

The preferred format for a sole source product is:

Manufacturer/Product is a sole source product that required to match other products in use.

4.1.2. BASIS OF DESIGN PRODUCTS

If a sole source is not desired, then the Authority may specify a Basis of Design product. These products are listed in Appendix 4.6 and Appendix 5.14. and are selected based on functionality, durability, ease of maintenance, life cycle, and sustainability.

NOTE: Appendix 4.6 and Appendix 5.14. are routinely revised when there are changes in technologies, improvements made by

manufacturers, and lessons learned through use of a product. You must therefore ensure that you are using the latest version.

Public Contract Code §3400 and SDCRAA Board Policy 5.01 have very specific requirements that must be followed when listing manufacturers and products:

When drafting specifications, the designer/design builder must list a minimum of one additional manufacturer and product that is equal in all material respects to the listed Basis of Design product. (More than one additional manufacturer and product is preferred.)

If the Authority (or its designer/design builder) is aware of an equal product that is manufactured in California, that product must be among those named in the specifications.

The list of products must be followed by the words "or equal".

The preferred format where there is a Basis of Design product is:

1. Manufacturer A, Product A (Basis of Design);
2. Manufacturer B, Product B;
3. Additional manufacturers and products, if available and desired;
4. Or equal.

4.2. BUILDING SYSTEMS

This subsection of the document outlines criteria by discipline for all areas of the Airport. When designing airport facilities, it is of utmost importance that the consultants layout systems in a logical manner. The Authority requires that the Consultant design the Mechanical, Electrical and Plumbing (MEP) systems (i.e. routing of ducts, plumbing pipes/conduits for electrical/IT, etc.) as utility corridors within the base building structure or within chases that will not be modified in the future. System mains shall be in the common areas only. Utilities within walls of tenant spaces shall only be used to feed tenant spaces. Any deviation from this will require written approval from the Authority during design.

4.2.1. STRUCTURAL

Structural design shall comply with all applicable codes and follow all design standards, along with codes and standards indicated elsewhere by the Project Definition Documents (PDD).

Structural design elements will comply with the following:

1. Concrete floor slabs, supported by composite steel deck;
2. Non-composite roof deck, without the use of concrete or lightweight fill;

3. Minimize use of diagonal bracing and or shear walls. Where required placement shall minimize interference with function of space, and be coordinated with all effected stakeholders.

4. Placement and footprints of structural columns shall be coordinated with functional spaces;

5. The depth of interior floor framing members shall not exceed a nominal 24 inches, except the depth of girders spanning a large distance, which may be a nominal 30 inches, if required:

    a. Support beams at the exterior perimeter edges of the building shall not exceed a nominal 27 inches in depth.

    b. The depth of roof framing members shall not exceed a nominal depth of 36 inches.

    c. Floor framing members that support mechanical levels or the airline clubs shall not exceed a nominal depth of 33 inches.

6. Use normal weight concrete for floor in mechanical or equipment room areas, and coordinate with the acoustics consultant to achieve an overall building system that satisfies sound attenuation requirements;

    a. Anticipate the use of double columns at expansion joints and building separations, instead of sliding beam.

4.2.2. ARCHITECTURAL

4.2.2.1. FUNCTIONAL AREAS

4.2.2.1.1. TICKETING

Check-in and ticketing space include full-service agent positions, self-serve kiosk positions, curbside check-in counters, airline ticket offices (ATOs), circulation, and allowances for the MEP support area(s), structural elements, art program, flight information display system (FIDS) monitors, and wheelchair assistance office and storage.

When finalizing the specifics of the ticketing hall, include the following:

1. Provide intuitive access and wayfinding to the next steps of passenger flow;

2. Provide FIDS displays for all arrivals and departures throughout the ticketing lobby in proximity to doors and en route to the Security Screening Check Point (SSCP). All FIDS shall include the appropriate technology to provide information in a format and contrast that consider both natural lighting and compliance with the Americans with Disabilities Act (ADA);

3. Provide adequate seating in the ticketing hall for well-wishers, passengers who are adjusting their luggage before checking in, and/or passengers who are waiting for specific counters to open;

4. Include baggage trolleys and locations for trolleys to be stored around processing area;

5. Provide a modern and inviting space by considering specific roof configurations, materials, and architectural expression;

6. Provide an economical design that maximizes the use of the natural light in the ticket lobby;

7. Consider seamless and efficient flows for all passenger groups (i.e., with or without checked bags, use of self-service technologies or agent-based check-in process, leisure or business);

8. Materials and finishes shall be more refined and grander in the ticketing hall than in other areas of the terminal. Design efforts must consider many variables including high pedestrian traffic, passenger expectations, acoustics, public art, aesthetics, and creating a smooth and soothing travel experience; and

9. Special consideration of materials with high impact resistance is required at the Airport as it experiences higher traffic volumes than other types of facilities;

The Authority and airlines will coordinate to determine final arrangements of check-in counters, kiosks, and bag-drop facilities. They also will coordinate to provide the most appropriate technology in dynamic signage behind the ticket counter, to designate specific airline brands and information.

4.2.2.1.2. BAGGAGE CLAIM

Materials and finishes shall be similar to those used in the ticket lobby. The baggage claim area (s) of the terminal shall follow these requirements:

1. Be complementary to the overall design;

2. Provide ample spacing for carts, luggage and passenger circulation;

3. Be well lit and have a high foot-candle level (refer to Section 4.2.9.6.);

4. Have epoxy terrazzo floors;

5. Be designed using highly durable materials;

6. Give priority to wayfinding signs;

7. Display airline logos via electronic Baggage Information Displays (BIDs); and

8. Have dynamic signage;

4.2.2.1.3. HOLDROOMS

The holdrooms shall be equipped with both traditional seating and a variety of alternative seating types, from "high top" counters to more casual seating arrangements adjacent to the dining areas. For the traditional beam seating, 100 percent of the seats must be powered and have cup holders.

Receptacles shall be circuited from dedicated branch circuits in the holdroom seating furniture system.

4.2.2.2. PASSENGER AMENITIES

4.2.2.2.1. AIRPORT DIRECTORIES

The Airport Directories will be seen as an interactive touchscreen wayfinding directory for the traveling public that conforms to the points below:

1. Hardware shall:
    a. Perform as an interactive touchscreen environment on touchscreen displays (min 55") allowing users to easily navigate through the Airport's directory;
    b. Allow zoom and pan for close-up viewing of regions;
    c. Have network connectivity, supporting both wired and WiFi connections;
    d. Have contingencies in place to continue content display and interaction in the event of a network outage;
    e. Provide sleep and screen saver modes shall deliver valuable content to include map display, current time/date, and "Need Information? Touch Here";
    f. Interact with boarding pass scanners to automatically build a wayfinding route for the customer;
    g. Provide options for wall mounting or a freestanding pedestal; and
    h. Have an integrated or mounted courtesy telephone.
2. Software functionality shall:
    a. Have software setting, for ADA compatibility, which changes the layout of the screen to accommodate access by passengers with disabilities. The EZ Access® Keypad is based on the Trace Research and Development Center at the University of Wisconsin. This keypad is an alternative input device for individuals with mobility disabilities. Please refer to the Trace Research and Development Center documentation for functionality.

b. Display a "you are here" dot to identify the location of the passenger

c. Have the capability to be configured in landscape or portrait orientation;

d. Support integration/data sourcing with the Authority's (san.org) website Content Management System (CMS)

e. Provide directions to passenger to ease navigation to their desired destination/concession/gate etc.;

f. Incorporate English, Spanish, German, and Japanese language support;

g. Display terminal specific content based on location, with the ability to view entire airport directory information (i.e. bag claim locations show info for arrivals, rental car info, ground transportation, transit options, baggage service info);

h. Display nearby concession options with the ability to preview menus;

i. Display appealing videos;

j. Display transportation pickup sites (i.e.: taxi, shuttle, bus, rental vehicles);

k. Ability to generate a dynamic path to guide users to their requested location;

l. Display estimated time to destination; for purpose of proposal consider standard walking times; security checkpoint wait times

m. Support Quick Response code scanning for further information;

n. Support quick flight lookup information; and

o. Provide multiple triggers to accommodate the displaying of emergency messages.

3. Integration:

   a. Directory shall integrate with the current FIDS (Flight Information Display Database System); and

   b. Provide dynamic integration for live media data sources such as video

4. Directory Content Management shall:

   a. Provide an easy-to-use, intuitive management user interface for content management;

   b. Provide the ability to add messaging for construction projects, closed gates, and post alerts for weather and flight delays;

c. Provide the ability to stage content for scheduled deployment;

d. Provide for content to be sourced from the CMS database DNN v7 in XML format;

e. Provide the ability to stage content for scheduled deployment; and

f. Include the ability to display promotions based on concession locations along selected route.

4.2.2.2.2. AIRPORT INFORMATION AREAS

The Airport utilizes staffed Information Desks as well as FIDs to assist passengers with finding their way at the Airport. Consultants shall coordinate with the APM regarding the locations for both amenities. In the design of the Information Desks and the armatures for the FIDs consideration of developing technologies shall be made.

Provide Information Desk with the minimum but not limited to:

1. Data;
2. Power;
3. LAN Line;
4. Workstation for one person minimum; and
5. Task Lighting.

4.2.2.2.3. AUTOMATED TELLER MACHINE (ATMS)

ATMs at the Airport are provided and installed by bank tenants of the Airport.

ATMs are provided for the convenience of travelers by allowing access to banking services. ATMs must be highly visible and accessible yet maintain visual compatibility with contextual architectural elements.

ATMs shall be in an alcove when possible and adjacent to the natural path of travel. They shall not impede or create an obstacle in the natural path of travel.

Unless otherwise indicated, all ATMs shall:

1. Conform to all applicable codes, regulations, and accessibility guidelines;
2. Be distinct yet complimentary to the overall architectural context;
3. Be secured in-place;
4. Be easily de-mountable without causing damage to the underlying architectural materials or when necessary the vendor shall return the area to original state upon ATM removal;
5. Have no sharp edges;
6. Have a large and easily-viewable screen;

7. Provide ample spacing to locate luggage adjacent to the unit;
8. Be finished on all sides;
9. Be protected with corner guards;
10. Have no exposed fasteners;
11. Be made of highly-durable materials (no plastic laminate);
12. Have a six (6) inch stainless steel base;
13. Be serviceable from the front of the unit;
14. NOT utilize the wall surface adjacent to the unit as part of corporate identification; and
15. Have a distinct, yet complementary finished surface adjacent to the unit that is visually divisible from the corporate identity.

4.2.2.2.4. BAGGAGE CART DISPENSERS

Baggage carts are an amenity that help passengers transport baggage through the terminals.

Baggage carts and associated dispenser units shall be adjacent to the natural path of travel so that they do not create an impediment to the circulation. The carts and dispensers shall be located pre-security in the Baggage Claim Hall and curbside on the departures level.

Carts and dispensers shall be made of brushed- or powder-coated stainless steel with a signage color matching other wayfinding signage throughout the Airport.

Unless otherwise indicated, baggage carts shall:

1. Have a floor space clearance of no less than 5'-0" in front of and behind the dispenser unit; and
2. Have power and data provided for each dispenser unit.

4.2.2.2.5. DRINKING FOUNTAINS

Refer to Section 5.5 for the Authority's approved products for drinking fountains at the Airport.

Drinking fountains shall be provided frequently and be of the same manufacturer make and model throughout all terminals.

Unless otherwise indicated, all drinking fountains shall be located:

1. In an alcove;
2. In between each restroom; and
3. Within or near all food courts.

Drinking fountains shall conform to all applicable codes and regulations, including

ADA, for drinking fountains and drinking fountain signage. ADA-accessible drinking fountains shall be paired with all standard types.

4.2.2.2.6. FURNITURE

Airport seating provides comfort and convenience for the airline passenger. The demands placed on airport seating require that the seating be durable, functional, comfortable and easy to clean. The design shall also be aesthetically pleasing, affordable and easy to service and replace.

Unless otherwise indicated in a specific section all airport seating shall:

1. Conform to all applicable codes and regulations;
2. Be reviewed by the Authority in consultation with a design professional;
3. Have rounded edges or projections;
4. Be easy to maintain; and
5. Have an extremely durable structure and finishes.

4.2.2.2.7. INTERIOR FURNITURE

Gate holdroom seating shall have combination convenience outlets (USB and Standard) and cup holders installed in the frame or arms. The percentage of combination outlets provided shall be coordinated with the Authority. Power cords shall not be visible and are to be fed through the floor when seats are not abutted up to a wall. Outlets shall be placed as close to beam seating legs as allowable.

The Authority's BOD Manufacturer and Product for beam seating at the Airport is the: Zoeftig Ltd. Zenky Power Arm System.

Gate Holdroom seating shall:

1. Have stainless steel for all exposed metal;
2. Join with a connector when arranged back to back; and
3. Include a wall-standoff piece when against a wall.

All other interior furniture shall:

1. Be covered in an extremely durable upholstery with a durability factor no less than 100,000 Double Rubs;
2. Have field replaceable seats and backrests;
3. Have a minimum of exposed seams; and
4. Have power and data at locations reviewed and approved by the Authority.

4.2.2.2.8. EXTERIOR FURNITURE

Unless otherwise indicated, all exterior seating shall:

1. Be constructed of durable weather-resistant material;
2. Be a bench style;
3. Have an exterior grade finish; and
4. Be easily secured.

4.2.2.2.9. PET RELIEF AREAS

Pet relief areas shall be provided in location and quantity as required by the Authority. These Pet Relief rooms shall be:

1. Located close to restroom cores for ease of wayfinding and shared building systems;
2. Enclosed and properly ventilated;
3. Sealed concrete, such as resin matrix flooring, covered with high-quality synthetic turf, and sloped to a sanitary drain; and
4. Be outfitted with a fresh-water hose bib, a maintenance closet, plastic waste bags, a trash can, a sink for hand washing, and a canine drinking fountain.

Pet relief areas are also required on the exterior of the building for arriving passengers and visitors.

4.2.2.2.10. RESTROOM FACILITIES

4.2.2.2.10.1 GENERAL DESIGN CRITERIA

Airport restrooms are one of the few airport areas that are in continual use every hour of the day. The restroom environment must be tranquil and functional. The materials and hardware used shall be durable, maintainable and easy to clean. Additionally, all restrooms shall be designed with security in mind, keeping the space free of hiding places and vandal-proof as much as possible. All design features, including features in gender neutral restrooms, shall comply with ADA requirements for restrooms and restroom signage.

Refer to Chapter 5.5. for specific plumbing fixture manufacturer and product information and design requirements.

All restrooms shall:

1. Have 2 separate entrance/exits or a double sided main entry/exit when possible;
2. Display art work on the partition separating the entry and exit to the restrooms;
3. Include a curved, perforated stainless steel wall panel in each restroom entry;
4. Use porcelain tile or stone to full wall height on every wall (no wall covering

or paint). Tiles shall be 12" High X 6" Wide above the terrazzo cove base with a 6" X 6" accent tile for the last row of tile below the ceiling, all corners shall have a stainless steel corner bead;

5. Abide by code regulations for sufficient abrasive index for slip resistant flooring;

6. Have a floor drain to the side of main traffic flow;

7. Have a epoxy terrazzo floor and base;

8. Have no expansion joint in the restroom floor;

9. Use a painted gypsum board ceiling, not acoustical ceiling tile, throughout for security reasons. Paint shall be moisture-resistant and the color shall be white;

10. Have a dynamic attendant static sign with the following message (subject to change, confirm with APM), "Does this restroom need attention/Text your comment to 55744Start your message with location SAN57 Thank you, SDIA"; Consultant to confirm locations in the restroom with the APM;

11. Have dynamic wayfinding digital sign at the entry to all restrooms directing passengers to additional restroom locations, Consultant to coordinate with APM and I&TS;

12. Have at least one gender neutral restroom external to the main men's and women's restrooms. Location of gender neutral restroom to be coordinated and approved by the Authority.

13. Have out swinging doors for ADA stalls; all other stall doors shall swing in;

14. Have seating outside of the restroom entries;

15. Have a semi-recessed baby changing stations in a countertop;

16. Have ADA and ambulatory stalls as required by code;

17. Have adequate water closet/lavatory counts to serve the function: all restroom counts shall be reviewed and approved by the Authority;

18. Have a separate vanity counter with no basin in all women's restrooms;

19. Have a recessed stainless steel utility shelf with stainless steel guardrails above all urinals and water closets. Approximate size of shelf shall be 26" H x 20" W x 12" D. Shelves in ADA stalls shall be 32" H;

20. Be designed so portions of each restroom can be closed for maintenance while other areas remain open;

21. Have a floor drain in the pipe chase.

22. Have a dedicated 20 amp circuit in plumbing chase; and

23. Have a walkable maintenance "Plumbing Chase" behind the wet wall. Shall be a minimum clear floor area of thirty-four (34) inches from face of pipe to face of pipe. Plumbing chase shall have continuous concrete curb with water proofing upturned on curbs. Plumbing chase shall have lights with switches. Switch shall be located at the entrance to the chase. All elevated floor pipe penetrations shall be sealed water tight.

4.2.2.2.10.2. TOILET COMPARTMENTS

The Authority's BOD Manufacturer and Product for toilet compartments is:

1. Hadrian Manufacturing, Inc.;
2. Bradley Corporation;
3. Global Partitions;
4. Or equal.

The Authority's BOD Product for toilet compartments is:

1. Elite Plus Models with High Density Universal Grab Bar Panels);
2. Or equal.

A pre-installation meeting is required prior to installation of any toilet compartments or accessories.

Coordinate proper blocking for fastening toilet compartment panels to restroom shell walls.

Toilet compartments shall have the following:

1. All public restrooms toilet compartments shall be floor-mounted with 72" high door and 72" high panel mounted 6" above above finish floor and an overall dimension height of 82" to the top of the head rail brace;
2. All compartment components shall be embossed Type 304 stainless steel sheet with Hadrian's 5 WL pattern finish or equal finish;
3. Provide masonite backing throughout panels for reinforcing of accessories;
4. Compartments shall be designed with zero sightlines into stall;
5. Overhead bracing: Custom continuous stainless steel head rail with antigrip profile in finish to match other hardware;
6. Doors: Shall be equipped with a gravity type hinge mounted on the lower pilaster hinge bracket. Door hinges shall be the wrap-around type and adjustable to permit the door to come to rest at any position when not latched;

7. Grab bar reinforcement: Provide concealed internal reinforcement for grab bars mounted on units;

8. All panel-to-wall and panel-to-pilaster and connections shall be made with full height channels;

9. Each door to be fitted with a combined coat hook and bumper and a concealed latch, with face mortised flush with edge strip of door;

10. Toilet indicator (vacant vs. occupied) lock bolt;

11. Coat/briefcase hook: Capable to withstand 300 lb. load. One (1) hook per stall is required;

12. Appropriate blocking in the walls, floors, and ceilings at partition attachment locations;

13. Provide adequate space within toilet compartments for luggage; and

14. Flat-panel urinal screens shall be provided between each urinal. Screens shall match The BOD products for the Authority currently being used for toilet partitions.

4.2.2.2.10.3. TOILET, BATH, AND LAUNDRY ACCESSORIES

This section includes public-use washroom accessories, non-public-use bathroom accessories, laundry and custodial accessories.

Of primary importance when specifying these items is their durability in public and back-of-house applications. Toilet-accessories are subject to repetitive use as well as vandalism which result in the need for regular repairs and maintenance beyond the normal restocking requirements.

Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

The following are the Authority's BOD Products:

1. Waste receptacle: Bobrick B-2280; 21-gallon, square, approximately 30 inches high, ADA compliant;

2. Circular waste chute ADA compliant: Bobrick B-529; alternative sizes shall be

reviewed and approved by the Authority;

3. Recessed toilet paper, seat cover dispenser and sanitary napkin disposal ADA compliant: Bobrick B-357;

4. Partition mounted toilet paper, seat cover dispenser and sanitary napkin disposal ADA compliant: Bobrick B-3571;

5. Recessed toilet paper and seat cover dispenser ADA compliant: Bobrick B-3474;

6. Partition-mounted toilet paper and seat cover dispenser, ADA compliant: Bobrick B-3471. Recessed sanitary napkin/tampon vendor, ADA compliant: Bobrick B-43500X2;

7. Stainless steel folding shelf: Bobrick B-287;

8. Clothes hook and bumper; ADA compliant, door-mounted, bright polished:

    a. Office/administrative areas: Bobrick B-212.

    b. Public areas: Bobrick B-671.

9. Grab Bar: Bobrick #B-6806.99;

10. Soap dispenser: Sloan "300", chrome color, hard wired with transformer;

11. Surface-mounted toilet seat cover dispenser: Bobrick B-221;

12. Partition mounted toilet paper dispenser: Bobrick B-27460;

13. Surface-mounted automated paper towel dispenser: Georgia Pacific "enMotion" touchless towel dispenser; color "translucent smoke". Mount at adequate height to avoid paper towel touching countertops and meet ADA reach requirements. Dispensers shall be placed centered between each sink within a stainless steel surround;

14. The Authority's BOD Manufacture for electric hand dryers is:

    a. Dyson

    b. Or equal.

15. Accessory Materials

    a. Back paint components where contact is made with building finishes to prevent electrolysis.

    b. Color Selections: All color selections (including color, texture, gloss, etc.) will be provided and approved by the Authority, unless otherwise indicated.

4.2.2.2.10.4 BABY CHANGING STATION

Provide separate countertop surface between partition walls for baby changing station in both men's and women's restroom. Station to include:

a. Horizontal baby changing table:

   i. Authority's BOD manufacturer and product is Koala Kare Products KB112-01RE.

   ii. Mounting: Changing table is recessed mounted into countertop.

   iii. Color: Gray

b. A sink;

c. A hand sanitizer dispenser;

d. A recessed paper towel dispenser;

e. A mirror that extents from partition wall to partition wall and is full height from countertop backsplash to accent tile band below ceiling; and

f. A wall mounted light on each partition wall.

   i. Trash receptacle within reach of the changing table.

4.2.2.2.10.5. MIRRORS

Mirrors shall be a custom size and full height from countertop backsplash to gray accent tile. Vertical breaks will occur in-between mirrors to allow for a stainless steel panel that houses the paper towel dispenser with recessed lighting above that meets ADA mirror requirements.

4.2.2.2.10.6 LAVATORIES

Lavatories shall be made of continuous solid surface material with a six (6) to eight (8) inch skirt along the front exposed edge of the counter and have a trash receptacle built-in under and adjacent to each basin with a hole cut-out in the top of the countertop for waste disposal. Provide a sloped Stainless Steel Cover to conceal trash receptacles and pipes. A lockable door with key to access is required to access the trash receptacle.

4.2.2.2.11. DRESSING ROOM

At least one dressing room shall be provided in both the men's and women's restrooms. These rooms are to be used as a place for passengers to change clothes between, before, and after their flights. Rooms shall be equipped with furniture and accessories. Refer to Section 4.2.2.2.7. for requirements.

4.2.2.2.12. FAMILY/COMPANION CARE ROOM

A secondary program element is to be integrated into each restroom. Each restroom shall have a multi-purpose room where families can have space to regroup/ recompose and assist fellow travelers who may need extra attention. Considerations shall be given to the size of the room to accommodate adults that require changing and attending to needs, particularly if mobility of the individual is an issue.

4.2.2.2.13. NURSING MOTHER'S ROOMS

Nursing mother's rooms shall be provided as a separate room at each women's restroom location to meet all regulatory requirements including, but not limited to, the State of California and FAA. These rooms shall include a sink for handwashing, a comfortable chair, a table, and a countertop semi-recessed baby changing station. The room shall be adequately sized, follow ADA code requirements, and allow space for a stroller to be parked.

4.2.2.2.14. JANITORIAL FACILITIES

Facilities shall be provided near all restroom blocks. Obtain custodial accessories from single source and single manufacturer.

Rooms for janitorial maintenance shall:

1. Be located with primary access to the restroom plumbing chase;
2. Be centrally located to provide direct access to men's and women's restrooms;
3. Have resinous flooring, continuous under mop sinks;
4. Be equipped with sinks and/or a mop cleaning station; Mop sink rooms need to comply with the Concessions Design Manual (CDM);
    a. Mop sinks shall be:
        i. at least 2'-0" x 2'-0";
        ii. Fiberglass reinforced paneling (FRP) on all three sides up to at least 8'-0" AFF;
        iii. Ends of walls shall be protected with FRP corner guards.
        iv. Lap FRP over mop sink base and seal with silicon sealant.
        v. The wall mounted chemical dispenser needs to have a back -flow preventer per code requirements.
5. Include sufficient area for storing cleaning supplies, carts, trash, and trash bins;
6. Include a utility shelf;

7. Include a combination utility shelf/pop and broom holder;
8. Include a drying rod;
9. Hooks: 2 for hanging rags; and
10. Mop/broom holders: 4 spring-loaded rubber cam holders at shelf front.

4.2.2.2.15. SHOE SHINE

Shoe shine stands are provided as a customer amenity in the secure areas of the Airport. Stands shall be designed as an integrated element with the surrounding architecture.

Shoe shine stands shall:

1. Be located adjacent to concession areas if possible;
2. Be built in an alcove when possible; and
3. Not impede on the natural path of travel.

4.2.2.2.16. VENDING MACHINES

Vending machines shall be provided in designated areas throughout the terminal. These designated areas shall be designed as alcoves to fully recess vending units out of the public circulation zones. The Authority may require that it approve the graphics that are displayed on the vending machine front panel.

4.2.2.2.17. WHITE COURTESY PHONES

White courtesy phones augment the Airport's informational and wayfinding programs and provide a level of comfort, security and convenience for the traveler. The goal of this standard is to regulate the design of white courtesy phones to complement the theming and architectural goals of the Airport.

Courtesy phones shall:

1. Be located in major paths of travel;
2. Be located approximately 100' apart from each other;
3. Conform to all applicable codes, regulations and accessibility guidelines and be located at a height compliant with ADA accessibility guidelines;
4. Utilize the same design and colors in every terminal and zone;
5. Be reviewed by the Authority;
6. Have no sharp edges;
7. Have hidden connections; surrounding wall plate to be installed with tamperproof security screws;
8. Be vandal resistant;
9. Be flush-mounted when possible;

10. Include a standard, wall-mounted Airport informational sign at every location for easy identification;
11. Have a backer wall plate made of heavy gauge stainless steel;
12. Have an armor-corded handset;
13. Be made of a white, highly durable material;
14. Have a chrome-plated cast metal cradle; and
15. Meet all code requirements for courtesy phones;

4.2.2.2.18. LIGHTING

Refer to Chapter 4.2.9.6. for lighting requirements in specific areas.

4.2.2.3. DOORS, FRAMES AND DOOR HARDWARE

4.2.2.3.1. DOORS—PUBLIC TO PRIVATE

Doors leading from public to private and vice versa shall be equipped with a lite to minimize collisions of doors with pedestrians. The lite glazing system shall be a fire-rated wire glass. Lite size shall be compliant with local code requirements.

4.2.2.3.2. DOORS—PASSENGER BOARDING BRIDGES

Doors entering into the Passenger Boarding Bridges (PBB) shall be a stainless steel frame and solid stainless steel door.

4.2.2.3.3. HOLLOW METAL DOORS

Door frames shall be fully welded frames

Doors at service corridors and MEP room locations shall be double door configuration.

Fire rated double doors require a removable, lockable center strike mullion.

Doors at security/card swipe conditions shall be equipped with continuous rather than butt-type hinges.

Doors throughout shall be assessed for the benefits that vision glass in the door will provide for safety when passing into hazardous areas. Also consider the fire separation requirements between occupancies.

All doors leading to AOA shall have lites.

Obtain hollow-metal work from the same manufacturer for the entire project.

The BOD Manufacturers for the Authority currently being used for Hollow Metal Doors and Frames are:

1. Ceco Door Products;

2. Curries Company;
3. Security Metal Products, Inc.;
4. Steelcraft; a division of Ingersoll-Rand;
5. Or equal.

Requirements for hollow metal doors:

1. Door top closures shall feature flush end closure channel, with top and door faces aligned;
2. Door edge profile shall meet manufacturer's standard for application indicated;
3. Typical door face sheets shall be flush;
4. Glazed lights shall feature non-removable stops on non-secure side;
5. Hollow metal panels shall be of same construction, performance, and finish as doors;
6. If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent;
7. Exterior doors shall be thermally insulated, Level 3 - extra heavy-duty, physical performance Level A, 1,000,000 cycles, Model 2 - Seamless;
8. Exterior hollow metal doors in public areas shall be powder coated;
9. Interior doors that are non-fire rated Level 3 - extra heavy-duty, Physical performance Level A, 1,000,000 cycles, Model 2 - Seamless;
10. Fire-rated doors shall be Level 3 - extra heavy-duty, Physical performance Level A, 1,000,000 cycles, Model 2 - Seamless;
11. Smoke and draft control doors shall be self-closing or automatic closing doors, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors;
12. Sound-rated doors shall be Level 3 - extra heavy-duty, Physical performance Level A, 1,000,000 cycles. Model 2 - Seamless; and
13. Security resistant interior and exterior doors shall be Level 4 - Maximum-duty, Physical performance Level A, 1,000,000 Cycles. Model 2 - Seamless.

4.2.2.3.4. HOLLOW METAL FRAMES

Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

Size exit doors requiring continuous hinges to frame.

Exterior door frames shall be full profile/ continuously welded type. Frame components shall be hot-dipped zinc-iron alloy-coated (galvannealed) with A40/ ZF120 coating. Extra-heavy-duty frames shall be SDI A250.8, Level 3.

Interior door frames, Non-fire rated: Full profile/continuously welded type. Frames shall be Extra-heavy-duty SDI A250.8, Level 3.

Fire-rated door frames shall be full profile/ continuously welded type with a labeled fire rating same as door. Frames shall be extra-heavy-duty SDI A250.8, Level 3.

Sound-rated door frames shall be full profile/continuously welded type with extra -heavy-duty SDI A250.8, Level 3.

Security resistant door frames shall have same security resistance as door; full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation. Extra-heavy-duty frames: SDI A250.8, Level 3.

Frames for wood doors shall be extra-heavy-duty frames: SDI A250.8, Level 3. Comply with frame requirements in accordance with corresponding door.

Mullions for pairs of doors shall be fixed, except where removable is indicated, with profile similar to jambs.

Borrowed lites glazing frames shall have construction and face dimensions to match door frames. Hollow-metal frames of metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm). Construction: full profile welded.

Transom bars shall be fixed, of same profile as jamb and head.

Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

Frames in masonry walls shall be sized to suit masonry coursing with head member 4 inch high to fill opening without cutting masonry units.

Frames wider than 48 inches shall be reinforced with steel channel fitted tightly into frame head, flush with top.

Frames installed back-to-back shall be reinforced with steel channels anchored to floor and overhead structure.

Masonry jamb anchors shall be adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1 mm) and as follows:

1. For stud-wall, anchors shall be designed to engage stud, welded back of frames;

2. For drywall slip-on frames, use adjustable compression anchors.; and

3. For in-place concrete or masonry, post-installed expansion jamb anchors shall be minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

Form floor anchors from same material as frames.

Frames occurring in concrete and masonry construction shall be filled with grout or concrete.

Anchors for frames occurring in steel stud partition systems shall be screwed, bolted, or welded to both flanges of studs, and floor clips shall be attached to the floor with two bolts or power driven anchors per clip. Conceal exposed fasteners in frames.

Secure glazing stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

4.2.2.3.5. STAINLESS STEEL DOORS AND FRAMES

Stainless steel doors and frames are primarily used for high visibility applications in passenger areas, club room entry doors, jet bridge entry doors, and executive office entry doors and are often part of the branding and color schemes of resident tenants.

As stainless steel is usually left exposed with only a clear finish, specify grain direction and finish sheen to provide desired appearance.

Provide stainless steel doors with heavy duty continuous hinges to avoid damage from regular use.

The BOD Manufacturers for the Authority currently being used for stainless steel doors and frames are:

1. Ceco Door;
2. De La Fontaine Inc;
3. Steelcraft, an Allegion brand;
4. Or equal
    a. Stainless-steel doors be not less than 1-3/4 inches (44 mm) thick, of seamless, hollow-metal construction. Construct doors with smooth, flush surfaces without visible joints or seams on faces;
    b. Stainless steel panels shall be of same construction, materials, and finish as specified for adjoining stainless-steel doors;
    c. The fabrication of the stainless steel frames shall be of construction indicated, with faces of corners mitered and contact edges closed tight. The frame shall be machine mitered and full (continuously) welded; and

d. Stainless-steel doors and frames shall be fabricated rigid and free of defects, warps, or buckles.

4.2.2.3.6. FLUSH WOOD DOORS

Provide flush wood doors at executive and private office suites and similar locations. Use solid core doors in fully-welded steel frames. Provide sidelights at offices and conference rooms. Wood doors cannot withstand intense use typical for most doors at the Airport.

Spray-on applications of materials (including paints, coatings, air barriers, vapor barriers, waterproofing, roofing, etc.) can only be performed with the Authority's approval.

Source Limitations: Obtain flush wood doors indicated to be blueprint matched with paneling and wood paneling from single manufacturer.

The BOD Manufacturers for the Authority currently being used for Wood Veneer Faced Doors are:

1. Eggers Industries;
2. Graham Wood Doors;
3. Haley Brothers, Marshfield DoorSystems, Inc.;
4. Oregon Door;
5. Or equal.

The BOD Manufacturers for the Authority currently being used for High Pressure Decorative Laminate (HPDL) Faced Doors are:

1. Ampco Products, Inc.;
2. Poncraft Door Co.;
3. VT Industries, Inc.;
4. Or equal.

The BOD Manufacturers for the Authority currently being used for Low Pressure Decorative Laminate (LPDL) Faced Doors are:

1. Maiman Company;
2. Marshfield Door Systems, Inc.;
3. Or equal.

Pre-Installation Conference is required with the Consultant and the APM prior to commencement of project.

4.2.2.3.7. ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

Exercise care when implementing glazing and entry systems into future designs with respect to damage potential from jet blast and collision with ground service equipment.

The Authority's BOD Manufacturer of security doors at the checkpoints:

1. Manufacturer: HUFCOR or equal.

2. Model: 4100 Glass Accordion or equal.

Doors shall be 18'-0" maximum in width.

All color selections (including color, texture, gloss, etc.) shall be reviewed and approved by the Authority.

Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels and accessories, from a single manufacturer.

The BOD Manufacturers for the Authority are:

1. Kawneer North America;

2. Tubelite, Inc.;

3. Trulite Glass & Aluminum Solutions, LLC;

4. AP America Inc.;

5. Or equal

    a. Aluminum doors shall have wide stiles (over 5 inches).;

    b. Storefront framing members shall be manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads;

    c. Aluminum-framed storefront shall be factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices;

    d. Vertical mullion dimensions shall be 2 inches wide, minimum by depth indicated on drawings;

    e. Fasteners and accessories shall be manufacturer's standard corrosion-resistant, non-staining, nonbleeding fasteners and accessories compatible with adjacent materials;

    f. Anchors shall be three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer;

    g. Concealed flashing shall be dead-soft, 0.018-inch- (0.457-mm-)thick stainless steel, recommended by manufacturer;

    h. Bituminous paint shall be cold-applied asphalt-mastic paint formulated for 30-mil (0.762-mm) thickness per coat;

    i. Aluminum framing members shall be tubular aluminum sections, thermally broken with interior

section insulated from exterior, drainage holes and internal weep drainage system, in addition to the following characteristics:

i. Framing members for interior applications need not be thermally broken.

ii. Glazing stops shall be flush.

iii. Structurally reinforced members shall be extruded aluminum with internal reinforcement of structural steel member.

iv. Glazing gaskets shall be manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

v. Glazing sealants shall be as recommended by manufacturer.

j. Infill panels shall be insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed. Finish shall be same as storefront;

k. Insulated spandrel panels shall be laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

In addition:

i. Exterior skin shall be aluminum. Thickness shall be manufacturer's standard for finish and texture indicated. Match finish of framing system. Texture shall be smooth. Backing sheet shall be manufacturer's standard for use intended.

ii. Interior Skin shall be aluminum. Thickness shall be manufacturer's standard for finish and texture indicated. Finish shall match storefront framing. Texture shall be smooth. Backing Sheet shall be 1/2-inch- (12.7-mm-) thick, gypsum board with proprietary fire-resistance-rated core.

iii. Thermal insulation core shall be manufacturer's standard expanded-perlite, mineral-insulation board.

l. Entrance door system shall be manufacturer's standard glazed entrance doors for manual-swing operation. Door design shall be wide stile; 5-inch (127-mm) nominal width, minimum. Finish shall be same as storefront. Material shall be Aluminum: Alloy and temper as recommended by manufacturer for type of use and finish indicated.

Finishes shall be Superior Performing Organic Coatings: Multiple coat, thermally cured polyvinylidene fluoride (PVDF) system.

The BOD products for the Authority currently being use are:

i. PPG Metal Coatings, Duranar; and

ii. Sherwin-Williams Company SHER-NAR 5000.

iii. All color selections (including color, texture, gloss, etc.) will be provided and approved by the Authority, unless otherwise indicated. Touch-up materials shall be as recommended by coating manufacturer for field application; and

m. Finishes shall be superior performing organic coatings, along with the following characteristics:

i. Factory finish all surfaces that will be exposed in completed assemblies.

ii. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

iii. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

4.2.2.3.8. AUTOMATIC ENTRANCES

Aluminum sliding entrance doors are used throughout terminal areas as the primary entry system for passengers and baggage. These doors are integrated into overall curtain wall systems, between exterior Landside and interior Landside public egress doorways.

Doors shall be motion activated with key overrides to control public entry/exit points during lower use periods of the day.

Sliding entry doors currently in Airport installations are subject to many thousands of cycles each day. Consider heaviest duty rating available in terms of life span and cycles.

Rails and stiles that frame doors shall measure no less than 5 inches (10 inches at base) in width in order to maintain overall door system stiffness given the tremendous loads.

Specify tempered dual glazing to provide thermal, safety and sound transmission resistance necessary for such applications.

Final coating applied to aluminum door system parts shall resist effects of prolonged exposure to salt air.

The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Automatic Entrances is:

1. Stanley Access Technologies; Model 3000

The Authority's Sole Source Manufacturer (required in order to match other products in use at the Airport) for Automatic Entrances Assemblies is:

1. Stanley Access Technologies.

The Authority's Sole Source Manufacturer (required in order to match other products in use at the Airport) for swing doors is:

1. Stanley Access Technologies.

Finishes shall be High-Performance Organic Finish: Two-coat fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

All color selections (including color, texture, gloss, etc.) shall be reviewed and approved by the Authority.

4.2.2.3.9. DOOR HARDWARE

All door hardware shall comply with current Airport hardware standards outlined in this section.

Door hardware preferences have been established and shall be observed to allow in-house maintenance to manage replacement stock and keying standards.

All exterior doors, including sliding doors, shall have a locking mechanism.

Standardization of door hardware is essential for maintaining the security and for the ease of maintaining a 24-hour facility. Provide individual items of a single type from the same manufacturer and same model,

Design consultant is responsible for incorporating these requirements and to develop the project specification designed to meet the programmatic requirements.

Coordinate installation of door hardware, keying, and access control (Access Control and Alarm Monitoring Systems (ACAMS)/ card swipe/keypad security system) with the Authority's Project Manager (APM).

Coordinate all door hardware with The Authority.

A Preinstallation meeting and a Keying Requirements meeting with the Authority is required prior to project commencement. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system. Record minutes and distribute copies within two days after meeting to participants; with two copies to the APM or Construction Manager, participants, and those affected

by decisions made. Deliver established keying requirements to manufacturers.

Coordinate keying of cylinder locks with the Authority. Keying system shall be approved in writing by the Authority.

Obtain each type of door hardware from single manufacturer.

4.2.2.3.10. HINGES

Include the following quantity of butt hinges for each door:

1. Two (2) hinges for doors up to 60 inches high;
2. Three (3) hinges for doors from sixty (60) inches to ninety (90) inches high;
3. Four (4) hinges for doors from ninety (90) inches to one hundred and twenty (120) inches high;
4. One (1) additional hinge per each additional thirty (30) inches in height for doors over one hundred and twenty (120) inches high, and
5. Two (2) hinges each leaf for dutch doors.

Hinges shall meet the following requirements:

1. Provide hinges on every swinging door;
2. Provide five-knuckle full mortise butt hinges unless otherwise indicated;
3. Provide ball-bearing hinges at each door;
4. Provide non-removable pins on exterior out swinging doors;
5. Provide non-removable pins on interior out swinging doors at locations as indicated in Door Hardware Schedule;
6. Provide power transfer hinges where electrified hardware is mounted in door leaf;
7. Size hinges to keep door leaf clear of walls, casings, jambs or reveals in door openings; furnish wide throw hinges where necessary; and

The Authority's Sole Source Manufacturer (required in order to match other products in use at the Airport) for hinges is:

a. Hager Companies, continuous geared Roton fully concealed, heavy-duty hinge "780-112HD".

The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Electronic Power Transfer is:

a. Von Duprin "EPT-10" power transfer device.

The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for hinges on other doors is:

a. Hagar "H-2 Full Mortise Ball Bearing HW BB2168"

Pivots shall include Center-Hung and Offset Pivots for standard opening with up to 1,750 lbs. of door weight.

4.2.2.3.11. LOCKSETS AND LATCH SETS

The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for locksets and latch sets is:

a. Schlage, Series "ND" and "L" heavy duty, mortise type

Provide lock and latch sets with not less than 3/4-inch throw for latch bolts and 1 inch throw for dead bolts.

Trims shall be lever type. Levers shall be supported by gun type spring housed within case to prevent sagging. Auxiliary spring mounted in the rose will not be acceptable.

4.2.2.3.12. EXIT DEVICES

Exit Devices shall be heavy duty, chassis mounting design, with one-piece removable covers, eliminating necessity of removing device from door for standard maintenance. Trim shall be thru-bolted to lock stile case. Lever Trim shall be same as specified with locksets. Rail Assemblies shall be brass or bronze base material, plated to standard architectural finishes, or solid stainless steel. Provide cylinder with cylinder dogging or locking trim. Provide exit devices properly sized for door width and height. Provide strike as recommended by manufacturer for application indicated. Provide less bottom rod (LBR) at scheduled locations to eliminate use of floor mounted strikes. For electrical options, provide quick connect plug-in pre-wired connectors.

Panic Devices shall be of either the type with "interior" actuating rods (inside the door body) or no actuating rods (bar only). Exterior rods have proven to be a constant maintenance problem due to damage from impact by luggage/supply carts.

The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Exit Devices is:

a. Von Duprin.

4.2.2.3.13. ELECTROMAGNETIC DOOR HARDWARE

Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated.

Electric strikes shall be UL® listed burglary -resistant electric strike; style to suit locks. Provide field selectable fail safe/fail secure modes. Provide transformer and rectifier as necessary for complete installation. Connect electric strikes into fire alarm where non-rated doors are scheduled to

release with fire or sprinkler alarm condition.

Electromagnetic door holders shall be wall or floor mounted, single unit, heavy duty, with strike plate attached to door. Door shall fail safe; door released to close automatically when electrical current is interrupted. Provide interface with fire detectors and fire-alarm system for fire-rated door assemblies.

Electromagnetic locks shall have holding force of 600 lbs., minimum. Provide concealed sensing device within device that monitors magnetic holding force to ensure appropriate door lock. Provide concealed adjustable time delay option to re-lock door, adjustable from 1 to 90 seconds.

Provide electromagnetic locks for fire-rated doors. Provide concealed sensing device that monitors magnetic holding force to ensure appropriate door lock.

4.2.2.3.14. DOOR PULLS AND PUSH PLATES

Door pulls and push plates shall be stainless steel, unless otherwise indicated.

Provide door pulls and push plates on doors without a lockset, latchset, exit device, or auxiliary lock unless otherwise indicated.

On solid doors, provide matching door pull and push plate on opposite faces.

4.2.2.3.15. CLOSERS

Specify product of single manufacturer continuity of design and consideration of warranty.

Heavy duty, surface mounted, hydraulic type, with high strength cast case.

Full rack and pinion constructed of heavy steel.

Size in accordance with manufacturer's recommendations at work site and respective openings.

Provide adjustable spring power which allows for closer sizing. Provide separate tamper resistant, non-critical regulating screw valves for closing speed, latching speed and backcheck control as standard features.

Closer arms shall be forged steel, interchangeable with all closers specified on a given project.

Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on interior side of exterior openings.

Furnish closers with special application and heavy-duty arms where necessary to provide proper operating, long-lasting opening.

Provide rectangular, full cover type closers, adjustable power, of non-ferrous, non-corrosive material painted to match lockset finish.

Provide door closer on each exterior door.

Provide door closer on each fire-rated and smoke-rated door. Spring hinges are not an acceptable self-closing device.

Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

At corridor entry doors, mount closer on room side of door. At out-swinging exterior doors, mount closer on interior side of door.

Floor closers shall be extra-heavy-duty, with 4 inch nominal depth floor preparation, and having 1500 pounds carrying weight.

The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Closers is:

a. LCN , Product: 4041.

4.2.2.3.16. KICKPLATES

Kickplates shall be leaf type or box type bumpers that maintain a gap between the bumper and the door (subject to impact damage by luggage/supply carts).

Kick plates shall be 10 inches high; mop plates 6 inches high, both by 2 inches or 1 inch less than door width.

Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated. Size shall be 12-inch high by 2-inch less door width (LDW) on push side of door.

Kickplates for doors with louvers or narrow bottom rails: Provide kick plate height 1 inch less than dimension from door bottom to bottom of louver or glass.

Kickplates in BOH spaces shall be galvanized steel checker plate to match wainscot.

The Authority's BOD Manufacturer for kickplates is:

1. Trimco;

2. Or equal.

4.2.2.3.17. THRESHOLDS

Provide threshold at each exterior door, unless otherwise indicated. Metal thresholds shall be extruded from 6063-T5 or 6463-T5 alloy and temper aluminum, modified to receive projecting bolts of flush bolts and exit devices. Thresholds for handicapped-accessible doors shall be beveled with slopes not exceeding 1:2 and with heights not exceeding 1/2 inch.

Provide threshold at interior doors for transition between two different floor types, and over building expansion joints, unless otherwise indicated.

Provide threshold with sound transmission Class as required at locations indicated.

Field cut threshold to profile of frame and width of door sill for tight fit. Provide non-corroding fasteners at exterior locations.

4.2.2.3.18. WEATHERSTRIPPING, SEALS, AND GASKETS

Provide gasketing for smoke and draft control doors (Indicated as "S" on drawings). Provide frame-applied intumescent gasketing on wood doors that are labeled as smoke and draft control doors, unless otherwise indicated.

Provide weather-stripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated. Provide door bottom sweep on each exterior door, unless otherwise indicated.

Provide sound-rated gasketing and automatic door bottom on doors indicated as "Sound-Rated", "Acoustical", or with "Sound Transmission Class (STC) rating"; fabricate as continuous gasketing, do not cut or notch gasketing material.

Provide applicable gasketing on doors indicated as "Lightproof."

The BOD Manufacturers for the Authority currently being used for weather-stripping and seals include:

1. National Guard Products, Inc.;
2. Pemko Mfg. Co.;
3. Reese Enterprises, Inc.;
4. Or equal.

The Authority's BOD Manufacturer / Product for weather-stripping and gasketing are National Guard Products, Inc. "Model 99VA", Pemko "Model 217AV", and Reese "Model DB596A". Do not use moving sweeps. Material shall be aluminum.

4.2.2.3.19. HARDWARE FINISHES

Hardware finishes shall be satin stainless steel 630. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum. Provide welded joints, butt joints will not be acceptable.

Silencers shall be gray rubber of type for use with metal frames.

Bumpers, stops, and holders shall be brass or bronze castings.

Plates and guards shall be Type 304 stainless steel with No. 4 brushed finish, grain running horizontal direction, and beveled sides.

Protection plates shall be stainless steel, extra heavy duty - flat plate: Thickness 1/8 inch, minimum, with smooth plate surface. Edges shall be beveled, on four sides unless otherwise indicated. Fasteners shall be countersunk screw fasteners. Provide clear anti-microbial coating that is silver ion -based. Drip guard shall be provided at head of exterior doors unless covered by roof or canopy.

Strikes shall be 16 gage curved steel, bronze or brass with 2 inch deep box construction, and lips of sufficient length to clear trim and protect clothing.

4.2.2.3.20. MISCELLANEOUS COMPONENTS

Provide coordinators on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf. Material shall be stainless steel, unless otherwise indicated. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

Provide a carry bar on active door when inactive door is opened first to allow coordinator to be engaged for proper door leaf closing sequence.

Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.

Provide wall stops to prevent damage to wall surface upon opening door.

Provide astragals with non-corroding fasteners at exterior locations.

Provide overhead stops and holders (door checks) for every swinging door, unless otherwise indicated.

Provide armor plates, edge guards and protective hardware in hard usage areas.

Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications. Aluminum fasteners are not permitted. Provide Philips flat-head screws with heads finished to match door surface hardware unless otherwise indicated. Bolts from China will not be acceptable.

Provide machine screws for attachment to reinforced hollow metal and aluminum frames. Self-drilling screws, TEK® or similar, are not permitted.

Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.

Provide wall grip inserts for hollow wall construction. Provide spacers with sleeves for through bolting of hollow metal doors and frames.

For fire-rated applications, provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

For concealed fasteners, do not use through or sex bolt type fasteners on door panel sides indicated as concealed fastener locations, unless otherwise indicated.

Large format cores are required.

The BOD Manufacturers for the Authority currently being used for miscellaneous hardware including floor stops, wall bumpers, door holders, push-pull units, protection plates, silencers and other miscellaneous hardware include:

1. Builders Brass Works;
2. Pemko Mfg. Co.;
3. National Guard Products;
4. Reese Enterprises, Inc.;
5. Trimco.;
6. Or equal.

Plates and guards shall be from Trimco.

4.2.2.4. INTERIOR FINISHES AND MATERIALS

4.2.2.4.1 METAL STUDS

All metal studs at the Airport shall be at minimum 20 gauge (no exception) and no more than 16" on center.

4.2.2.4.2. GYPSUM BOARD

Gypsum Wall Board shall be at minimum 5/8" thick.

Level of finish shall be as follows:

1. All public areas: Level 5
2. Offices behind ticket counters: Level
3. Offices at ramp level / tug drive: Level 3

4.2.2.4.2. CARPET

All carpet used throughout the Airport shall be of commercial grade and superior quality. The use of carpet, in the public areas, is limited to the holdroom areas of the terminal and tenant spaces. Carpet tiles are the Authority's standard. Rolled carpet is not allowed. All carpet selections are subject to approval by the Authority.

4.2.2.4.3. WALK OFF ENTRANCE FLOOR MATS

Walk off entrance floor mats shall:

1. Be located at all public entrances from the exterior;
2. Be extremely durable products such as rubber (often recycled car tires), olefin polyester, or aluminum;
3. Lie in an approximate 2" built-in recess, such that the mat lies flush with the surrounding floor;
4. Be easily removable for cleaning and maintenance;
5. Extend no less than 10'-0" toward the interior space from the doors;
6. Match the width of the automatic door opening;
7. Not buckle, warp, shrink, curl or pose a trip hazard;
8. Be sturdy, extremely durable, non-clattering and heel-proof. System shall be appropriate for high-volume of pedestrian traffic with rolling bags; and
9. Have a structural performance as follows:
    a. Provide heavy-duty roll-up rail mats and frames capable of withstanding a wheel load of not less than 1,000 lb. (453.6 kg) per wheel.
    b. Have recessed frames with manufacturer's standard extrusions and a clear anodic finish.
    c. Be filled with concrete and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

4.2.2.4.4. INTERIOR PAINTING

The Authority's BOD Manufacturers for primers are:

1. Dunn Edwards;
2. Sherwin Williams; and
3. Xim,
4. Zinsser
5. Or equal.

Primer sealers shall be from the same manufacturer as top coats.

Primers for gypsum wallboard shall be water-based, factory-formulated, for interior application.

The Authority's BOD Manufacturers for interior primers for are:

1. Dunn-Edwards Corp: Zero or low VOC Primer; and

2. Sherwin Williams Co.

3. Or equal.

Primers for concrete and masonry shall be factory-formulated alkali-resistant acrylic-latex.

Primers for ferrous metal shall be factory-formulated quick-drying rust-inhibitive. The Authority's BOD Manufacturers are:

1. Dunn-Edwards Corp; and

2. Sherwin Williams Co.

3. Or equal.

Primers for non-ferrous metal shall be Factory-formulated quick-drying rust-inhibitive. The Authority's BOD Manufacturers are:

1. Dunn-Edwards Corp.

The Authority's BOD Manufacturers for paint are:

1. Benjamin Moore;

2. Dunn Edwards;

3. Glidden;

4. Sherwin Williams; and

5. Vista Paint;

6. Or equal.

The Authority's BOD Manufacturers finish coats are:

1. Dunn-Edwards Corp.

    i. Acrylic Eggshell Enamel shall be factory-formulated eggshell acrylic-latex enamel.

    ii. Acrylic Semi-Gloss Enamel shall be factory-formulated semi-gloss acrylic-latex enamel, California Formula.

    iii. Acrylic Gloss Enamel shall be Factory-formulated gloss acrylic -latex enamel, California formula.

    iv. Acrylic Semi-Gloss on Metal Only shall be water-base rust-preventative, for ferrous and non-ferrous metals.

    v. Acrylic Gloss on Metal Only shall be water-base rust-preventative for ferrous and non-ferrous metals.

2. Or equal.

All color selections (including color, texture, gloss, etc.) shall be reviewed and approved by the Authority.

Provide materials for use within each paint system that are compatible with one another and the substrates indicated.

For each coat in paint system, provide products recommended by manufacturers of topcoat for use in paint system and on the intended substrate.

Provide manufacturer's best-quality paint material of various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

Finish both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.

Finish elevator pit ladders.

Finish surfaces inside cabinets.

Prime surfaces to receive wall coverings.

Mechanical and Electrical Painting:

1. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.

2. In all areas, paint shop-primed items.

3. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.

4. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

In finished areas, paint pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/ under.

In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

Do not paint or finish the following items:

1. Items factory-finished unless otherwise indicated (materials and products having factory-applied primers are not considered factory finished); and

2. Items indicated to receive other finishes; items indicated to remain unfinished; fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment; stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items; Marble, granite, slate, and other natural stones; floors, unless specifically indicated; ceramic and other tiles; brick, architectural concrete, cast stone, integrally colored plaster and stucco; glass; acoustical materials, unless

specifically indicated; concealed pipes, ducts, and conduits.

Paints and Finishes shall be ready mixed, unless intended to be a field-catalyzed paint.

As a general practice, apply one primer and two top coats. All color selections (including color, texture, gloss, etc.) will be reviewed and approved by the Authority, unless otherwise indicated.

Products with a high Volatile Organic Compound (VOC) content (greater than 50 gl) will not be accepted for use in interior painting.

Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

Obtain primers and undercoat materials for each coating system from manufacturer product that is compatible with selected finish coats.

Patching material shall be latex filler.

Fastener head cover material shall be latex filler.

4.2.2.4.5. STAINING AND TRANSPARENT FINISHING

All color selections (including color, texture, gloss, etc.) shall be reviewed and approved by the Authority.

Water based products are preferred.

Spray-on applications of materials (including paints, coatings, air barriers, vapor barriers, waterproofing, roofing, etc.) can only be performed with the Authority's approval.

Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

The Authority's BOD Manufacturers for staining and transparent finishing are:

1. Benjamin Moore;
2. Dunn Edwards;
3. Glidden;
4. Sherwin Williams;
5. Vista; and
6. General Finishes;
7. Or equal.

4.2.2.4.6. RESINOUS FLOORING

Resinous flooring is used in a variety of spaces. There are two types of resinous flooring used, one for front of house spaces and one for back of house spaces.

Front of house spaces include concourses, baggage claim areas, restrooms, and other high traffic areas.

Back of house spaces include storage and maintenance rooms, and other areas subject to heavy loads, impacts, and chemical spills. Front of house spaces are limited to using epoxy terrazzo matrix flooring. Back of house spaces shall use standard resinous flooring as these spaces are not visible to the public.

Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source, from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, from manufacturer recommended in writing by the manufacturer of the primary materials.

The Authority's BOD Manufacturers for Resinous Flooring are:

1. Crossfield Products Corporation;
2. Key Resin Company;
3. General Polymers (A division of Sherwin Williams);
4. Terrazzo and Marble;
5. Or equal.

Flooring shall follow these characteristics.

a. Abrasion, impact, and chemical resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor surfacing designed to produce a seamless floor with an integral cove base.

    i. NOTE: Integral cove base is only required in the restroom facilities. Integral base in restrooms shall be six (6) inches high.

b. Wearing surface: provide slip coefficient of 0.42 minimum for anticipated life of product;

c. Overall system thickness: match existing unless otherwise directed; provide maximum depth possible;

d. Provide resinous flooring system using manufacturer's standard compatible components;

e. The body coat shall be epoxy-resin. The formulation shall match existing. Provide self-leveling slurry with broadcast aggregates;

f. The primer and waterproofing membrane shall be of a type recommended by manufacturer for substrate and body coats indicated;

g. Provide a manufacturer-recommended flexible epoxy membrane for substrate and primer and body coats that prevent

substrate cracks from reflecting through resinous flooring. Provide fiberglass scrim embedded in reinforcing membrane;

h. Provide a topcoat of two coats minimum epoxy-resin product; formulation, type and finish to match existing; UV resistant. Provide antimicrobial formulation if in food preparation area; and

i. Accessories:

   i. Divider strips shall be zinc alloy, height to match flooring thickness, with anchoring features; color as selected.

   ii. Base caps, and separator strips shall match divider strips, with projecting base of zinc alloy, color as selected..

   iii. Cant strips shall be molded of flooring resin material.

   iv. Subfloor filler shall be white premix latex; type recommended by flooring material manufacturer.

   v. Primers and adhesives shall be waterproof; types recommended by flooring manufacturer.

4.2.2.4.7. RESINOUS MATRIX TERRAZZO FLOORING

The Authority's BOD Manufacturers and Products for the Authority currently being used for resinous matrix terrazzo flooring are:

1. Master Terrazzo Technologies, Morricite Thinset Epoxy Terrazzo;
2. General Polymers div. of Sherwin Williams; Thin-Set Epoxy Terrazzo #1100 Flooring System;
3. Terrazzo & Marble Supply Companies; Terroxy Resin System; or
4. Crossfield Products Corp., Dex-O-Tex Division; Dex-O-Tex Cheminert Terrazzo.
5. Or equal.

Resinous matrix terrazzo flooring shall be used throughout the following areas of the Airport:

1. Ticketing;
2. Baggage Claim;
3. Concourse Circulation areas;
4. Elevators;
5. Public stairways;

6. Restrooms (including gender neutral restroom, nursing mothers room, family restrooms, dressing rooms;

7. All other public areas that will be used by passengers (Concession spaces are an exception to this rule, refer to Concessions Design Manual for requirements which can be found here: https://www.san.org/Business-Opportunities/Concessions).

The following are requirements of terrazzo floor applications:

1. Design, colors, and patterns of terrazzo flooring shall be reviewed and approved by the Authority.

2. All epoxy-resin terrazzo shall comply with National Terrazzo and Mosaic Association (NTMA) "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and aggregate proportions and mixing.

3. Manufacturers shall have at least 10 years good standing with NTMA to be considered as a substitution to the manufacturers listed above.

4. Flooring products shall comply with the Authority's Sustainability Design and Construction Requirements and the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

5. Warranty Period: Five (5) years from the date of Substantial Completion.

6. Resinous matrix terrazzo flooring system to include the following:

   a. Moisture vapor barrier;

   b. Flexible epoxy membrane (crack bridging membrane);

   c. Fabric reinforcing; and

   d. Abrasive inserts.

7. Divider and stop strips shall be zinc alloy.

   Resinous matrix terrazzo flooring to be sealed with 3M Scotchgard™ Stone Floor Protector. Consultant to included requirements for grinding and finishing in coordination with the technical specifications for the specified sealant product. No substitutions.

8. Consultant to schedule pre-installation meeting prior to the start of any resinous matrix terrazzo flooring work.

4.2.2.4.8. ACCESS FLOORING

Access flooring system locations shall be reviewed and approved by the Authority. Consultant to confirm with APM requirements of access flooring.

4.2.2.4.9. EXPANSION AND SEISMIC JOINTS

To avoid cracking on either side of the seismic and or the expansion joint provide a material that will not crack due to the movement of the joint.

Use of material to safely absorb temperature-induced expansion and contraction of building materials, and vibration, or to allow movement due to ground settlement or seismic activity.

4.2.2.4.10. STAINLESS STEEL COLUMN COVERS

Custom stainless steel column covers are used when building columns are projecting out into public spaces. The Consultant is to coordinate the design of these elements with the Authority.

4.2.2.4.11. WALL BASE—BLACK GRANITE

A three-quarter inch (3/4") black granite wall base shall be used in all public areas at the Airport.

Top edge to be beveled at a forty-five degree angle back a half an inch (1/2").

The height in public areas shall be a minimum of eight (8") inches.

The height in the baggage claim area shall be a minimum of ten (10") inches.

4.2.2.4.12. WALL AND DOOR PROTECTION (FOH)

Stainless steel integral; inch and one-half (1 1/2"), corner guards shall be used on walls in the concourse, baggage claim, security, holdroom areas to protect finish surfaces from damage and wear, and in areas prone to regular impact by equipment.

Corner guards in public areas shall be installed to a minimum height of eight feet (8'-0") AFF.

All public circulation zones shall use a large format tile. The Authority's standard large format tiles is:

1. Manufacturer: Crossville
2. Style: Pattern Lamina Collection;
3. Color: Neve; and
4. Size: One (1) meter x three (3) meters

If large panel type wall protection does not fit well with an aesthetic scheme, rails can be located at pre-determined heights on a wall such as chair or cart level and will allow for a smaller profile device to be used.

All offices shall have stainless steel corner guards installed at a minimum of four (4'-0") feet in height.

Use stainless steel bumpers on lower wall surfaces and column surrounds in high traffic areas where excessive damage could occur.

All color and texture selections for wall and door protection (including color, texture, gloss, etc.) shall be reviewed and approved by the Authority.

Products specified for wall and door protection shall have a warranty period of 5 years from the date of substantial completion.

Source Limitations: Obtain wall and door protection products of each type from single source, from single manufacturer.

4.2.2.4.13. WALL AND DOOR PROTECTION (BOH)

A 1/8 inch galvanized steel checker plate wainscot shall be used on all walls in BOH house spaces. The wainscot shall be a height of 4'-0" AFF minimum. Drill and countersink holes for flush installation of screws or bolts.

Provide 8" high and 1 1/2" deep continuous solid rubber wall guard anchored through checker plate wainscot to metal studs. The Authority's BOD Manufacturer / Product for wall guards in BOH house spaces is Wallguard; 2200 Rubber Bumper.

Corner guard characteristics for BOH spaces shall be as follows:

1. Material shall be stainless-steel sheet, Type 304;
2. Thickness shall be minimum 0.0781 inch (2.0 mm), 14 gauge;
3. Finish shall be directional satin, No. 4;
4. Wing size shall be nominal 2-1/2 by 2-1/2 inches (65 by 65 mm);
5. Corner radius shall be 1/8 inch (3 mm);
6. Corner guards shall have stainless steel grain running vertically;
7. Surface-mounted, metal corner guards shall be fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
8. Mounting shall be done using flat-head, countersunk screws through factory-drilled mounting holes; and
9. End caps shall be pre-formed.

End-wall guard characteristics for BOH spaces shall be as follows:

1. Material shall be stainless-steel sheet, Type 304;
2. Thickness shall be a minimum 0.0781 inch (2.0 mm);
3. Finish shall be directional satin, No. 4;

4. Wing size shall be nominal 2-1/2 by 2-1/2 inches (65 by 65 mm);

5. Corner radius shall be 1/8 inch (3 mm);

6. Surface-mounted, metal, end-wall guards shall be fabricated from one-piece, formed or extruded metal that covers entire end of wall; with formed edges; and

7. Mounting shall be done using flat-head, countersunk screws through factory-drilled mounting holes.

FRP may be used, either as a wainscot or a full-height finish for non-public areas only.

Products specified for wall and door protection shall have a warranty period of 5 years from the date of substantial completion.

4.2.2.4.14. WINDOW TREATMENTS

In general, window treatments are discouraged in the public areas unless sun glare prohibits terminal activities from functioning efficiently.

In such areas where glare is a problem but exterior views are desired, built-in window treatments shall be used.

A system such as "MechoShade", "ElectroShade" or an equal product is the only type of method approved to mitigate glare. Other methods such as applied vinyl or curtains are not approved.

Unless otherwise indicated, all window treatments shall:

1. Be grouped to open and close together electrically;

2. Have built-in, hidden track;

3. Allow maximum visibility to the exterior, while still mitigating glare; and

4. Have hidden electrical controls, not accessible by the public.

4.2.2.4.15. SIMULATED STONE SURFACING

The Authority's BOD Manufacturers and Products for the Authority currently being used for solid surfacing materials (homogenous solid material) are:

1. Dupont Corian® Quartz. Subject to comply with requirements, a comparable product by one of the following manufacturers will be acceptable:

2. Samsung Chemical USA;

3. Wilsonart Contract;

4. Or equal.

This section includes horizontal and trim solid-surfacing material for countertops, with or without undermount bowls, backsplashes, end splashes, apron fronts, sinks, tabletops, bar tops, and cafeteria surfaces.

Provide materials and products as selected by the Authority from manufacturer's full range.

Tops shall be fabricated:

1. In one piece, unless otherwise indicated;
2. With shop-applied edges of materials and configuration indicated; and
3. With loose backsplashes for field application.

Drill holes in countertops for plumbing fittings and soap dispensers in shop; sink bowls will be under-counter mounted.

Comply with solid-surfacing manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing. Do not use adhesives that contain urea formaldehyde. Use manufacturer-approved adhesive that will create color matched seam, where required.

Quality standard shall be premium grade.

Solid surfacing shall be solid surfacing sheet or plastic resin casting over continuous substrate.

Back and end splashes shall be same sheet material, square top; minimum 4 inches high.

For wood-based components, wood fabricated from old growth timber is not permitted.

4.2.2.4.16. CEILINGS

Ceiling designs and materials shall be reviewed and approved by the Authority.

4.2.2.5. EXTERIOR MATERIALS

4.2.2.5.1. TRAFFIC COATINGS

The Authority's BOD Manufacturers for parking striping are:

1. Ennis Traffic Safety Solutions (Pervo);
2. Vista Paint;
3. or equal.

Landside traffic coatings shall be fluid-applied indicator markings on vehicular and pedestrian traffic areas including pavement, curb, and walk areas; parking lot striping, accessibility path markings, traffic restriction markings, and exterior metal stair treads.

Airside area traffic coatings shall be limited to those maintained directly by the Authority maintenance personnel; vehicular traffic and parking areas on aprons, along taxiways, and around airport buildings are included. Air Operations Area (AOA) markings for aircraft movement are limited to apron and taxiway.

Limit sourcing to locally available products that have been identified by Authority as acceptable.

Pedestrian Coating shall:

1. Be brush/roller-applied water-based acrylic membrane with fiberglass fabric reinforcement;
2. Be slip resistant with a textured surface; and
3. Have a finished coating thickness of 60 mils (0.060 inch), minimum, not including topping, and comply with ICC -ES AC39.

Vehicular coating shall:

1. Be fluid-applied acrylic with slip-reducing aggregate surface; and
2. Have a finished coating thickness of 50 mils (0.050 inch), minimum.

4.2.2.5.2.THERMAL INSULATION

The Authority's BOD Manufacturers for thermal insulation are:

1. Atlas Roofing Corporation;
2. BASF Corporation or equal;
3. Carlisle Coatings & Waterproofing, Inc..;
4. Dow Chemical Company;
5. GAF;
6. Johns Manville;
7. Kingspan Insulation LLC.;
8. Owens Corning Corporation; and
9. Rmax Inc.;
10. Or equal.

Thermal insulation includes extruded polystyrene foam-plastic board, molded polystyrene foam-plastic board, polyisocyanurate foam-plastic board, mineral-wool blanket, mineral-wool board, loose-fill insulation and reflective insulations.

Spray-on applications of materials (including paints, coatings, air barriers, vapor barriers, waterproofing, roofing, etc.) can only be performed with the Authority's approval.

Glass fiber products will not be acceptable.

Mechanical fasteners shall include adhesively-attached, spindle-type anchors; adhesively-attached, angle-shaped, spindle-type anchors intended for attaching insulation to mullions while preventing it from touching spandrel glass; and insulation-retaining self-locking washers. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in crawl spaces, ceiling plenums, and attic spaces.

Insulation standoff shall be fabricated spacer from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space distance between face of insulation and substrate to which anchor is attached.

Anchor adhesive shall have demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

Adhesive for bonding insulation shall be compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

Tape shall be bright aluminum self-adhering type, mesh reinforced, 2 inch wide.

Nails or staples shall be steel wire; galvanized.

Wire mesh shall be galvanized steel, hexagonal wire mesh.

Adhesive shall be vapor retarder type, trowel consistency; fire retardant, compatible with insulation and substrate.

4.2.2.5.3. MEMBRANE ROOFING SYSTEM

The Authority's BOD Manufacturer is: Sika Sarnafil or equal.

Subject to the Authority's approval, roofing systems manufactured by others may be acceptable provided the roofing system is completely equivalent in materials and warranty conditions, and the manufacturer meets the Authority's qualification requirements.

Single-ply, PVC, fully-adhered roofs are the Authority's preferred roofing solution.

Single-ply roofing shall be fully adhered to a roof and sealed at seams either by means of chemical or heat activated sealants. Fully adhered installation provides a superior life span and water tightness.

Roof color dictated by current codes and regulations.

Minimum of 20 year warranty required.

Obtain all components of roofing system from the same manufacturer.

Slope shall not be less than 1/4-inch per foot of slope at all areas of roofing.

All roofs shall have a FM Global rating of 1-90.

4.2.2.5.4. BIRD DETERRENTS

All roofs, canopies, and fixed equipment (i.e. —fixed sections of passenger boarding bridges) shall have bird deterrents installed. Products shall be reviewed and approved by the Authority.

4.2.2.5.5. EXTERIOR HIGH PERFORMANCE COATINGS

All color selections (including color, texture, gloss, etc.) shall be reviewed and approved by the Authority.

Spray-on applications of materials (including paints, coatings, air barriers, vapor barriers, waterproofing, roofing, etc.) can only be performed with the Authority's approval.

For particular substrates including metals and masonry, specify these paints in a multi -coat system with sealers that shield color layer from wear and inhibit rust.

High-performance coatings see limited use in mechanical and electrical areas on heat generating machinery including transformers, generators, and heat pumps.

These coatings are formulated for use on aluminum where standard paints do not perform well.

Zinc-rich paints are commonly used for high-temperature applications.

Obtain primers and undercoat materials for each coating system from manufacturer product that is compatible with selected finish coats.

The BOD Manufacturers for the Authority currently being used are:

1. Benjamin Moore;
2. Concrete Solutions, Inc.;
3. Dunn Edwards;
4. Glidden;
5. Proline;
6. Rustoleum;
7. Sherwin Williams;
8. Vista Paint;
9. Or equal product by another manufacturer if they meet the following performance criteria:
    a. Products shall be of same manufacturer for each coat in a coating system;
    b. Surface burning characteristics: Flame spread/smoke developed index of 0/0, maximum;
    c. Materials for use within each paint system shall be compatible with one another and substrates indicated. For each coat in a paint system, products shall be recommended by topcoat manufacturer and on substrate indicated; and
    d. Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

4.2.2.5.6. ELASTOMERIC COATINGS

For maintenance only, Elastomeric coatings for coating vertical exposed concrete, masonry, and stucco surfaces shall be coordinated between elastomeric undercoat and subsequent paint finish to ensure compatibility. All new surfaces shall have integral color and sealer to withstand jet fumes.

Spray-on applications of materials (including paints, coatings, air barriers, vapor barriers, waterproofing, roofing, etc.) shall only be performed with the Authority's approval.

All color selections (including color, texture, gloss, etc.) shall be reviewed and approved by the Authority.

Obtain elastomeric coating materials from single source and from single manufacturer with a minimum 15 years manufacturers warranty.

The BOD Manufacturers for the Authority currently being used are:

1. Benjamin Moore;
2. Dunn Edwards;
3. Sherwin Williams;
4. Vista;
5. Or other equal manufacturers if they meet or exceed the following product characteristics:

    a. Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List.";

    b. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience;

    c. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated; and

    d. For crack fillers, primer and concrete unit masonry block filler, provide manufacturer's recommended elastomeric coating, factory-formulated crack fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated.

4.2.2.5.7. CEMENTITIOUS COATINGS

Cementitious coating products are used for coating and resurfacing exposed concrete, masonry, and brick.

Undercoat substrate shall be brushed or spray-applied for standard or high performance paints. Ensure compatibility when specifying requirements for cementitious undercoat and subsequent paint finish.

All color selections (including color, texture, gloss, etc.) shall be reviewed and approved by the Authority.

The BOD Manufacturers for the Authority currently being used are:

1. Benjamin Moore;
2. Concrete Solutions, Inc.;
3. Dunn Edwards;
4. Glidden;
5. PROline;
6. Sherwin Williams;
7. Vista;
8. Or other equal manufacturers if they meet or exceed the following product characteristics:
    a. Cementitious coatings includes polymer-modified cementitious coating containing Portland cement, polymer, and hydrated lime or aggregates.
    b. Provide other materials including crack fillers, block fillers, and related materials that are compatible with cementitious finish-coat materials and substrates indicated.

4.2.2.5.8. SKYLIGHTS

The use of skylights in any design applications will be subject to review and approval by the Authority.

4.2.2.6. EQUIPMENT

4.2.2.6.1. AED CABINETS

Automated External Defibrillator (AED) cabinets shall be located throughout all areas of the Airport. The Consultant shall coordinate the quantity and locations with the APM and per applicable code regulations and other requirements.

AED cabinets shall:

1. Be wall-mounted at a height that complies with applicable codes, regulations, and other requirements;
2. Be a freestanding element when wall mounting is not possible,
3. Have blade signage above as required by code; and
4. Have power and data provided to the cabinet and be connected to the BMS.

4.2.2.6.2. FIRE EXTINGUISHERS

Fire extinguishers shall be located in recessed cabinets and be located throughout all areas of the Airport. The Consultant shall coordinate the quantity and locations with the APM and applicable codes, regulations, and other requirements.

Unless otherwise indicated, each fire extinguisher shall:

1. Be semi-recessed;
2. Have a #4 finish, stainless steel cabinet that is not painted; continuous piano hinge;
3. Have the words "Fire Extinguisher" embossed as appropriate, painted red and displayed vertically;
4. Be identified with the Airport identification signage standards, including sign, color, and font;
5. Be latched closed, but easy to open upon emergency;
6. Be placed at a height as regulated by building code and ADA; and
7. Have a wall-mounted identification sign above complying with the Airports signage standards.

4.2.2.6.3. TRASH AND RECYCLING CONTAINERS

Design and requirements of trash and recycled containers requires review with the APM.

4.2.2.6.4. CONVEYING EQUIPMENT

This section includes elevator systems, escalator systems and moving walks.

Elevator and escalator installations, whether in new or existing hoistways, are a multidisciplinary effort and involve coordination of architectural, structural, mechanical, electrical, fire alarm, Building Management System (BMS), Access Controls Systems (ACS), Closed-Circuit Television (CCTV), and fire protection input.

The type, brand, and size must be chosen early in the design phase such that designers can get information specific to any given manufacturer's product. Similarly, the chosen product must be ordered early in the construction phase to avoid delays with manufacturing times.

Minimum criteria for specifying conveying equipment, as applicable, includes the following:

1. Elevator cab, door frame, and outer door finishes; finish of these components shall be stainless steel.
2. Finishes and configurations of elevator controls and indicator lighting; finishes

of these components shall be stainless steel.

3. Pit ladders;
4. Separation fencing, if more than one elevator car will be in a hoistways;
5. Fire/Emergency operation settings/ dispatching;
6. Electrical requirements including power source voltage;
7. Security/passcard requirements;
8. Elevator car capacity;
9. Elevator speed;
10. Escalator balustrades shall be glass at interior and exterior locations;
11. Minimum of three (3) flat steps at top and bottom of escalator; and
12. High traffic designation of escalators; and shop drawing requirements for the Authority's approval.

Provide machine room-less (MRL) elevators only. Provide traction elevators typically in applications over three stories in height. Provide hydraulic-actuated elevators typically in applications up to 30 feet, or three stories.

Elevator controls shall include provision of landing operating panels and landing indicator panels. Landing operating panels shall be metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators. Landing indicator panels shall be Illuminating.

Interconnect elevator control system with building security, fire alarm, card access, smoke alarm, and building management control systems.

Lobby Monitoring Panel shall:

1. Locate status indicator and control panel for each individual elevator and group of elevators;
2. Engrave face plate markings in panel and fill with paint of contrasting color;
3. Include direction indicator displaying landing "Up" and "Down" calls registered at each landing floor;
4. Include position and motion display for direction of travel of each elevator;
5. Display appropriate graphic characters on non-glare screen;
6. Indicate position of cars at rest and in motion;
7. Include a "Remove From In Service" switch for each elevator which then calls car to ground floor and parks car with doors open;

8. Include emergency power selector switch for each group of elevators that overrides automatic emergency power selection; and

9. Include "Firefighter's Service Switch" that manually recalls each elevator to main floor.

Set-up elevator operation to run with building emergency power supply when the normal building power supply fails. Building emergency power supply shall be supplied by backup generator; provide elevator system components as required for emergency power characteristics with phase rotation the same as for normal power.

Elevator cab finishes will be manufacturer's standard stainless steel finishes for walls and terrazzo floor finish for floors. Sills/ thresholds shall be configured to align with frame return and shall be coordinated with floor finish. Thresholds shall be stainless steel. Cabs shall have a minimum door height of 8'-0" and a clear ceiling height of 9'-0".

For moving walks, provide ample width for standing and walking riders as well as intermittent breaks to allow for exiting along the procession past gates. Ensure adequate pedestrian traffic space exists around the moving walkway. Specify speed of moving walks.

All new escalator equipment shall provide a minimum step width of 48", except as specifically authorized by the Authority. Specify speed of escalators. All new escalator equipment shall include step edging and demarcation strips on the sides of the steps which are bright (safety) yellow in color. All starting/operating switches shall be keyed to match the Authority's standards.

Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

The BOD Manufacturers for the Authority currently being used are:

1. Fujitec, Inc.;

2. Kone Corporation;

3. Otis Company; and

4. ThyssenKrupp.

5. Or equal.

4.2.3. WAYFINDING

4.2.3.1. INTRODUCTION

The San Diego International Airport wayfinding and signage system must be designed to accommodate changes in a holistic manner. Regardless of an individual facility's demarcation, the wayfinding pathways extend to and from the surrounding roadways, parking, curbsides, and terminal areas. The architecture, services, functions and amenities, as well as vertical and horizontal routes, must be carefully considered as part of the airport's interconnected and overall wayfinding system including graphic/visual cues and human behavioral responses.

4.2.3.2. PURPOSE

This document includes the minimum requirements for wayfinding in the development of the signage system for all areas of the San Diego International Airport.

4.2.3.3. WHAT IS WAYFINDING

The sign system must be designed using consistent sign placement, terminology, message hierarchy, and graphic standards. Sustainable design and future maintenance must be considered when developing the sign family design.

Airport information must be presented in a variety of ways to meet the needs of all users. These include visual, verbal, digital, and passive wayfinding, defined as follows:

Visual: Directional, informational, and identification signs help guide most users to a destination.

Verbal: A small number of users depend on one-on-one assistance and will ask for help or will seek assistance at an information booth.

Digital: Airport's website provides pre-trip information related to airport services, flight information, and parking/transportation options. Interactive directories and mobile apps provide personalized information, based on location and needs.

Passive: Landmarks, art or architecture, or other design elements such as floor patterns, environmental graphics, and lighting can encourage forward motion. Passive elements support the primary wayfinding system and reduce the number of active signs required for successful wayfinding.

4.2.3.4. PASSIVE WAYFINDING

Successful wayfinding occurs when a person understands where he/she is and then moves with intention to a destination. The two types of wayfinding are active and passive. Active wayfinding requires components added to the environment to formally promote spatial orientation. These elements include signs and maps.

Passive wayfinding is where architecture and user experience intersect. Instead of relying only on signage to provide wayfinding information, the architecture and interior design can convey information that provides direction and guides people intuitively. Passive wayfinding elements are the physical environment itself and the built -in cues that provide intuitive information (i.e., obvious entrances, logical paths, and predictable destination locations). Strong passive wayfinding reduces the need for directional signs. Active and passive wayfinding tools work together to make logical and accessible environments.

Passive Wayfinding Opportunities:

1. Strong and differentiated architectural features;
2. Clear unobstructed views to destination components or spaces and exterior features;
3. Visible entrances clearly designated by canopies or other architectural elements;
4. Distinctive artwork integrated with the Airport Art Master Plan Program;
5. Intuitive placement of destination landmarks;
6. Visible elevators and escalators where applicable;
7. Intuitive naming of facilities;
8. Enhanced or prioritized lighting, especially in major public spaces where there is no distinct day lighting;
9. Landscape architectural elements; and
10. Bollards, railings, fencing and other physical barriers.

4.2.3.5. INTERNATIONAL SYMBOLS

The Society for Experiential Graphic Designs (SEGD) describes symbols (pictograms) as the "universal vocabulary that can transcend words, languages, locations, and cultures" which can often communicate information more concisely than words. While words convey key information, symbols are often needed to supplement and sometimes even replace words. Symbols identify key destinations or services quickly, regardless of the language understood by the user.

ACRP Report 52 "Wayfinding and Signage Guidelines for Airport Terminals and Landside" recommends the following basic principles related to the use of International Symbols in airport wayfinding systems:

1. A clear and consistent pairing of symbol and associated message reinforces the symbol's effectiveness. Once this association has been firmly established, some of the more common symbols can function as stand-alone communicators. Examples include Restroom or Parking symbols;

2. Consistency in placement and visual presentation of symbols creates the greatest level of recognition and shortens the time required to process the message. Variations in symbol size, placement on signs, and background colors shall be kept to a minimum within an individual facility;

3. Environmental or architectural conditions may require customization of symbols (colors, use of field, etc.) in order to maximize the effectiveness of the system. In such cases the goal shall be to maintain the standard to the highest degree possible while remaining sensitive to any special conditions;

4. Cross-platform consistency is an important part of reinforcing the symbol language and making it recognizable for travelers. Ensure that symbol selection and usage is consistent throughout all of the airport's visual communication platforms—signage, print, and online applications;

5. Symbol readability is a function of many combined factors, including size, viewing angle and distance, color, background contrast, and the type, direction and intensity of lighting. Field test to confirm the effectiveness of any symbol application, for both readability and comprehension; and

6. All symbols to comply with all ADA requirements.

4.2.3.6. SIGNAGE SYSTEM MINIMUM REQUIREMENTS

Appropriate directional messages shall be located at all key decision points.

Nomenclature shall be consistent with the existing messaging used in Terminal 2 West (Green Build), unless directed otherwise by the Authority.

Frequency of sign locations shall be consistent and rhythmic.

All signage shall be provided in English and international pictograms shall be used in lieu of second or multiple languages.

Passenger line-of-sight shall be considered when determining appropriate placement of signs.

Coordination with security shall always occur when selecting sign locations to avoid blocking security cameras and other devices.

Identity signs must always be separate from directional signs.

Visual clutter shall be avoided by organizing messages into fewer and more purposeful sign placement.

Consistent nomenclature shall be used on all signs.

Separate and distinct locations for informational versus advertising signage.

Adhere to the vertical wayfinding "Information Bands" for wayfinding, art, and advertising whenever possible.

Design for ADA and California Title 24 compliance where applicable. Current guidelines shall always be reviewed.

Industry best practices shall be used, such as those found in the ACRP Report 52, Wayfinding and Signing Guidelines for Airport Terminals and Landside.

Internally-illuminated signs shall be considered for improved visibility at locations where wayfinding challenges exist. This may include low-light conditions and primary decision points where multiple paths and destinations need to be presented.

Flexible signage with the ability to adjust and change. Sign message panels shall be easily changeable, internal components shall be easily accessible, and signs shall be easy to maintain and repair. The consultant shall coordinate with The Authority for guidance.

Attic stock shall be coordinated with the Authority on select items. The Authority will provide a list of specific items.

Only non-proprietary parts, available from multiple manufacturers, shall be specified.

Early collaboration with architectural design is strongly encouraged. Signs shall complement the architecture. Close coordination will ensure architecture or other interior functions do not negatively affect the wayfinding system. The wayfinding system shall enhance the architecture and not distract from it.

Room numbers will be developed by the consultant in close coordination with the Authority. All doors shall be identified with small, non-tactile signs with the room number on the inside and outside of the door frame. This is in addition to the tactile room identity sign that shall be installed as required by the ADA.

Use of electronic signage (e.g., LED, LCD) shall be evaluated for message applications that need to be updated frequently and across all displays airport-wide, or that function as a response to operational changes (e.g., signs with airline names).

Existing and future technology shall be evaluated, related to wayfinding and customer experience. Designs shall accommodate future implementation of these technologies.

Samples of materials, prototypes, and shop drawings shall be submitted by vendors, reviewed by the consultant, and approved by the Authority before fabrication.

The preferred roadway sign color scheme is green, white, black and yellow as specified in section 4.2.3.9. of this document.

The preferred exterior sign color scheme is green, white and yellow to match the existing exterior signs.

The preferred interior sign color scheme is black and white with yellow accent to match the existing Terminal 2 West (Green Build) as specified in section 4.2.3.13. of this document.

Consider color-coding for parking levels as a secondary identification method.

Integration and coordination of the Parking Guidance System (PGS) into the overall wayfinding concept.

Temporary signs may be required for projects which multiple phases and must be coordinated with the Authority.

Contextually relevant information shall be provided at the right time to create a seamless experience.

The consultants shall ensure that information is easy to understand and usable.

The consultants shall consider new technology to enhance traditional wayfinding.

The consultants shall resolve operational issues with wayfinding where possible.

See Appendix for information about Governing Bodies, Codes & Regulations.

This section defines the minimum requirements for effective wayfinding for 1-Roadway, 2-Parking Plaza, and 3-Terminal Signage at the San Diego International Airport.

4.2.3.7. ROADWAY WAYFINDING

Roadway signage must serve the overall operation of vehicle circulation at the Airport. Several different categories of signage must provide clear and concise messaging to drivers for access to, and departure from, the Airport. To enhance the customer experience the signs must be clear, intuitive, and consistent, allowing seamless navigation along the airport roadway network to each of the airport's facilities.

The Roadway signs must:

1. Clearly identify entrance to the airport including roadway monuments and include appropriate signage for parking, arrivals, departure level, commercial vehicles, international arrivals, valet, cell phone lot and cargo. Roadways shall be well lit and have landscaping that is easy to maintain and far enough from the road to eliminate any risk of collision;

2. Provide dynamic signage on the Elevated Departure Roadway (EDR) and ensure weatherproofing so it is suitable for outdoor use. Preference for static signs indicating arrivals, departures,

parking, cell-phone lot, terminals, TSA pre-screening areas, and anything else that is permanent. Preference for dynamic signage on items that fluctuate, like announcements and airline names;

3. Signage in the transportation island shall be facing the drivers for ease of identification, signage shall not face the curb itself;

4. Roadway signage shall be in conformance with the current edition of the California Manual on Uniform Traffic Control Devices (CA MUTCD);

5. Sign mounting, placement, and material shall be in accordance with the current Caltrans Standard Plans and Specifications;

6. Messaging on overhead signage shall be limited to air carrier information and directing private vehicles to arriving flights, departing flights, and parking. Messaging for all other operations shall be accommodated by ground-mounted signage;

7. Graphic layout, including shape, color, and font, shall be in accordance with the "San Diego International Airport Wayfinding System – Signage Design Intent Documents: Roadways – Harbor Drive 100% Design Issue Date: 06.30.2016" document; and

8. Text size shall be in accordance with the current CA MUTCD based on the design speed of the roadway.

4.2.3.8.ROADWAY SIGN TYPES

1. Directional signs

2. Identification signs (terminal identity with airline lists)

3. Informational sign variable message signs (VMS)

4.2.3.9. ROADWAY SIGN COLORS

Matthews Paint	Product Specification
White	MP N202
Grey PMS 429C	MP (TBD)

All paint to have a satin finish.

3M Vinyl	Product Specification
White Opaque	3M 7725-20
White Reflective	3M 4090 DG3
Green PMS 342C	3M 4097 DG3
Black PMS Black C	3M 7725-22
Yellow PMS 116C	3M 4091 DG3

4.2.3.10. PARKING PLAZA WAYFINDING

The comprehensive pedestrian and vehicular identification and wayfinding system shall use "super graphics" including color-coded floor, column, stair, and elevator graphics. Pedestrian and vehicular signs shall direct parkers to appropriate airlines.

The Parking Plaza sign design shall generally conform to the signage installed throughout the airport and terminal buildings. It is expected that additional and unique signage with wayfinding themes will be developed for the Parking Plaza. The consultant shall consider wayfinding signage that allows for cost effective interchangeability should, for example, an Airline change terminal locations.

The Parking Plaza signs must:

1. Identify floor vertical clearance using clearance signs/bars at all vehicular entry and exit points;
2. Identify and provide directions to vehicular and pedestrian entrances and exits;
3. Identify entrance and exit lanes by user and technology types;
4. Display weight restrictions, speed limits, and traffic controls;
5. Display parking rates and regulations using variable-message signs (VMS);
6. Identify levels, general parking areas, preferred parking areas, and vehicular and pedestrian circulation pathways;
7. Levels, zones, and spaces shall be denoted with an intuitive system of letters and numbers;
8. Identify individual ADA, electric vehicle, alternative fuel vehicle, reserved, restricted and preferred parking spaces; and
9. Using VMS, identify number of available spaces by facility, level, and preferred zones.

Parking Plaza Sign Types

1. Directional signs (vehicular and pedestrian);
2. Identification signs (general/preferred parking areas, level/row identity, space, elevator);
3. Informational signs (parking rates & regulations, maps, FIDS, visual paging); and
4. Warning signs (clearance, weight restrictions, speed limits, traffic controls).

4.2.3.11. TERMINAL WAYFINDING

A comprehensive terminal signage program begins the moment a departing passenger steps onto the terminal curbside but must also consider an arriving passenger's journey to curbside. A variety of information and signs are required for these paths.

4.2.3.11.1. CURB

1. Digital signs – exterior rated overhead signs identifying airlines; and
2. Directional signs—exterior rated overhead signs directing to Ticketing/ Check-In.

4.2.3.11.2. TICKETING/CHECK-IN

1. Directional signs—overhead signs directing to the gates; and
2. FIDS—for flight and gate information.

4.2.3.11.3. SECURITY CHECKPOINT

1. Identification of the checkpoint;
2. Informational signs at the checkpoint (airline names, processing time); and
3. TSA-required regulatory signs (processing instructions).

4.2.3.11.4. POST-SECURITY

1. Directional signs— overhead signs directing to the gates;
2. Airport directories—for orientation and information; and
3. FIDS—for flight and gate information.

4.2.3.11.5. GATE AREA

1. Gateway Information Displays (GIDS) – Flight and boarding information;
2. Gate and facility services identity and information; and
3. Airport directories—for orientation and information.

4.2.3.11.6. GATE AREA EXIT

1. Directional signs— overhead signs directing to baggage claim areas, curbs, parking, ground transportation, and other facility services.

4.2.3.11.7. GENERAL TERMINAL AREA

1. Directional signs— overhead signs directing to baggage claim areas, curbs, parking, ground transportation, and other facility services.

4.2.3.11.8. BAGGAGE CLAIM AREA

1. BIDS—for bag claim carousel information; and
2. Directional signs— overhead and/or floor mounted directing to bag claim carousels.

4.2.3.11.9. BAGGAGE CLAIM AREA EXIT

1. Directional signs— overhead signs directing to curbside, parking, and ground transportation

4.2.3.11.10. TERMINAL SIGN TYPES

1. Directional signs;
2. Identification signs (gate numbers, restrooms);
3. Informational signs (maps, FIDS, BIDS, GIDS, Visual Paging);
4. Regulatory signs (TSA, CBP, FAA signs);
5. Warning signs (do not enter, authorized personnel only);
6. Accessibility signs (ADA and California Title 24); and
7. Electronic Informational signs.

4.2.3.12. WAYFINDING INFORMATION BANDS

Eliminating visual clutter will strengthen the wayfinding system and foster a positive passenger experience. Competition for space with art and advertising programs is a common challenge. Establishing vertical information bands that are clear of competing elements will result in a positive passenger experience.

The following guidelines shall be followed for all areas where wayfinding signage is present:

BAND 1 – UP TO 6'-0" AFF

Regulatory/Code Information, Art & Advertising, Directory Maps

BAND 2 – 6'-0" TO 8'-6" AFF

FIDS and Identity (gates and tenant)

BAND 3 – 8'-6" TO 11'-6" AFF

Wayfinding Signs

BAND 4 – ABOVE 11'-6" AFF

Art & Advertising

Refer to the ACRP Report 52, Wayfinding and Signing Guidelines for Airport Terminals and Landside for best practices recommendations.

4.2.3.13. TERMINAL SIGN COLORS

Matthews Paint	Product Specification
Blackstone	MP 33348
White	MP 03673
Silver	MP 413425 SP
Blue PMS 2955C	MP 74418

All paint to have a satin finish.

3M Vinyl	Product Specification
Black	3M 7125-12
White	3M 7125-10
Red	3M 7125-63
Yellow	3M 7125-25
Yellow	3M 7125-25

4.2.3.14. TECHNOLOGY CONSIDERATIONS

4.2.3.14.1. BAGGAGE INFORMATION DISPLAY SYSTEM (BIDS)

BIDS provide specific baggage-related information to arriving passengers, meeters/greeters, and airport/airline personnel in the assigned baggage claim area. BIDS devices are composed of an industrial LCD/LED long-life panel, with a networked FIDS controller with access to the FIDS information network.

4.2.3.14.2. ELECTRONIC GATE INFORMATION DISPLAY SYSTEM (EGIDS)

EGIDS provide airline identity and flight information at or near each gate podium and loading bridge entrance location. Minimum capacity shall include one airline and one flight information for each gate podium and loading bridge entrance.

4.2.3.14.3. FLIGHT INFORMATION DISPLAY SYSTEM (FIDS)

FIDS provide flight-related information regarding arrivals and departures to the traveling passenger, meeters/greeters, and airport/airline personnel. FIDS shall be located along the primary wayfinding nodes, ticket lobbies, and in the concession areas. Modern FIDS devices are composed of an industrial LCD/LED long-life panel, with a networked FIDS controller with access to the BIDS information network.

4.2.3.14.4. RAMP INFORMATION DISPLAY SYSTEM (RIDS)

RIDS provide information pertaining to the most recent flight assigned to a specific ramp/loading bridge, to airline personnel, airport operation, and ramp service personnel. In addition to flight identification, this system also can be used for the countdown time of baggage, loading crews, and weather-related messages.

4.2.3.14.5. VISUAL PAGING DISPLAY SYSTEM (VPDS)

VPDS provide a method of displaying the visual paging messages and other emergency information to people with hearing impairments via electronic display media, in compliance with ADA requirements.

4.2.3.14.6. DIRECTORY MAPS

Interactive wayfinding maps provide orientation and concession information through a convenient self-service platform. Having access to this information will promote exploration.

See section 4.2.2.2.1, Airport Directories.

4.2.3.14.7. VARIABLE MESSAGING SIGNS (VMS)

VMS are traffic control devices used to provide drivers with information. This information is most often displayed in real-time and can be controlled either from a remote centralized location or locally at the site. VMS are designed to affect driver behavior to improve traffic flow and operations.

4.2.3.15. GOVERNING BODIES, CODES & REGULATIONS

Governing bodies, codes, city ordinances and standards affecting the Airport wayfinding sign system are outlined below.

The accompanying lists have been compiled from various entities and codes affecting airport properties, however, it is not to be considered a complete or final list of requirements. These lists have been initially established by the airport, and changes will be coordinated with and approved by the airport as required on an individual case-by-case basis. If there is a conflict between a requirement listed here and another authoritative code or standard, the more stringent one shall be applied.

NOTE: This section is for general reference only. It is the responsibility of the sign vendor to always fabricate/engineer/install all signage to meet or exceed all current applicable local, state and national codes and regulations.

4.2.3.16. GOVERNING BODIES & AUTHORITATIVE ORGANIZATIONS

The following list includes (but may not be limited to) the governing bodies and authoritative organizations as applicable to design and engineering at airport properties:

1. AAAE: American Association of Airport Executives
2. AASHTO: American Association of State Highway & Transportation Officials
3. ACC: Airport Consultants Council

4. ACRP: Airport Cooperative Research Program
5. AIGA: American Institute of Graphic Arts
6. ANSI: American National Standards Institute
7. ASTM: American Society for Testing and Materials
8. ATA: Air Transport Association of America
9. AWI: Architectural Woodwork Institute
10. CAA: Civil Aeronautics Administration
11. CAB: Civil Aeronautics Board
12. CABO: Council of American Building Officials
13. CBP: Customs and Border Patrol
14. CSI: Construction Specification Institute
15. FAA: Federal Aviation Administration
16. FHA: Federal Highway Administration
17. IATA: International Air Transport Association
18. NEMA: National Electric Manufacturers Association
19. NFPA: National Fire Protection Association
20. CalTrans: California Department of Transportation
21. Other governing bodies and authoritative organizations as deemed necessary by the Airport

4.2.3.17. CODES & REGULATIONS

The following list includes, but is not limited to, the codes and regulations as applicable to design and engineering at airport properties:

1. ACRP: Report 52, Wayfinding and Signing Guidelines for Airport Terminals and Landside
2. ADA: Americans with Disabilities Act and California ADA
3. ANSI: American National Standards Institute
4. CBSC: California Building Standards Code
5. CDLR: California Department of Licensing and Regulation
6. IBC: International Building Code
7. LSC: Life Safety Code (written by the NFPA)
8. NEC: No Exposure Certification
9. SPC: Standard Plumbing Code (written by the NFPA)

10. SBCCI: Standard Building Code
11. UBC: Uniform Building Code
12. Other codes and regulations as deemed necessary by the airport

NOTE: This section is for general reference only. It is the responsibility of the Consultants to always fabricate/engineer/ install all signage to meet or exceed all current applicable local, state and national codes and regulations.

4.2.4. ADVERTISING

4.2.4.1. IN-TERMINAL AND OUTDOOR ADVERTISING

In-terminal and outdoor advertising programs are a critical component of the Airport's non-airline revenue. In 2018, the Authority entered into a 10-year agreement with Clear Channel Airports for in-terminal advertising, which is projected to yield $22.5M in revenues to the Authority over the contract term. New opportunities for advertising, including locations within the new Terminal 1, are anticipated to activate even higher revenue potential. Consideration of how advertising is integrated within the terminal's architecture, surrounding landscape, and amongst the journey of our passengers should be carefully considered. The following is an overview of the criteria for advertising programs at the San Diego International Airport.

4.2.4.2. ADVERTISING PROGRAM GOALS

1. Optimize revenue generated from a variety of creative and innovative advertising platforms by identifying advertising opportunities for maximum effectiveness and sales;
2. Facilitate the creation of intentional advertising and associated theming which contribute to the creation of memorable spaces which complement the customer experience;
3. Accommodate the latest trends and technologies in airport and large venue advertising;
4. Leverage advertising as a means of forming business partnerships, creating community, and showcasing local, national and international business; and
5. Create dedicated space for advertising while recognizing that wayfinding is as a top priority for effective circulation and to achieve the Authority's customer experience goals

4.2.4.3. ADVERTISING PLATFORMS

To strengthen the Authority's ability to implement a state-of-the-art advertising program that can achieve the above noted goals, an appropriate mix of following types of advertising should be accommodated:

1. Digital activation of the terminal environment which may include independent or clustered digital screens, and digital projection of video and dynamic graphics;
2. Tension fabric displays and monument/floor displays;
3. Wrapping of architectural elements such as columns, baggage carousels, bridges;
4. Experiential exhibit space;
5. Wrapping or other means to advertise on airport fleet vehicles; and
6. Sponsorship and naming rights and associated advertising platforms.

4.2.4.4. ADVERTISING PLACEMENT

Advertising should never obscure or compete with wayfinding signage or impede the natural path of passenger travel. The Information Bands guidelines should be considered for all areas where wayfinding signage is present, and should be used to assess whether advertising would impede views of, or create visual congestion around wayfinding signage. Placement of potentially conflicting elements of wayfinding signage, art, and advertising should be evaluated on a case-by-case basis through a multi-stakeholder decision-making process to determine how to effectively integrate these elements while balancing function, creativity, innovation, and revenue generation goals.

Recognizing that advertising locations may change over time, installations should be designed to minimize impact to architectural elements and finishes of walls, columns, and flooring. All efforts should be made to alleviate the need for extensive restoration in the event of installation removal.

Recommendations:

1. Collaborate early with consultants;
2. Design advertising elements to be complementary to the design of other airport elements;
3. Obtain feedback from industry experts on future trends and best practices;
4. Coordinate advertising locations with other departments early in the design process;
5. Identify the optimum medium range based on target market, Authority's vision for the Terminal, etc.;
6. Identify larger-format and specialty advertising locations during early stage of architectural and interior design phase;
7. Determine maximum power, data, and other supporting infrastructure requirements during design phase;

8. Compile proposed inventory;
9. Conform with all applicable codes and regulations; and
10. Design so connections, infrastructure and hardware are hidden.

4.2.5. THE AIRPORT ARTS PROGRAM

The Airport Arts Master Plan is the first comprehensive review of the San Diego International Airport Arts Program in seven years, and it updates the Arts Program's last Master Plan, which was completed more than a decade ago. This project is the result of extensive research and stakeholder engagement conducted in an effort to develop a broad framework for how the Arts Program will operate over the next decade and beyond. The Plan outlines recommended strategies for each of the Arts Program's core components (Public Art, Performing Arts, and Temporary Exhibitions) as well as communications, engagement, evaluation, and overall planning approaches, in addition to recommended revisions to the Airport Authority's Policy 8.50 which governs the Airport Arts Program. It also includes a Site and Opportunities Plan that outlines how the Arts Program can develop public art projects, arts infrastructure and arts programming related to the proposed Airport Development Plan (ADP). The ADP, which includes the redevelopment of Terminal One and related facilities and transportation improvements, provides significant opportunities for the integration of public art and the expansion of ongoing programming.

The Master Plan was developed over the course of nearly two years. The planning process included engagement of over 200 internal and external stakeholders. This engagement included dozens of interviews with community artists, civic and cultural leaders as well as current and former Airport Authority staff, ten topic-specific roundtable meetings to engage administrators from local arts organizations and key stakeholder interest groups, more than 500 intercept surveys of customers in the Terminals, and an online survey distributed to more than 9,000 contacts. The Airport's Arts Advisory Committee was engaged throughout the process as well.

Key findings from these efforts included:

1. 91% of respondents to the intercept survey said that arts in the Airport improved their airport experience, with 59% reporting it improved their experience "very much."
2. 75% of respondents selected "mostly true" for the statement that art makes using the Airport less stressful and more enjoyable.

3. 85% of survey respondents said they would like to see more arts at the Airport.

4. 80% of intercept survey respondents said that attending a performance improved their airport experience "very much."

Other deliverables that were part of the master planning process included the benchmarking of 18 other airport and transit arts programs, policy and program review, and a preliminary economic impact report.

Visit this link to download the Airport's new Arts Master Plan.

4.2.6. PLUMBING

Water conservation measures shall be used where applicable and in accordance with the Airport Design Standards. The plumbing system shall be supported and anchored in accordance with current seismic codes. All plumbing systems shall be labeled in accordance with the requirements outlined in this document. All public restroom plumbing fixtures shall be provided with wired motion sensors for operation and shall be circuited on the standby power supply. Each public drinking fountain station shall have a standard and ADA-compliant cold water dispenser and a water bottle dispenser. All isolation valves and other devices requiring periodic maintenance shall be accessible, as best as possible, without the use of tall ladders or manlifts.

4.2.6.1. DOMESTIC COLD WATER AND HOT WATER

A domestic cold water line shall be provided to meet demand at water velocities of approximately 4 ft. per second. Sufficient pressure shall be available for the site distribution system to provide adequate pressure at the most remote plumbing fixture. If required, a booster pump shall be added to provide adequate pressure to remote fixtures. A pressure-reducing valve station shall be included, to regulate pressures to plumbing fixtures to a maximum 80 pounds per square inch gauge (psig). A domestic water main branch not served by the pressure reducing valve station shall be provided to each gate, to supply the potable water cabinets for the aircraft. Each gate connection shall be provided with a pressure regulator set at 80 psig.

A one inch (1") domestic cold water line shall extend to each tenant space with an isolation valve and be capped for future build-out. Each tenant is to be provided with an E-Mon/D-Mon water meter, interfaced with Airport's existing Building Automation System (BAS).

A domestic water hose bib shall be provided at every roof access point. Natural gas- red water heaters shall be provided to serve the domestic hot water supply. Water

heater operation shall be interfaced with the Airport's existing BAS..

Isolation valves with caps shall provide hot water supply branches for the future build-out of tenant spaces. Hot water shall be distributed at 120˚F to these spaces. F&B tenants requiring a higher water temperature supply shall provide their own special water heater. The hot water system shall use duplex circulating pumps to maintain the hot water temperature throughout distribution. One of the pumps shall serve as a redundant pump. Each water heater shall be sized for 33 percent of the required volume of hot water. Domestic water piping materials shall be in accordance with the Chapter 5 Construction Standards. ProPress piping connections are acceptable. Polyethylene piping is not acceptable.

4.2.6.2. DRAIN, WASTE, AND VENT SYSTEMS

Drain, waste, and vent systems shall use materials as required for above-ground and below-ground installation. Floor drains shall be provided in all restrooms, F&B restaurants, and at the bottom of all plumbing chases. The floor drains shall have electronic-controlled trap primer and be located in access panels. Access panels shall be located in areas where it can be easily maintained. Below-grade grease interceptors, located outside the terminal, shall be provided for the F&B areas. The grease interceptors shall be sized to serve F&B areas or zones. The grease interceptors shall be metered with E-Mon/ D-Mon meters to report to the Airports existing BAS. The grease interceptors shall be centrally located, near each food and beverage area.

a. Narrow areas and areas beyond gores shall be paved (see Caltrans Highway Design Manual Index 504.2 [2] for guidance on contrasting surface treatment beyond the gore pavement)

4.2.7. MECHANICAL

4.2.7.1. GENERAL

The mechanical systems for all facilities at the Airport are to be based on straight-forward, design techniques utilizing systems with a minimum of 5 years of proven successful implementation with readily available equipment and hardware. The overriding criteria for the use of systems and equipment shall be safety, sustainability, reliability, life cycle cost, and the comfort of the public and occupants of the buildings.

It is important that the systems installed serve the public well, are readily serviceable and maintainable, are stable, reliable, and direct in their operation, and provide flexibility for future change and development. All equipment, appurtenances, and hardware shall be accessible for adjustment and

maintenance. Suitable access is required to permit removal and replacement of equipment items. Provisions are to be made for centralization of operating and maintenance diagnostics, controls, measuring, monitoring, alarms, and trending analytics.

It is anticipated that there will be changes and development in many areas of the airport facilities and the mechanical systems will be revised or expanded to accommodate these changes. . All designs of mechanical systems must include built-in flexibility in keeping with the nature of change that is ever present for air transportation facilities.

In addition, energy conservation and cost savings will also be the guiding criteria in the design of mechanical systems. All facilities must meet the California State and City of San Diego energy conservation Standards, plus SDIA Energy Master Plan requirements, whichever is most stringent. Both initial system and equipment costs and life cycle owning and operating costs are to be important considerations in concept design efforts and these considerations must be carried through final design and construction. Life-cycle cost analysis shall be provided for all designs. As a government agency the Life-cycle cost analysis shall be based on the corresponding Standards.

4.2.7.1.1. SYSTEM FLEXIBILITY

Special provisions are to be made in determining the heating and air conditioning load requirements to properly allow for the dynamic nature of the application of these loads. During normal operation these loads can vary dramatically from zone to zone and the peak load can fluctuate significantly within each zone. This is due to the rapid mass movement of people within the building, as well as, the shifting solar load on glass walls, infiltration loads associated with people and baggage movement in and out of the building, and outside air ventilation requirements.

Heating and air conditioning system controls must provide system flexibility to adequately respond with the shifting internal cooling loads as well as coordinating for future interconnection with planned development of existing systems. The HVAC system must be able to handle varying perimeter loads during heating and cooling seasons while the internal and other loads fluctuate between no load and peak conditions. In addition, appropriate air quality conditions must be maintained in the spaces while the natural ambient (outside) conditions are very often of less than ideal quality.

4.2.7.1.2. DESIGN PARAMETERS

Indoor Design Temperatures: It is intended that the mechanical systems (in general) maintain indoor design conditions in all

occupied spaces normally accessible to the public as follows (unless specified otherwise):

1. Summer: 70 - 72 degrees F, 50% percent maximum relative humidity
2. Winter: 70 - 72 degrees F

The following parameters are used for the design of the HVAC system:

Altitude (above sea level): 138 ft

Latitude: 32.73˚ N

Longitude: 117.20˚ W

Location: San Diego, CA

Climate Zone (CA Energy Code): 7

Indoor Design Temperatures- SDIA Design Standards:

UPS, IT MPOE and Telecommunication Rooms: 68˚F

All other rooms: 72˚F (cooling) & 68˚F (heating)

Design Temperatures: Outdoor design temperatures in accordance with current Title 24, Part 6 Building Energy Efficiency Standards.

These design criteria conditions are based on the recommended conditions listed for San Diego in the ASHRAE Fundamentals Handbook at the 0.5% summer condition and the 99.8% winter condition. That is, based on historical data, the outdoor temperatures can be expected to exceed the summer design conditions 0.5% of the time and exceed the winter design conditions 0.2% of the time. The more stringent design condition is required for winter criteria due to inherent outdoor infiltration condition present in most airport situations. The standards establish only baseline criteria for equipment sizing.

4.2.7.1.3. VENTILATION STANDARDS

Ventilation Standards for occupied spaces are to be based upon the latest revision of ASHRAE Standard 62, "Ventilation for Acceptable Indoor Air Quality" and the California Code of Regulations Title 24; whichever, is more stringent. The minimum required ventilation rate of outdoor air per person is to be 15 CFM per person, with several special use areas in the buildings having significantly higher requirements.

4.2.7.1.4. ENERGY EFFICIENCY REQUIREMENTS

Energy efficiency is an important consideration in the design of the mechanical systems for all Airport facilities. HVAC systems are to be designed to exceed the requirements of the latest revision of ASHRAE Standard 90.1 - "Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings," and be in accordance with the SDIA Energy Master Plan.

Equipment selections must be specified to meet or exceed ASHRAE, State of California, or City of San Diego standards, whichever is more stringent. The equipment and systems described herein must be selected to obtain the optimum in conserving owning and operating costs considering energy efficiency, initial costs, maintainability, and comfort.

4.2.7.1.5. NOISE CRITERIA

The mechanical (HVAC) system shall be designed to minimize noise in the occupied space. The system and components shall be designed so as not to transmit or generate sound above a specified noise level in the space. Sound attenuators, duct liner, lower duct velocities and appropriate ductwork fittings and components shall be utilized as required to attain acceptable sound levels. Vibration isolation shall also be evaluated and utilized. Sound attenuators shall be isolated from the building structure.

Sound tests shall be conducted in accordance with accepted procedural standards in and around all major sound producing equipment to either confirm adequate attenuation or to identify problem areas requiring additional modifications as required by the APM.

Maximum noise levels in the occupied space produced by HVAC equipment shall be in accordance with the following NC (noise criteria) curves.

Where white noise is to be utilized for sound masking, RC (room criteria) curves shall be utilized as described in the ASHRAE Handbook, "Fundamentals."

Equipment and ductwork noise levels to permit attaining sound pressure levels in all 8 octave bands in Tenant occupied spaces shall conform to noise criteria NC-35 curves. Motor drives for pumps or any equipment shall operate with noise levels not exceeding OSHA 8 hour 90dBA Time Weighted Average (TWA). Noise levels shall be determined in accordance with IEEE Standard #85 Test Procedure for Air-Borne Noise Measurements on Rotating Electric Equipment.

Design Consultants will be required to submit sound attenuation analysis.

1.	Offices	NC-30
2.	Terminals & Concourses	NC-40
3.	Maintenance Facilities	NC-40
4.	Mechanical Equipment Rooms	NC-50
5.	Museum	NC-25
6.	Exercise Rooms	NC-30
7.	Conference Rooms	NC-30
8.	Lobbies, Corridors and Waiting Areas	NC-40
9.	Quiet Rooms and Meditation Rooms	NC-25

4.2.7.1.6. SUPPORTS AND PENETRATIONS

All supports for mechanical and plumbing equipment shall be designed, detailed and specified by a California licensed Structural

Engineer. Penetrations and reinforcement of penetrations through structural floors and\or walls shall be designed, detailed and specified by a California licensed Structural Engineer.

4.2.7.1.7. HVAC COMPUTER-BASED LOAD ANALYSIS

The HVAC loads calculations shall be performed with a computer-based program using the latest ASHRAE Handbook of Fundamentals Heat Balance Method (HB), Radiant time Series (RTS) Method, or Transfer Function Method (TFM), developed for the hourly analysis of heating and cooling loads in commercial buildings. All projects are required to submit load calculations.

The program shall be capable of calculating each zone's peak heating and cooling load as well as the whole-building "block" loads. The program shall, at a minimum, calculate: solar gains through fenestration, internal gains from occupants including latent heat for cooling purposes, internal gains from lighting and equipment, outside air loads (sensible and latent) from ventilation and infiltration, and heat gains or losses through fenestration, walls, floors and roofs. The heating load calculations must be done without credit for occupants and internal gains.

The HVAC loads calculations report shall include all input and output used in the heating and cooling calculation program, and shall include zone peak heating and cooling loads results, and whole building "block" loads, air-handling unit coil selections, and psychrometric process charts.

4.2.7.1.8. PREDICTIVE ENERGY MODELING

The building energy analysis shall be performed using the ASHRAE Standard 90.1 Energy Cost Budget methodology, and must demonstrate compliance with the latest editions of ASHRAE Standard 90.1. The analysis shall be included in each design submission.

The analysis shall evaluate the energy performance of the building design including the proposed building envelope, HVAC systems and components, the lighting systems, and domestic hot water systems, as well as the proposed control strategies for these building systems. The analysis shall be based on actual parameters and values found in the proposed building design and not simply on defaults assigned by the simulation program.

The analysis shall be performed using a simulation program. The simulation program shall be a computer-based program for the analysis of energy in buildings. Simulation programs must be capable of simulating: 8,760-hours per year, hourly variations in occupancy, lighting power, miscellaneous equipment

power, thermostat setpoints, and HVAC system operation defined separately for each day of the week and holidays, thermal mass effects, the number of required HVAC zones, part-load performance curves for mechanical equipment, capacity and efficiency correction curves for mechanical equipment, air-side and water-side economizers, and temperature controls.

The building energy analysis report shall include all input and output used in the simulation programs, including: established energy goals for the project, detailed descriptions of the budget and proposed building models, actual local utility rates, descriptions of any and all energy conservation measures, an analysis of results with final conclusions and recommendations.

4.2.7.1.9. MAINTENANCE SERVICE

Service Access Space shall be provided around all HVAC system equipment as recommended by the manufacturer and in compliance with local code requirements for routine maintenance. Access doors or panels shall be provided in ventilation equipment, ductwork and plenums as required for in-site inspection and cleaning. Equipment access doors or panels shall be readily operable and sized to allow full access. Large central equipment shall be situated to facilitate its replacement. The HVAC Consultant shall be cognizant of the necessity to provide for the replacement of major equipment over the life of the building and shall ensure that provisions are made to remove and replace, without damage to the structure, the largest and heaviest component that cannot be further broken down.

In addition, adequate methods of access shall be included for items such as: chillers, boilers, air-handling units, heat exchangers, cooling towers, reheat coils, VAV terminals, pumps, water heaters, condenser units, and all devices that have maintenance service requirements.

To facilitate equipment access, maintenance, removal and replacement, a freight elevator stop shall be provided to serve each floor housing HVAC systems and equipment.

Where stairs are required, they must allow for safe transport of equipment and components. Ship's ladders are not permitted for access and maintenance of any equipment.

Vertical Clearances: Mechanical equipment rooms shall have clear ceiling heights of not less than 12 feet. Catwalks with stairways shall be provided for all equipment that cannot be maintained from floor level. Where maintenance requires the lifting of heavy parts (100 lbs. or more), hoists and hatchways shall be installed.

Horizontal Clearances: Mechanical rooms shall be configured with clear circulation aisles and adequate access to all

equipment. The arrangement shall consider the future removal and replacement of all equipment. The mechanical rooms shall have adequate doorways or areaways and staging areas to permit the replacement and removal of equipment without the need to demolish walls or relocate other equipment. Sufficient space areas (noted by outlining manufacturer's recommendations) for maintenance and removal of coils, filters, motors, condensate pans, and similar devices shall be provided. Air-handling units require a minimum clearance of 2'-6" in on all sides, except the sides that filters and coils are accessed, where clearance shall be equal to the length of the coils plus 2'-0".

1. Housekeeping Pads: Housekeeping pads shall be at least 6 inches wider on all sides than the equipment they support and shall be tall enough to comply with equipment condensate trap height requirements. .

2. Mechanical Rooms: All mechanical rooms must be mechanically ventilated to maintain room space conditions as indicated in ASHRAE 62 and ASHRAE 15. Water lines shall not be located above motor control centers or disconnect switches and shall comply with requirements of the NEC, or NFPA 70. Plumbing and Mechanical design consultants shall coordinate mechanical room floor drains and condensate discharge ports from mechanical units in close proximity to minimize drain piping requirements. Mechanical rooms shall not be used as return air, outdoor air, or mixing plenums. Mechanical equipment rooms must be designed in accordance with the requirements of ASHRAE Guideline15: Safety Code for Mechanical Refrigeration.

3. Electrical Equipment Rooms: No water lines are permitted in electrical rooms, except for fire sprinkler piping. Avoid placing restrooms, kitchens or utility rooms above Electrical Equipment Rooms.

4. Communications Closets: Communications closets must be cooled in accordance with the requirements of Electronic Industries Alliance and Telecommunications Industry Association (EIA/TIA); Standard 569. Closets which house critical communications components shall be provided with dedicated air-conditioning systems that shall be connected to the emergency power distribution system.

5. Elevator Machine Rooms: A dedicated heating and/or cooling system must be provided to maintain room mechanical conditions required by equipment specifications. In the event the building is equipped throughout with automatic sprinklers, hoist way venting is not required.

6. Emergency Generator Rooms: The environmental systems shall meet the requirements of NFPA Standard 110: Emergency and Standby Power Systems and meet the combustion air requirements of the equipment. Rooms must be ventilated sufficiently to remove heat gain from equipment operation. The supply and exhaust louvers shall be located to prevent short circuiting. Generator exhaust shall be carried up to roof level in a flue or exhausted by way of compliance with the generator manufacturer's installation standards. Horizontal exhaust through the building wall shall be avoided.

7. Provide a minimum of four feet (clear space) around all sides of boilers and chillers, plus tube pull space. Provide three feet (clearance space) around all sides of pumps, and air handling equipment. These are minimum design requirements, if manufacturers recommendations exceed these values, Design Consultant shall comply with the more stringent requirement.

8. All rooftop equipment shall be serviceable through existing roof access. Drawings shall show minimum clearances for service and access to equipment.

9. Design Consultant shall coordinate with all systems and disciplines throughout the design process to insure adequate space is available and to avoid interferences.

4.2.7.2. HVAC SYSTEMS

This section outlines basic HVAC system parameters and options. It is the responsibility of design professionals to provide a collaborative solution with all aspects of building and system design.

4.2.7.2.1 AIR HANDLING SYSTEMS

The most appropriate designs for an airport terminal necessitate that the space conditioning system be flexible and responsive to wide swings in thermal loads. Factors include constantly changing people loads, high people door usage, air infiltration, shifting passenger densities, shifting solar loads, and baggage handling transfers in and out of the building. These items change in timing and intensity depending on changes in aircraft schedules and special peak passenger periods.

The AHU selection must consider the primary system design. For the Airport, the AHUs will utilize hot and chilled water from a four-pipe distribution system. Separate cooling and heating coils shall be required. The heating coils shall be selected for a minimum 20 degrees F temperature differential (180 degrees F to 160 degrees F). The cooling coils shall be selected for an approximate 10 degrees F temperature differential (42 degrees F to 52 degrees F) or as required by the psychrometrics of the

specific system design. This criterion shall be coordinated with the Central Plant.

Packaged AHUs should be used for applications below 25,000 CFM. Customized, built-up AHUs may be used in applications above 25,000 CFM.

Cooling and heating coils are to be sized and arranged for water velocities in the 6 fps range. Air cooling coils shall be designed to have a maximum air face velocity of 600 FPM. Air heating coils shall have a maximum air face velocity not to exceed 800 FPM. Fin spacing shall be as wide as possible to provide the specified leaving coil conditions. Condensate traps shall be 1 inch deeper than suction pressure. Drain pans shall be sloped to center.

DX cooling coils shall be row split (in lieu of face split) where multiple coil sections are required. All supply AHUs shall be draw-through, built-up systems except in instances where sound control would favor the application of blow-through units. Each unit shall consist of a non-overloading supply air fan with selected for maximum efficiency. Fan selection shall be based on noise criteria requirements. Fan walls are the preferred system type, however, other fan type may be considered if economy, efficiency and noise criteria parameters can be assured. Fan static pressure shall be based on final filters at end of life and pre-filters at midlife. Fan walls shall be provided with variable frequency drive (VFD) and redundant back-up VFD.

In addition, each AHU system shall contain separate cooling and heating coils (includes cooling only units), a final filter section, a throwaway filter section, a photo catalytic oxidation (PCO) filter, an air blender section to eliminate air stratification, a mixed air plenum for outside air and return air duct damper connections, and a sound attenuation section if required. Integral face and bypass dampers shall be considered for pre-heat coils in appropriate areas. Each AHU section shall be provided with an access door and non-breakable plenum light (coordinate with corresponding electrical designs). Heating coils shall be located upstream of the cooling coils, with space in between the two coil sections to facilitate access for maintenance and inspection. Air-tight shutoff type dampers shall be provided for the outside air damper.

All equipment visible from public line of sight shall be reviewed by the SDIA review committee. Non-standard equipment color and finishes may require additional screening. The following air handling systems may be used for various applications at the Airport terminal and concourse areas:

1. Single-Zone Systems: Single-zone type air handling systems will effectively handle any particular local area (zone) of a facility. However, a multitude of

different temperature zones may necessitate a high number of single-zone AHUs. The disadvantages of such a design would be the requirement for more mechanical room space, higher maintenance costs, and increased capital cost due to the number of individual units that would be required. The use of single-zone AHUs on a large scale is not economical. A multitude of single zone units serving large, main spaces would also reduce the flexibility required to accommodate future space modifications.

Single-zone AHUs do have suitable application, however, to serve certain perimeter zones of the terminal building and concourses. They also have application in many areas in the various support facilities, where their use would prove to be the most suitable solution.

2. Heat-Pump Systems: Heat-pumps are a viable alternative for decentralized buildings.

3. Roof-Mounted HVAC Systems: Another alternative, viable in many building applications, is the decentralized, roof mounted, packaged HVAC system. Rooftop HVAC equipment shall not be incorporated into the designs for the Airport terminals. This equipment does have application however, for some of the support facilities. Whenever a roof-top unit is utilized in the mechanical design of a building, the following concerns should be addressed in detail:

   a. Maintenance: is the equipment readily accessible.

   b. Energy Efficiency: select equipment to be energy efficient.

   c. Noise and Vibration: proper vibration isolation is usually not provided unless special requirements are specified.

   d. Aesthetics: this equipment can have a negative impact on the appearance of a building, depending on the elevation of other buildings or facilities in the vicinity. An architectural enclosure shall be provided around roof- mounted mechanical equipment.

4. Variable Air Volume (VAV) Systems: In a VAV system, the air volume supplied to the conditioned space is modulated to maintain the space temperature utilizing a constant supply air temperature. This system can offer the best approach to meet two major goals; energy efficiency and moderate initial capital costs.

   The VAV system shall contain the air-handling system components described above for air handling systems, plus fan inlet vane controls or variable frequency fan motor drives. The air distribution system shall be of a

single design. The appropriate variable volume terminal boxes shall then be provided to control the airflow to the space.

It is important with VAV systems that proper outside air ventilation rates be maintained, as well as building pressurization. Additional HVAC equipment or controls may be required with VAV systems to control pressurization. This issue will be addressed in the temperature control system requirements. The advantages of VAV systems both in flexibility and energy efficiency outweigh the additional control requirements.

Variable air volume systems are recommended for a number of areas in the Airport terminal buildings and in office areas, concourses and many other interior zone applications.

Systems shall be designed to deliver a minimum 0.5" WC at the most remote VAV box.

5. Perimeter Systems: Any expanse of exterior glass wall area, in the Terminal, Concourses, or other areas will require a perimeter thermal conditioning system. These systems are to be designed to handle at least the conduction and infiltration loads of the perimeter walls plus potentially some radiant solar and internal loads near the perimeter, depending on the application.

   a. There are three suitable methods to handle the perimeter loads.

   b. A perimeter finned-tube hot water radiation system.

   c. Radiant slab system.

   d. A forced air system at the perimeter. Air circulation at the perimeter reduces pockets of stagnant hot or cold air.

If a perimeter forced air system is to be provided it should be a constant volume system in order to provide the necessary "throw" at the sill diffusers during mild weather. The perimeter system is preferably located at the sill rather than overhead to counteract down-draft at the windows during the winter. Some perimeter areas with low ceilings (9 ft. or less above finished floor) may use ceiling supply for the perimeter system; in addition these areas could be VAV with reheat if the system supplies only the perimeter and can handle both heating and cooling peak load conditions.

Perimeter finned-tube hot water radiation systems can be used to meet the perimeter loads. Ensure that the perimeter radiation system and forced air distribution systems don't work against each other causing them both

to constantly cycle. Caution should be used in providing sill system components so that they do not easily collect trash.

6. Split DX System: Provide an independent Split DX to serve Special System Rooms (SSR), Server Rooms, Rack Rooms, MDF and IDF rooms, and Elevator Machine Rooms. Systems shall be sized to serve the cooling load in the room and maintain a 72 degree temperature. The electrical power source for the split a/c systems that service these rooms shall be supplied by the emergency power distribution system integrated into the facilities.

4.2.7.2.2 VENTILATIONS SYSTEMS

1. Outdoor Air Requirements: Outside air shall be brought in through the air handling systems to satisfy minimum ventilation requirements plus provide building pressurization and minimize air infiltration at building entrance door areas.

   Existing outdoor air requirements on air handling equipment in the terminals were designed around previous revisions of ASHRAE Standard 62. Minimum outside air ventilation amounts shall be provided in accordance with the latest revision to ASHRAE Standard 62 and California Mechanical Code, there may be a conflict in the required amount of outdoor air. Consultant shall coordinate those requirements with the Building Inspection and Code Enforcement (BICE) Department and provide electronic copies of correspondence and documentation of final design direction to the APM. It is the responsibility of the Consultant to provide documentation that the existing equipment can comply with any modifications in outdoor air.

   Outside air intakes shall be located high and away from landside vehicle traffic and airside jet exhaust to the greatest extent possible, a minimum of seven feet above grade. Most ventilation air will be brought in through air intakes in the mechanical penthouses. Computerized Fluid Dynamics modelling shall be utilized to validate intake air locations. All effort shall be made to provide distance and dilution as primary air quality solutions. See 202.2 and 203.5 for air quality controls and filtration.

2. CO_2 Monitoring: Monitor CO_2 concentrations within all densely occupied spaces. CO_2 monitors must be between 3 and 6 feet above the floor. CO_2 monitors must have an audible or visual indicator or alert the building automation system (BAS) if the sensed CO_2 concentration exceeds the setpoint by more than 10%. Calculate appropriate CO_2 setpoints using

methods in ASHRAE 62.1–2010, Appendix C.

For spaces where air contaminants are likely, evaluate potential sources of additional air contaminants besides CO2. Develop and implement a materials-handling plan to reduce the likelihood of contaminant release. Install monitoring systems with sensors designed to detect the specific contaminants. An alarm must indicate any unusual or unsafe conditions.

3. Air Economizer Control: All air-handling units (AHUs) over 4,000 CFM capacity shall be equipped with air side, dry-bulb economizer cycle operation. The control system for this operation must be arranged to modulate outside and return air dampers to maintain a mixed air set point temperature. Outside air dampers will close to the minimum position and return air dampers open when the outside air is 75°F or higher (adjustable).

   AHU's shall not be installed at ramp level.

4. Return Air \ Transfer Air: Return air from the conditioned space back to the AHU should be via ductwork. The pressure drop in the return air system shall be minimized in the design. Return air fans should not be required in most cases. Maximum velocity shall be 500 FPM over net free area for general return and transfer air and 200 FPM over net free area for smoke control areas.

5. Ventilation Rates: As described earlier in this document, the outside air ventilation rate shall be as recommended in the latest edition of ASHRAE Standard 62. Careful consideration shall be given to these new recommended rates, particularly considering recent attention in the HVAC industry to indoor air quality. A summary of the applicable rates published in ASHRAE Standard 62, as applicable to airport building spaces.

   Outside air requirements, unless otherwise specified, shall be as follows for "normal" occupancy levels.

   The occupancy load in many public areas of the airport (i.e., concourses, hold rooms, ticketing areas, baggage claim, etc.) is highly variable. As an alternate to the ventilation air flows indicated as based on "normal" occupancy levels, it is acceptable to calculate the minimum ventilation rate on 10 CFM per person, based on peak load occupancy; unless exhaust requirements override this amount.

6. Filtration: Air filtration is an important consideration in the design of HVAC systems to serve airport facilities. Air should be brought in at the roof or penthouse level wherever possible in an attempt to use the highest quality air

available. As a minimum, outside air is to be filtered by the use of 2" dry type pre-filter sections having a minimum rating of Minimum Efficiency Reporting Value (MERV), MERV 8 (30% - 35% efficient with a maximum allowable particle size of 10.0 micron), 12" dry type filter section having a minimum rating of MERV 13 (89% - 90% efficient with a maximum particle size of 1.0 micron. Filters for small air-handling units serving maintenance or non-public areas should be provided with 4" dry type pre-filter section having a minimum rating of MERV 10 (50% - 55% efficient with a maximum particle size of 3.0 micron).

Ventilation shall be provided in all ground level spaces that may have occasional or full-time occupancy. This ventilation shall be such as to minimize any possibility of an accumulation of radon gas; however, shall not be less than one (1) air change per hour.

Unoccupied crawl spaces in contact with the ground, shall be ventilated likewise to eliminate radon gas hazards at a rate of one (1) air change per hour - on a time clock to run not less than four one-hour periods in each 24-hour day.

4.2.7.2.3. HEATING, VENTILATION, AND EXHAUST SYSTEMS

This section covers areas of the building that are primarily mechanically heated and/or ventilated only; no air conditioning to be included. Basically, ventilation rates, filtration etc., mentioned previously for HVAC systems will apply unless otherwise indicated. Special exhaust requirements are also discussed.

1. Toilet Exhaust: The ventilation (exhaust) rate for all toilet room facilities shall be a minimum of 2.0 CFM/SF of floor space or 15 air changes per hour, whichever is the larger requirement. Toilets with extremely high traffic, such as those located in concourse areas, should have a minimum daytime exhaust rate of 2.5 CFM/SF or 19 air changes per hour, whichever is the larger requirement.

   Under no circumstance shall a positively pressurized toilet exhaust duct run through a return air plenum or occupied space.

2. Tenant build-outs, including kitchen spaces, are covered by the SDIA Concessions Development Standards and not part of the base building design.

3. Atrium/High-Bay Areas: The atrium of the terminal building shall contain a relief air system in the high bay area

which will relieve air to exterior due to pressure or temperature build up. A make-up air unit shall also serve the high bay area to provide ventilation air and pressurization when required. These systems shall also be incorporated into a smoke removal system as required by NFPA and the California Building Code for high rise structures.

4. Displacement Ventilation (DV): DV is a means of providing cool supply air directly to the occupants in a space. The fresh air, supplied near the floor at a very low velocity, falls towards the floor due to gravity and spreads across the room until it comes into contact with heat sources. It is ideal for high-bay areas for cooling and ventilation only.

   Diffusers shall be mounted near the floor level deliver 65˚F supply air at less than 75 FPM velocity. Air flow causes a thermally stratified space and vertical air movement towards the return located high in the space.

   A single AHU shall not be used for displacement ventilation and an overhead forced air system. They should have different supply air temperatures.

5. Air Intake Minimum Separation Distances: Provide separation between exhaust outlet and outside air intakes.

   Minimum separation distances as indicated on the following table:

Exhaust Discharge	Distances to Nearest Outside Air Intake*
Aircraft Jet Engine Exhaust	25
Cooling Tower	20
Fan Exhaust	15
Plumbing Vents	15
Kitchen Exhaust	25
Generator Stack	25

*Minimum Separation between Exhaust and Outside Air Intake

*Minimum separation between exhaust and outside air intake in feet.

4.2.7.2.4 EQUIPMENT IDENTIFICATION

All major air handling equipment shall have a unique equipment designation. Engineer shall obtain designation from the SDIA Facilities Maintenance Group.

4.2.7.2.5 EQUIPMENT SUPPORTS

All equipment supports shall be manufactured systems or designed and detailed by a Professional Engineer licensed in the State of California. Supports shall be coordinated with Architectural and Structural disciplines. Under no

circumstances shall the Construction Documents direct a Contractor to provide supports without detailed performance specifications outlining criteria and requirements of supports and their design and installation.

4.2.7.3. AIR DISTRIBUTION SYSTEMS

4.2.7.3.1 DUCTWORK

Ductwork layout and sizing shall be done using the best practices to ensure minimum energy loss by thermal transfer and friction. Ductwork shall generally be designed for low pressure, i.e., 2.0 in. w.g. or less. In no instance shall the pressure exceed 4.1 in. w.g. All medium pressure ductwork shall be sized based on the static regain method. All low pressure ductwork shall be sized using either the static regain method or the equal friction method. Existing main ductwork upstream of VAV boxes is considered medium pressure. All ductwork systems shall be designed to minimize noise transmission through the ductwork and avoid noise generation from components or fittings.

Ductwork air velocities shall not exceed the following limits:

1. Mains (equipment rooms and non-occupied spaces: 3000 FPM
2. Mains (occupied spaces): 2000 FPM
3. Branch (or mains w/diffuser connection: 1200 FPM
4. Branch with diffusers: 1000 FPM
5. Aspect ratios shall not exceed 4:1 for mains.

Exceptions shall be submitted for review. Allowances can be acceptable depending on the design options and cost impact.

Ductwork shall be either rectangular or round (spiral) as appropriate for the specific application. All designs shall be in accordance with Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) "HVAC Duct Construction Standards" and the technical criteria in this manual. All supply air distribution ductwork shall be galvanized sheet metal with flanges, seams, supports, etc., to match the appropriate duct classification as defined by SMACNA unless moisture in the system dictates the use of aluminum or stainless steel materials. Kitchen exhaust ductwork shall be welded stainless steel. Ductwork shall be designed in classification and maximum air velocities for all in accordance with ASHRAE: Handbook of Fundamentals, Duct Design and constructed in accordance with the ASHRAE: HVAC Systems and Equipment Handbook. Ductwork construction shall be tested for leakage per the Duct Construction Chapter, and the SMACNA Design to installation.

Flexible round duct shall be a maximum of 5 feet in length and be of a material acceptable by the California Mechanical

Code. Elbow into diffusers with flex is acceptable with a long radius turn. Crimping the flex duct at the elbow or under obstructions is prohibited. Aluminum flex duct is prohibited.

4.2.7.3.2 DAMPERS

All volume control dampers shall be opposed-blade type and isolation/shut-off dampers shall be parallel blade type. Outside air intake dampers shall have air-tight seals at both the edges and ends of the blades. The seals shall be of a material that will not disintegrate with exposure to jet exhaust fumes.

Control dampers shall be provided on all main branch take-offs and on the main ductwork downstream of a branch take-off.

All fire dampers shall be U.L. listed and conform to the standards and requirements of the California Building Code. Fire dampers shall be located at all fire zone penetrations and will have access doors provided for service and maintenance.

All combination fire-smoke dampers (FSD) shall be U.L. listed and conform to the standards and requirements of the California Building Code. Fire-smoke dampers shall be located were required by code and have access doors provided for service and maintenance. FSD shall feedback to building Fire Alarm System.

4.2.7.3.3 DIFFUSERS

Various types of diffusers are to be considered based on architectural input. Consideration shall be given to quality, durability, capacity, aesthetics, throw and noise level. Coordinate with the architect all diffuser types and locations. Linear slot diffusers shall be individual, 4-foot maximum sections with individual supply boots. Perforated face diffusers are not to be used.

Sidewall and perimeter diffusers shall be selected based on quality, durability, aesthetics, capacity, throw and noise level. Coordinate with architect all diffusers types and locations. Continuous linear slot diffusers shall be individual 4 (four) foot maximum sections with an individual supply boot. NC levels at the diffuser and at the neck connection should be consistent with design sound levels in rooms.

4.2.7.3.4 GRILLES

Refer to Section 23 37 13 DIFFUSERS, REGISTERS, AND GRILLES"

4.2.7.3.5 TRANSFER AIR

Transfer air openings are required in all walls to structure in return air plenums and smoke control zones. Transfer air openings shall be sized for a maximum velocity of 200 FPM in smoke zones and 500 FPM in return air plenums that are not used for smoke control. Sizing shall accommodate

the entire return air\smoke control system to the point of installation.

4.2.7.3.6 VAV TERMINAL AIR UNITS

Designer shall ensure all components of VAV terminals are completely accessible for maintenance and no additional HVAC or Tenant equipment is required to be removed from operation in order to complete maintenance activities. Control modules shall have a minimum twenty-four (24) inches of clear space to allow for maintenance activities.

4.2.7.3.7 SECURITY GATES

Security grates shall be installed on all ductwork and transfer air openings larger than 144 square inches between public spaces and private spaces. All roof penetrations larger than 144 square inches with a direct path of access to indoors shall be required to have a security grate.

4.2.7.4. CONTROLS

A complete system of automatic controls shall be provided to maintain space conditions within allowable limits. When heating and cooling is incorporated in one system for personnel comfort, the automatic temperature controls shall not be capable of simultaneous heating and cooling and shall provide a "dead band."

The system shall consist of all necessary control devices, control valves, control dampers, damper motors, electric switches, relays, gages, panel boards, and fittings, including all necessary accessories required for a complete and operative control system. All control wiring and control system electric power is to be furnished to provide a complete system of environmental control and central panel functions.

Control systems shall be electronic, digital systems controlling all HVAC equipment utilizing local microprocessor control panels located in the applicable adjacent equipment rooms. The field panels shall be tied to the master Energy Management Control System (EMCS) server, but capable of stand-alone operation. Siemens is the Authority's Sole Source Manufacturer (required in order to match other products in use at the Airport) for DDC control hardware. Any new proposed system must integrate with the current system in place at the Airport.

1. EMCS Levels and Architecture. EMCS shall be Direct Digital Control (DDC) based system for providing lower operating costs and ease of operation. The BAS shall adjust building systems to optimize their performance and the performance with other systems in order to minimize overall power and fuel consumption of the facility.

   BAS shall utilize 'open' communication protocols, such as BACnet, to minimize the costs of providing integration and to

allow interoperability between building systems and control vendors. A/E to specify and include functional design manual, hardware manual, software manual, operation & maintenance manual, and as-built drawings with sequence of operations. BAS shall have energy management and monitoring software.

EMCS architecture shall include standalone zone or terminal controls with Local Control Panel (LCP) for centralize HVAC equipment. Building Level Controls (BLC) shall integrate all LCP in the building, Boarding Area, and Terminal. The all new projects shall provide full communication with the EMCS system. Projects must provide fiber, server, address, graphics, and programming to integrate new HVAC control systems with the existing EMCS system.

2. Integration. All BLC systems shall be capable for standalone operation at the local level. And all BLC systems shall be coordinated and provided with full integration, control, communication, monitoring, and connectivity to the front end Airport system. Design and coordination shall be indicated in drawings and in control architectural diagrams. Details of IT network connections and server addresses must be specified with communication fiber routing as part of the BLC system design. Front end EMCS graphic upgrades and additions must be included as part of every new BLC.

3. Enhanced Commissioning. The intent of enhanced commissioning is to further support the design, construction, and eventual operation of a project that meets the owner's project requirements for energy, water, indoor environmental quality, and durability. See Chapter 3 For Sustainability Design and Construction Guidelines.

4. EMCS Naming Standard. All points within the EMCS shall comply with established Airport naming conventions. The Authority' shall provide the most current naming convention to the Contractor. If a established naming convention for a system does not exist, Contractor shall provide a submittal of all points to The Authority for review and approval prior to starting construction.

5. Control Components. Zone thermostats mounted in public areas shall be sensors only with controllers. Zone thermostats in private areas shall be programmable.

   Carbon monoxide and nitrogen dioxide sensors shall be provided in the service drive or wherever internal combustion engine traffic is utilized in an enclosed space. Sensors shall increase air flow and/or alarm out-of-tolerance conditions.

4.2.7.5. SPACE REQUIREMENTS, ACCESS AND MAINTAINABILITY

Mechanical equipment and layout shall be selected to maximize equipment performance; and minimize equipment servicing, repair and maintenance. Equipment selection shall also consider durability, reliability, maintainability and serviceability.

Equipment arrangement and layout shall allow for safe and efficient accessibility for equipment removal, replacement, repair and maintenance. Provide sufficient service corridors, pathways, fall protection, and door access to deliver replacement equipment and parts.

During the design phase, coordination with other design disciplines is essential to provide for the necessary access to equipment. All otherwise inaccessible equipment and equipment components shall be provided with OSHA approved catwalks, platform, or etc. to allow maintenance. The catwalks, platforms, and adequate lighting, etc. shall provide for maximum safety to both personnel and equipment while allowing access for equipment maintenance. Standardization of equipment and materials shall be used to the maximum extent possible. Standardization and interchangeability will minimize the space and expense of the maintenance spare parts inventories. Items for consideration for standardization shall include, but not be limited to: AHUs and components, terminal units, control components, heat exchangers, pumps, valves, and fans.

The design shall, in general, include equipment layouts with maintenance and repair clearances indicated. Special maintenance items or equipment, or necessary auxiliary equipment shall be specified to be provided and installed with the equipment it is to serve. Avoid locating equipment requiring frequent service or repair above ceilings or in occupied spaces. Hydronic systems and associated gauges check valves, and shutoff valves all need to be design for ease of access, inspection, and maintenance. Air side systems and components should also be designed and configured for ease of access inspection, and maintenance.

4.2.7.5.1. EQUIPMENT SELECTION

Equipment shall be selected for stable operation at both full and part-load conditions. Equipment selections shall be below maximum limits for capacity, speed, temperature and pressure. The equipment installation design and specification shall include sufficient instrumentation for measuring, indicating, monitoring, operating and servicing at full and part loads.

4.2.7.5.2. BEARINGS

Use permanently lubricated bearings on fans, if available. Equipment which cannot

be furnished with permanently lubricated bearings shall have lubrication lines extended to the exterior of the unit.

4.2.7.5.3. CONSTRUCTION REQUIREMENTS

Contractor shall include in the shop drawing submittals manufacturers recommended spare parts lists, maintenance and service clearances, special maintenance equipment or requirements and recommended maintenance schedules. Conflicts between equipment and maintenance requirements or clearances shall be submitted, along with Contractors' solutions to the conflicts, for approval. Approval of conflict resolution shall be required before equipment installation.

4.2.7.5.4. FAN HOUSING

All supply fan housings shall have ladder rungs mounted on the side of each unit next to the coil pipe connections to provide access to the top of each unit without stepping on insulated pipes.

4.2.7.5.5. ACCESS DOORS

All AHUs shall be equipped with access doors for each compartment (coils, filter, fan, etc.), with piano hinges, door handles, and a viewing window in each compartment access door. The doors should be sturdy enough to permit opening the door using one handle.

Provide in accessible locations access doors of adequate size at all fire damper locations for the purpose of inspection as well as for replacing fusible links.

For combination FSDs provide ceiling access doors and duct access doors. Access doors shall be properly located and size for adequate access to the FSDs. Duct access doors shall be properly labeled.

Labeling and service access shall be provided for all controllers and duct sensors.

4.2.7.5.6. MECHANICAL ROOMS

Mechanical room space requirements and dimensions shall be coordinated with the architect so that appropriate space is provided for the equipment and its service and maintenance.

4.2.7.5.7. MECHANICAL CHASES

Mechanical chase space requirements shall also be determined and coordinated, including space for supply and return air ductwork, outside ventilation air, exhaust air, hot and chilled water piping, domestic water piping, sanitary drainage, and roof drains, etc. All chases with plumbing equipment shall have a minimum one floor drain.

4.2.7.5.8. MECHANICAL CHASES

Provide a minimum of four feet (clear space) around all sides of boilers and

chillers, plus tube pull space. Provide three feet (clearance space) around all sides of pumps, and air handling equipment. These are minimum design requirements, if manufacturers recommendations exceed these values, Design Consultant shall comply with the more stringent requirement.

All rooftop equipment shall be serviceable through existing roof access. Drawings shall show minimum clearances for service and access to equipment.

Design Consultant shall coordinate with all systems and disciplines throughout the design process to insure adequate space is available and to avoid interferences.

4.2.8. ELECTRICAL

4.2.8.1. ELECTRICAL CODE

Electrical systems shall comply with all applicable codes, regulation and the following:

1. Illuminated Engineering Society of North America (IESNA), Lighting Handbook;
2. Recommended Security Guidelines for Airport Planning, Design and Construction, Transportation Security;
3. California General Order 128;
4. San Diego Gas and Electric (SDG&E) Underground Standards; and
5. San Diego International Airport – 12kV Electrical Infrastructure Policy and Guide Specifications.

In cases where there are conflicting criteria and standards, the most stringent shall apply.

4.2.8.2. ELECTRICAL MAIN ELECTRICAL SERVICE

The main electrical service to supply the Airport comes from an existing 12kV loop distribution line.

A redundant electrical distribution at 12kV infrastructure shall be required to minimize service disruptions of power and each of the automatic-throw-over switches will feed a dedicated 12kV switchgear but will be looped to provide redundancy.

Each of the 12kV switchgears shall be provided with protective relaying and metering. Metering at 12kV distribution shall be compliant with the airport energy metering requirement and be designed to communicate with the Authority's BMS. Metering-interface signal wiring from 12kV switchgear to the BMS will be provided and run from electrical rooms to the nearest IT/ communication room. Metering will be coordinated with the Authority and will be compliant with airport IT standards.

An auxiliary DC power or AC capacitor power control system shall be designed for back-up power to the 12kV switchgear

relay protection system during normal (utility) power outages.

4.2.8.3. ELECTRICAL ROOMS

Electrical rooms shall be provided with exhaust fans, as appropriate. Electrical rooms with large or multiple transformers shall be provided with the necessary VAV boxes or fan coils.

The airport standard for stepping 12kV loop feed distribution to 480 or 208-volt (V) utilization is through oil-filled power distribution transformers. Each of the electrical rooms shall be provided with transition curbs at the entry doorway to the room, with the curb to function as an oil containment system in the event of an oil leak from the oil-filled transformers. A clean -agent fire extinguishing system shall be provided to each electrical room with an oil -filled transformer. A secondary 480 or 208 switchboard shall be provided in the same electrical room with the oil-filled transformers. Both 12kV oil-filled transformers and secondary switchboards is envisioned to be inside the electrical rooms, with truck access for maintenance. Design of electrical rooms with truck access will be coordinated with the airport gate design, to comply with airside traffic requirements. The airport standard does not allow a double-ended arrangement (a tie-bus configuration) of switchboards. All redundancy in electrical power distribution will occur only on the 12kV side.

4.2.8.4. NORMAL POWER DISTRIBUTION

The power distribution transformers shall be designed to 200 percent rated capacity of determined connected load. The maximum rating of power distribution transformer that will be allowed for use will be kept to a maximum rating of 2500kVA.

The secondary distribution switchboards that are supplied from the power distribution transformers shall be located in the same electrical room with the transformers and will be provided as a guideline. The incoming power from the 12kV loop distribution will be received and switched via 12kV, 600A automatic-throw-over switches

A code-compliant electrical grounding system shall be designed and each of the electrical rooms shall be designed with a dedicated ground bus for bonding electrical distribution equipment at the electrical room. Electrical distribution equipment may be located inside the mechanical rooms (when allowed by code and if it serves the loads in the room); otherwise, the equipment shall be located inside an electrical room/closet near the mechanical loads it serves.

The electrical rooms and satellite electrical rooms/closets shall be located on different levels in a vertical stacked configuration whenever possible. Vertical and horizontal utility shaft/chases shall be provided for

feeder and branch circuit runs between electrical rooms when stacking is not possible. Provisions for running conduits from electrical rooms shall be made from different levels to the roof, for connection to photovoltaic systems. Segregation of electrical loads shall be provided (i.e., segregation between lighting, receptacle, control/signal equipment, and mechanical/motor loads).

A dedicated power distribution system shall be provided for the baggage handling/ conveyor system, Data Center, UPS system, passenger screening and check point system.

All concession and tenant loads shall be on a separate service and segregated from the main building power and also be sub-metered, in compliance with the Airport's Concessions Design Manual to avoid interrupting main building power supply. Metering shall be coordinated with the Authority and compliant with airport IT standards. All electrical distribution equipment/devices located at wet locations, outdoors, or covered but exposed to weather (damp location) environments shall be rated NEMA 4X. All receptacle outlets in public areas shall be the tamper-resistant type. Public art/ decorations shall be provided with receptacle outlets that are supplied from a dedicated branch circuit and spaced at every 30 ft of linear wall space and each column. Each utility room shall be provided with a receptacle outlet. A minimum of two receptacle outlets or one receptacle outlet for every 10 ft of accessible wall space shall be provided in the mechanical/ electrical rooms. Meeting rooms shall be provided with a minimum of one receptacle outlet at each wall and one receptacle in the recessed floor box under the meeting table. Location of receptacles shall be coordinated with IT/AV devices. Receptacles shall be circuited from dedicated branch circuits in the holdroom seating furniture system.

Normal power will be provided for the following electrical loads:

1. Terminal (interior and landside) lighting and receptacle loads;
2. Retail/concessions;
3. Common Use Passenger Processing System (CUPPS);
4. Common Use Customer Service System (CUSS);
5. Airport passenger circulation signs;
6. Baggage Information Display System (BIDS);
7. Mechanical System (HVAC and plumbing);
8. Elevators, Escalators, and Moving Walkway System;
9. Baggage Handling/Conveyor System;

10. Baggage Explosive Detection System;
11. Pre-Conditioned Air Unit (PCA) for Aircraft;
12. Ground Power System 400Hz (GPS) for Aircraft;
13. Electric Charging Station (Ground Support Equipment);
14. Flight/Airport Information Display System;
15. Trash/Garbage Management System; and
16. Distribution Antenna System (DAS)

4.2.8.5. EMERGENCY POWER DISTRIBUTION

The emergency power supply system (EPSS) will be sized to supply power to 100 percent emergency (life safety) and legally required standby loads, optional standby loads (there is a list of systems identified by Airport to be on stand-by) and an available 30 percent spare capacity. The generator set will be configured to pick up half of the facility life safety, legally required and optional standby loads (i.e., airport-identified stand-by loads).

Emergency power shall be segregated according to code-required generator load pick-up time and load classification. Load segregation shall be accomplished using automatic transfer switches, interlocked with the generator control panel and connected equipment controllers/panel. The generator set shall be provided with a fuel capacity equal to 8 hours when running at 100 percent generator rating and integral load bank (the size shall be 100 percent of the generator rating). Generator fuel storage shall use sub-base tanks and above-ground day tanks as required to comply with the 8-hour running capacity. Fuel tank system shall be provided with local and remote alarm and monitoring system. The generators shall be housed inside generator rooms. located on ground level. Emergency distribution will be provided through emergency switchboards. Each of the switchboards will be bus-connected to an automatic switch, sized for the capacity of the generator sets.

4.2.8.6. LIGHTING

The lighting system shall be designed to meet recommended IESNA lighting levels and Airport specific lighting level requirements, which may exceed IESNA lighting levels. The lighting system shall be fully integrated into the overall design of interior spaces and shall have the capability to interface with the BMS, to provide area occupancy information and control heating and cooling loads. The lighting system shall be specified with drivers that interface with an intelligent, addressable lighting control system. Luminaires shall be specified for 277V utilization voltage; other voltage, as required by special application lighting. Luminaires shall be specified to provide

lamp types, luminaire efficiency, lamp color characteristics, and optics that complement the task and aesthetics of the space. The primary light source for interior and exterior lights shall be LED. Light fixtures/luminaires (general lighting) in public areas shall be specified as low-profile recessed unless specifically intended to be visible, complementing the aesthetics of the space. Recessed or surface-mounted, industrial-type light fixtures/luminaires shall be specified only for BOH areas or as required to comply with applicable code. All luminaires shall be compliant with local municipal codes, this document, and the California Title 24 Energy Code. In spaces provided with a clerestory architecture feature/element or artwork, the lighting shall be designed to integrate the artificial and natural light source using innovative lamp/luminaire selection and light controls. Ease of maintenance access to the light fixtures by ladder or lift shall be considered in the design and selection of the light fixtures. Design of restroom lighting shall not include cove lights near walls. Retail/concession lighting shall comply with the Airport's Concessions Design Manual. Meeting/conference rooms in the airport shall be provided with light zones that are dimmed to office independent, adjustable light-level switching in the front, center, and back of meeting/conference rooms. Light sources shall have a correlated color temperature (CCT) between 2,700 degrees and 3,500 degrees Kelvin, and a color-rendering index (CRI) greater than or equal to 92 CRI in all areas exposed to public view, unless required otherwise (lower or higher) by applicable code.

The use of colored lights and bare light sources is not permitted unless applied as an artistic application; installation shall be considered as an exception request and will require Authority review and approval.

4.2.8.7. INTERIOR LIGHTING

The lighting at the terminal shall be designed to comply with the most stringent lighting levels and control requirements of national codes, IESNA, California Title 24, industry standards, and this document.

Compliance with the following average lighting levels (foot candle [FC]) will be complied with in designing interior lighting in the terminal:

1. Concourse: 30 FC;
2. Corridors and Stairways: 10 FC;
3. Restrooms: 15 FC (in front of mirrors: 20 FC)
4. ;Restroom maintenance utility space: 20 FC
5. Airport BOH: 20–25 FC;
6. Working areas/maintenance shops: 25–35 FC;
7. Baggage Handling Areas: 75–85 FC;

8. Concessions and Food Courts: 30 FC;
9. Information Desks: 50 FC;
10. Ticketing Counters: 50 FC;
11. TSA: 50 FC (queuing) / 55 FC or lighting level required in the latest TSA Checkpoint Design Guide;
12. Gate area Holdrooms: 30 FC;
13. General illumination: 30 FC;
14. Airport/Airline Offices: 50 FC;
15. Meeting/Conference Rooms: 30 FC;
16. Baggage Claim areas: 30 FC (floor) / equipment–conveyor: 60 FC);
17. Ticket Lobbies: 50 FC;
18. Smart curbs: 30–40 FC;
19. Pedestrian Bridges: 20–25 FC;
20. Elevators: 50 FC;
21. Passenger Boarding Bridges: 20 FC;
22. Mechanical/Electrical Rooms: 20 FC;
23. Plumbing/Mechanical chases: 20 FC;
24. Telco, LAN rooms: 50 FC;
25. All areas that require pan-tilt-zoom (PTZ) surveillance cameras: 55 FC; and
26. General storage areas/lockers: 30 FC

4.2.8.8. EXTERIOR LIGHTING

1. Compliance with the following average lighting levels (foot candle [FC]) will be complied with in designing exterior lighting:
2. Aprons
    a. Aircraft Parked Position: 2 FC
    b. Aircraft Stands: 2 FC
    c. Cargo Facility loading and unloading: 5 FC
    d. Fueling operations: 2 FC
3. Curbs:
    a. Recommended values for the pedestrian portion of pedestrian/ vehicular underpasses:
        i. Day: 5—10 FC
        ii. Night: 2—4 FC
    b. Recommended values for high pedestrian conflict areas:
        i. Mixed vehicle and pedestrian: 1—2 FC
        ii. Pedestrian only: 0.5—1 FC
4. Parking Lots: 1—1.5 FC

4.2.9. FIRE ALARM AND FIRE SUPPRESSION SYSTEMS

4.2.6.1. FIRE SUPPRESSION SYSTEMS

The fire protection systems for the Airport shall be governed by the current editions of the California Building Code (CBC), California Fire Code (CFC), and applicable NFPA codes, as amended by the CFC. All fire protection systems shall be installed, repaired, operated, and maintained in accordance with these codes. NFPA Codes to include, but not limited to, 13, 14, 15, 20, 72, 75, 291, 415, 2001.Where the CBC or CFC has specific requirements, it shall govern.

4.2.9.2. WATER SUPPLY

In compliance with NFPA 291, a fire hydrant flow test shall be conducted by the consultant to determine the available water supply at the time of system design. The Consultant must determine whether a fire pump is required. A fire pump will be required if the available water pressure is not sufficient to meet fire sprinkler and standpipe system demands. A fire pump, if required, shall be designed in accordance with NFPA 20 and the CFC. An electric fire pump shall be provided with emergency power, as required by applicable standards and codes. A fire pump and controllers shall be located in dedicated fire pump rooms with appropriate access and clearance space, as outlined in the applicable standards and codes. The booster pump shall draw water from the dedicated fire water loop, circling the facility. A backflow preventer shall be provided at each fire water tie-in point to the City of San Diego (City) supply. Additional information regarding the on-site underground firewater distribution will be provided to the Consultants. Model fire hydrant data was provided by the City to perform a preliminary analysis. This analysis indicated that a fire pump would not be required; however, the Consultant must confirm this.

4.2.9.3. FIRE SPRINKLER SYSTEM

A combined sprinkler and automatic standpipe system shall be supplied throughout the building. Floor control valves for the fire sprinkler system shall be provided in the stairwell or a dedicated fire riser room in the building. In addition to the requirements of NFPA 13, each floor control shall be provided with a check valve to prevent false activation of the flow switch, resulting from normal static pressure fluctuations. The maximum area that may be protected by one wet-pipe fire sprinkler system per floor is 52,000 SF. Additional floor control valve assemblies shall be provided to satisfy this requirement and any system zoning requirements. All control valves for any fire suppression system shall be unobstructed and located so that access easily can be achieved without the use of a lift or ladder. An access panel shall be provided for any valves located behind a wall. The inspector's test

and main sprinkler drain discharge shall be routed to an interior drain location. The Consultants shall coordinate with the plumbing engineer to ensure that the drain is capable of handling the maximum water discharge. The necessary precaution shall be taken to guard against the effects of splashing.

Hydraulic calculations shall be performed in accordance with NFPA 13 for all fire protection systems. A 10 percent factor of safety shall be factored for all fire sprinkler systems.

The CFC does not reference NFPA 415, Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways. However, paragraph 2001.2 of the CFC states, "Regulations not specifically contained herein pertaining to airports, aircraft maintenance, aircraft hangars and appurtenant operations shall be in accordance with nationally recognized standards." NFPA 13 does not address airport terminals specifically for sprinkler design requirements. NFPA 415 does and will dictate the design criteria for these areas.

The portions of the building used as passenger handling areas shall be classified as Ordinary Hazard Group 1, as required by NFPA 415. The portions of the building used as baggage, package, and mail handling areas shall be classified as Ordinary Hazard Group 2. All other areas are to be classified per NFPA 13. Retail spaces shall be classified as Ordinary Hazard Group 2; mechanical rooms and similar spaces shall be classified as Ordinary Hazard Group 1; offices, restrooms, and similar spaces shall be classified as Light Hazard. The hose stream allowances listed below are per NFPA 13. For the terminal, NFPA 415 requires the hose stream allowance to be 500 gallons per minute (gpm) for all hazard classifications. The design areas may be reduced for the use of quick response sprinklers, as allowed by NFPA 13 based on the ceiling heights of each area.

The design criteria for each classification of hazard per NFPA 13 are as follows:

1. Concealed sprinklers shall be provided at all front-of-house (FOH) spaces throughout the terminal. The faceplate of the concealed sprinkler shall be factory-painted to match the interior ceiling finish. Recessed pendant and upright sprinklers shall be provided for all BOH areas throughout the terminal, as required by NFPA 13. Sprinkler heads shall be located center of tile and aligned with lighting fixtures.

2. The CFC does not reference NFPA 75, Standard for the Fire Protection of Information Technology Equipment. The critical nature of the IT rooms in this type of facility lends itself to the application of this standard. To ensure the greatest level of protection against water damage and interruption of

operations, NFPA 75 shall apply. A double-interlock, pre-action system shall be installed to protect all IT rooms, in accordance with NFPA 13 and NFPA 75. The pre-action sprinkler system shall be supplied from the adjacent combined sprinkler and standpipe system main. The location of the pre-action sprinkler system riser room shall be coordinated with the architect, to locate it as close as is reasonable to the protected space.

3. A FM-200 clean agent system shall be installed in all IT rooms, in accordance with NFPA 2001 and NFPA 75, to supplement the pre-action sprinkler system. Sequencing of these systems shall be done so that the clean agent system activates before the sprinkler system. Smoke detector to be Photo Electrics type. If the clean agent system fails to extinguish the fire, the pre-action sprinkler system will activate as a last resort. NFPA does not require the clean agent system, but it is being proposed at the request of the Authority. The CFC allows the use of dual systems.

4. Fire suppression systems for IT rooms shall be zoned independently of each other. Each IT room shall be provided with dedicated control valves and releasing panels. Alarming of one IT room should not result in emergency power off (EPO) in adjacent IT rooms. The fire suppression systems for main electrical rooms containing transformers shall meet the same requirements as IT rooms.

5. Where potential fuel spill points (as defined in NFPA 415, such as hydrant pits) are within 100 ft of airside windows, a deluge water spray system shall be provided, in accordance with NFPA 15. The deluge spray system shall be activated automatically and designed to provide a density of 0.25 gpm/SF over the exterior surface area of the glazing, as required by NFPA 415. All nozzles on a particular system shall discharge simultaneously. All systems in the hazardous region shall activate simultaneously.

6. No infrared system shall be used.

4.2.9.4. FIRE ALARM SYSTEM AND ZONING

The terminal shall be protected throughout by an emergency voice/alarm communication (EVAC) system, designed and installed in accordance with NFPA 72. The system alarm panel shall be from the latest technology by Siemens and must be compatible with the existing facility-wide Siemens fire alarm system (FAS). The fire alarm terminal cabinet (FATC) shall be centrally located in an air-conditioned, humidity-controlled re alarm control room, adjacent to the backup SOC. In addition, this room shall be part of Phase 1 construction and located so that access is from a non-densely populated area on the

public (non-secure) side of the terminal. An annunciator panel shall be provided adjacent to the access door, leading to the re alarm control room. The backup SOC shall be accessible from the secure side only.

The fire control system room shall to be wired to emergency electrical system backups. The fire alarm system shall be supervised electronically, and signals shall be transmitted automatically to the Authority's approved central monitoring station service. Normal, supervisory, trouble, and alarm signals also shall report to the BMS.

Where manual pull stations are required by the CFC to be located in public circulation areas, they shall be provided with a protective cover to prevent malicious or accidental damage and activation. Notification devices, including strobes and speakers, shall be attached to the exterior of the building, to notify personnel on the ramp and baggage tug routes.

Fire alarm zoning shall be closely coordinated with the Authority, to ensure alignment with evacuation and emergency response plans. The zoning also shall be compliant with the CFC, NFPA 72, and local fire marshal requirements. In addition to occupant life safety, a primary objective of the fire alarm zoning plan shall be to maintain continuity of operations. The fire alarm zoning shall be designed to maximize horizontal evacuation to adjacent spaces, minimize evacuation from secure circulation to the ramp, and restrict evacuation from public circulation to secure circulation. Under circumstances where secure and public areas are adjacent, such as the security checkpoint, these areas shall be separate fire alarm zones. Creative strategies and special building features, such as horizontal exits, shall be employed to create areas of refuge within the protected space, remote from the hazard. Where fire shutters or other automatic means of creating fire areas are used, the operation of shutters and doors shall not cause harm to any building occupants. The zoning plan shall anticipate construction phasing so that the re alarm system easily can be expanded with little rework, and the zoning objectives can be satisfied during both construction phases. The commissioning and testing of Phase II expansion shall not affect operation of the Phase I fire alarm system. Fire alarm zoning also shall coincide with the re sprinkler system and the paging system.

Emergency evacuation of the terminal, partial or complete, has extreme impact on business operations. Therefore, the possibility of false alarm and undue occupant evacuation is critical to mitigate. The activation of multiple devices to start the fire alarm shall be required for cross-zoning of areas subject to false alarm activation, such as offices, break rooms, tenant spaces and other similar areas. The Authority has an agreement with the local fire marshal to allow a pre-signal feature.

This feature allows a 10-minute delay in evacuation notification while on-site personnel investigate and respond to the cause of an alarm. On activation of the first device, a pre-evacuation announcement will play until: a) the source of the alarm is investigated and cleared; b) another device activates to confirm the first; or c) the 10-minute window elapses without action. In the case of either b or c, the evacuation announcement will sound.

The FATC shall include single-line circuits (SLCs), dedicated to new space for all addressable initiating devices. The SLCs shall have a 30 percent spare capacity. The FATC shall include dedicated amplifiers for speaker circuits, with a minimum of four zones or as required to achieve the evacuation/zoning plan. All amplifier circuits shall have 25 percent spare capacity. In addition, the FATC shall include power module(s) for strobe circuits. All strobe circuits shall have 25 percent spare capacity. Strobe circuits may be powered by remote power panels, located in areas closer to these devices to meet voltage drop requirements. Locations of power extenders shall be coordinated to be located in communication rooms. Circuits in remote power panels also shall be required to have 25 percent spare capacity.

4.2.10. TELECOMMUNICATIONS

4.2.10.1. CRITERIA AND STANDARDS

Codes and design standards from the following sources are applicable for the telecommunication distribution systems:

1. National Fire Protection Association (NFPA 70), The National Electrical Code and other NFPA standards;
2. City of San Diego, Requirements;
3. The Authority's Information Technology Infrastructure Standards Construction Manual;
4. BICSI Customer Owned Outside Plant Design Manual;
5. BICSI Outside Plant Design Reference Manual;
6. BICSI Telecommunications Design Methods Manual; and
7. ANSI/TIA-758-B Customer-Owned Plant Telecommunications Infrastructure Standard

New 4 by 4 by 4-ft communication vaults will be installed to support the proposed underground infrastructure. Conduit duct banks will be installed with eight 4-in conduits per fiber loop. In addition, six 4-in conduit duct banks will be provided for third-party service carriers.

Duct banks for communications systems will use long sweeps, and hand-holes will not be used in lieu of sweeps. To provide flexible fabric innerduct (two 4-in three-cell packs) in all 4-in ducts that are used in initial installation and will provide an additional two 4-in three-cell packs in one of the spare ducts for future use. To provide pull tape in all conduits and innerducts and to provide manholes no greater than 400 ft apart, to allow copper cabling to be installed. The new duct banks must be constructed outside traffic lanes. Where ducts enter the building, watertight plugs will be provided on vacant ducts, and re-enterable foam sealant will be provided on used ducts. Re-enterable sealant shall be able to withstand 22 feet of water head-pressure continuously.

4.3. AIRSIDE FACILITIES

4.3.1. AIRSIDE DESIGN REQUIREMENTS

Design and construction standards for airside facilities are established by the FAA through various Advisory Circulars, Engineering Briefs, Regional Guidance Letters, Orders, and Notices. These documents apply to all airports under the jurisdiction of the FAA. The Consultant will coordinate with applicable Authority stakeholders to develop Airport specific requirements for implementation of the governing FAA standards.

Airside design requirements will cover the following topics:

1. General Guidance:
    a. Critical Aircraft (FAA AC 150/5000-17)
    b. Design Flight Schedule Operations
    c. Value Engineering (FAA AC 150/5300-15)
    d. Authority requirements for FAA airport grant project
2. Geometrics (FAA AC 150/5300-13)
3. Pavements (FAA AC 150/5320-6)
4. Pavement Markings (FAA AC 150/5340-1, Airport specific apron)
5. Signage (FAA AC 150/5340-18)
6. Lighting/Electrical (FAA AC various)
7. Security Fencing and Gates (Airport AvSec specific)
8. Storm Drainage (FAA AC 150/5320-5):
    a. Coordinate requirements with the Authority's Stormwater Management Plan
9. Construction Safety and Phasing Plans (FAA AC 150/5370-2)

10. Standard Details:

    The Consultant will prepare Airport specific standard detail drawings for the following:

    a. Aircraft Gate Position Markings

    b. Vehicle Service Road Markings

    c. AOA Fence (up to 3 alternative applications)

11. Specifications (FAA AC/150/5370-10):

    a. The Consultant will develop general guidance related to preparing Special Provisions for the Authority's airside projects.

    b. This Task Authorization does not include development of Airport specific standard specifications or identification of Item by Item customization requirements for FAA specifications.

4.4. LANDSIDE FACILITIES

4.4.1. LANDSIDE DESIGN REQUIREMENTS

Design and construction standards for landside facilities will, to the extent applicable, be based on Caltrans requirements (Highway Design Manual (HDM), Standard Plans, Standard Specifications). For items where Caltrans standards are not applicable, City of San Diego standards will be used (Greenbook, White Book, Regional Standard Drawings). Airport specific standards will be developed, as directed by the Authority, for items not covered by Caltrans or the City of San Diego. The Consultant will coordinate with applicable Authority stakeholders to develop Airport specific requirements for implementation of the landside facility standards.

4.5. SITE UTILITIES

4.5.1. SITE UTILITY DESIGN REQUIREMENTS

Design and construction standards for site utilities will be based on other agency standards as directed by the Authority. The Consultant will coordinate with applicable Authority stakeholders to develop Airport specific requirements for implementation of the site utility facility standards. Site utilities are defined as trunk distribution or other scale utilities, located outside the footprint of a building, that are typically constructed as part of a Civil improvements project. Site utility design requirements will cover the following topics:

1. Potable Water:

    a. Design Requirements;

    b. Standard Details; and

    c. Specifications:

i. The Consultant will develop general guidance related to preparing Special Provisions for the Authority's roadway projects using other agency specifications.

2. Fire Protection Water:

   a. Design Requirements;

   b. Standard Details; and

   c. Specifications;

      i. The Consultant will develop general guidance related to preparing Special Provisions for the Authority's roadway projects using other agency specifications.

3. Sanitary Sewer:

   a. Design Requirements;

   b. Standard Details; and

   c. Specifications:

      i. The Consultant will develop general guidance related to preparing Special Provisions for the Authority's roadway projects using other agency specifications.

4. Electrical:

   The Consultant will utilize the 12kV system specifications already developed by The Authority/Chula Vista Electric as the basis for the electrical design requirements.

   a. Design Requirements;

   b. Standard Details; and

   c. Specifications:

      i. The Consultant will develop general guidance related to preparing Special Provisions for the Authority's roadway projects using other agency specifications.

5. Communications:

   a. Design Requirements

      i. Pull box/splice vault requirements;

      ii. Fiber optic cable requirements; and

      iii. General communication/fiber topology.

   b. Standard Details

   c. Specifications:

      i. The Consultant will develop general guidance related to

preparing Special Provisions for the Authority's roadway projects using other agency specifications.

6. Natural Gas:
    a. General Requirements:
        i. Reference to CFR 49 Part 191, 192, 199;
        ii. Reference to ASME B31.8, Section V, and other industry applicable standards/codes;
        iii. Reference to API 5L, 6D, 1104; and
        iv. Reference ASTM/ANSI industry applicable codes/standards.
    b. Design Requirements:
        i. Drawing Guidelines and Requirements; See Chapter 7.
        ii. Typical Tie-In Details;
        iii. Typical pipe/component support details;
        iv. Soil Investigation;
        v. Design Loads;
        vi. Design Pressures;
        vii. Material Selection Guidance; and
        viii. Cathodic Protection Methods.
    c. Construction Requirements:
        i. Method of Installation
            a) General Requirements;
            b) Jack & Bore;
            c) Horizontal Directional Drilling; and
            d) Open Cut.
        ii. Joining Methods
        iii. Coating Specifications
        iv. Pressure Testing Methods
        v. Purging and Venting consideration and references to applicable AGA documents
        vi. As-built / Record Drawing requirements
    d. Specifications:
        i. The Consultant will develop general guidance related to preparing Special Provisions for the Authority's roadway projects using other agency specifications.

7. Hydronic Distribution:
    a. Design Requirements;
    b. Standard Details; and
    c. Specifications:
        i. The Consultant will develop general guidance related to preparing Special Provisions for SAN roadway projects using other agency specifications.

4.5.2. 12KV ELECTRICAL INFRASTRUCTURE POLICY AND GUIDE SPECIFICATIONS

The Authority will provide a link to the 12kV Electrical Infrastructure Policy and Guide Specifications in the future.

4.6. APPENDIX

APPENDIX A—SOLE SOURCE / BOD MANUFACTURERS AND PRODUCTS

DOOR HARDWARE			
Manufacturer & Products	**Application**	**Sole Source Manufacturer / Product (required in order to match other products in use at the Airport)**	**Basis of Design Product**
Application	**Automatic Sliding Entrances Door**		
Manufacturer:	Stanley	X	
Product:	Model 3000		
Application	**Heavy Duty Hinges**		
Manufacturer:	Hager Companies	X	
Product	Continuous geared fully concealed, heavy-duty hinge "780-112HD"		
Application	**Emergency Doors**		
Manufacturer:	Von Duprin	X	
Product	Hinge leaf cutout to accommodate Von Duprin "EPT-10" power transfer device.		
Application	**Hinges**		
Manufacturer:	Hager Companies	X	
Product	"H-2 Full Mortise Ball Bearing HW BB2168"		
Application	**Locksets and Latches**		
Manufacturer:	Schlage	X	
Product	Series ND and L		
Application	**Exit Devices**		
Manufacturer:	Von Duprin	X	
Product	None listed.		
Application	**Door Closers**		
Manufacturer:	LCN	X	
Product	4041		
Application	**Kick-Plates and Guards**		
Manufacturer:	Trimco		X
Product	Product: None listed.		

APPENDIX A—SOLE SOURCE / BOD MANUFACTURERS AND PRODUCTS (CONTINUED)

TOILET ACCESSOIRES			
Manufacturer & Products	**Application**	**Sole Source Manufacturer / Product (required in order to match other products in use at the Airport)**	**Basis of Design Product**
Application	**Waste Receptacle**		
Manufacturer:	Bobrick		X
Product:	B-2280 - 21-gallon, square, approximately 30 inches high under the counter.		
Product:	B-529 -Circular waste chute ADA compliant		
Application	**Recessed toilet paper, seat cover dispenser and sanitary napkin disposal ADA compliant**		
Manufacturer:	Bobrick		X
Product:	B-357.		
Application	**Partition mounted toilet paper, seat cover dispenser and sanitary napkin disposal ADA compliant**		
Manufacturer:	Bobrick		X
Product	B-3571.		
Application	**Recessed toilet paper and seat cover dispenser ADA compliant**		
Manufacturer:	Bobrick		X
Product	B-3474		
Application	**Partition mounted toilet paper and seat cover dispenser ADA compliant**		
Manufacturer:	Bobrick		X
Product	B-3471		
Application	**Recessed sanitary napkin/tampon vendor ADA Compliant**		
Manufacturer:	Bobrick		X
Product	B-43500X2		

APPENDIX A—SOLE SOURCE / BOD MANUFACTURERS AND PRODUCTS (CONTINUED)

TOILET ACCESSOIRES			
Manufacturer & Products	**Application**	**Sole Source Manufacturer / Product (required in order to match other products in use at the Airport)**	**Basis of Design Product**
Application	**Stainless steel folding shelf**		
Manufacturer:	Bobrick		X
Product	B-287		
Application	**Grab Bars**		
Manufacturer:	Bobrick		X
Product	B-6806.99		
Application	**Surface mounted toilet seat cover dispenser**		
Manufacturer:	Bobrick		X
Product	B-221		
Application	**Partition mounted toilet paper dispenser**		
Manufacturer:	Bobrick		X
Product	B-27460		
Application	**Surface mounted automated paper towel dispenser**		
Manufacturer:	Georgia Pacific		X
Product	enMotion- touchless towel dispenser; color "translucent smoke		
Application	**Horizontal baby changing table**		
Manufacturer:	Koala Kare		X
Product	KB112-01RE Color: Gray		
Application	**Clothes hook and bumper; ADA compliant, door-mounted, bright polished**		
Manufacturer:	Bobrick		X
Product	B-671- Public Areas		
Product	B-212 - Office/Administrative Areas		

CHAPTER 05:
GUIDE SPECIFICATIONS

5.1. INTRODUCTION
5.2. SPECIFICATIONS REQUIREMENTS
5.3. STRUCTURAL (RESERVED)
5.4. ARCHITECTURAL (RESERVED)
5.5. PLUMBING
5.6. MECHANICAL
5.7. ELECTRICAL
5.8. FIRE ALARM AND FIRE SUPPRESSION SYSTEMS
5.9. TELECOMMUNICATIONS (RESERVED)
5.10. IT AND SECURITY (RESERVED)
5.11. AIRSIDE FACILITIES (RESERVED)
5.12. LANDSIDE FACILITIES (RESERVED)
5.13. SITE UTILITIES (RESERVED)
5.14. APPENDIX

5.1. INTRODUCTION

This Chapter provides design guidelines and requirements for the systems in use at as well as the requirements for specification writing for projects at the Airport.

It is not the intent for this document to replace existing technical specification, more so, to allow technical specification to be written by utilizing these guidelines as a base. The Consultants shall research and validate the current Basis of Design Manufacturers and Products for acceptability by the Authority prior to product submission, due to the frequent changes with technology.

Architects, engineers, planners, consultants, installers, tenants, and staff are among the intended audience. The result of adhering to this specification is to provide infrastructure that:

1. Is secure;

2. Provides for growth (Scalability);

3. Conforms to industry standards;

4. Implements best practices;

5. Improves reliability;

6. Increases serviceability;

7. Provides physical redundancy; and

8. Provides ease of maintenance.

5.1.1. SOLE SOURCE PRODUCTS

If the Authority requires that a product exactly match other products in use, then that is a "sole source" product. Internal Authority approval for that sole source is required prior to the release of the specifications. Those sole source products are listed in Appendix 4.6 and Appendix 5.14.

It is required by Public Contract Code §3400 and Authority Board Policy 5.01 that a specification listing a sole source product must state a reason that is allowed by that section.

The preferred format for a sole source product is:

Manufacturer/Product is a sole source product that required to match other products in use.

5.1.2. BASIS OF DESIGN PRODUCTS

If a sole source is not desired, then the Authority may specify a Basis of Design product. These products are listed in Appendix 4.6 and Appendix 5.14. and are selected based on functionality, durability, ease of maintenance, life cycle, and sustainability.

NOTE: Appendix 4.6 and Appendix 5.14. are routinely revised when there are changes in technologies, improvements made by manufacturers, and lessons learned through use of a product. You must therefore ensure that you are using the latest version.

Public Contract Code §3400 and SDCRAA Board Policy 5.01 have very specific requirements that must be followed when listing manufacturers and products:

When drafting specifications, the designer/ design builder must list a minimum of one additional manufacturer and product that is equal in all material respects to the listed Basis of Design product. (More than one additional manufacturer and product is preferred.)

If the Authority (or its designer/design builder) is aware of an equal product that is manufactured in California, that product must be among those named in the specifications.

The list of products must be followed by the words "or equal".

The preferred format where there is a Basis of Design product is:

1. Manufacturer A, Product A (Basis of Design);
2. Manufacturer B, Product B;
3. Additional manufacturers and products, if available and desired;
4. Or equal.

5.2. SPECIFICATION REQUIREMENTS

5.2.1. QUALITY ASSURANCE

The Consultant has a contractual obligation to the Authority to provide professional quality, technically accurate calculations, drawings, specifications, and cost estimates. Ambiguity, omissions, and conflicts in construction contract drawings and specifications generally result in higher bids and field change orders, thereby causing an unnecessary expenditure of public funds. The liability of the Consultant for design errors and omissions may be pursued by the Authority.

5.2.2. QUALITY CONTROL

Project specifications shall be complete and explicit.

The specifications complement the drawings and together the two shall address all known conditions of the physical aspects of the project.

The drawings shall define the quantities, dimensions, sizes and location of the materials, while the specifications describe the quality of the materials and the techniques and methods of assembling them, including quality of workmanship and the conditions under which the project is to be constructed.

Digital drawings must conform to standards specified in Chapter 7. This includes conformance to digital media, format, naming and symbology standards. For large or complex projects, the Consultant must submit a quality control plan to the Authority for review and approval prior to the start of design work.

5.2.3. FORMAT

The format of specifications shall be patterned after the Construction Specifications Institute's Uniform System, except for special or exclusive formats submitted in advance by the Consultant and approved in writing by the APM.

Specifications for airfield work must be in FAA format.

Format of Specifications:

1. Specifications at the 100% and final stages shall be printed on 8-1/2" x 11" white bond paper. The specifications must also conform to the following standards:

    a. Font: Arial 12pt

    b. Margins: 1" on all sides

    c. Outline levels are marked respectively: **1.x | A. | 1. | a. |** etc. (as needed). Tabs after numbers/ letters begin at 0.5", and follow at 1.0", 1.5", etc. (as needed).

d. End of each section or item shall be marked. Example: **END OF SECTION or END OF ITEM L-127**

e. Footer shall include Specification Number.

f. Specifications shall follow the this numbering system:

g. Section Number & Title:

   i. Part 1 - General;

      a) Related Documents;

      b) Summary;

      c) Definitions;

      d) Submittals;

      e) Quality Assurance;

      f) Delivery, Storage, & Handling;

      g) Field Conditions;

      h) O&M;

      i) Training;

      j) Warranty.

   ii. Part 2 Products;

      a) Performance Requirements;

      b) Material;

      c) Fabrication.

   iii. Part 3 Execution;

      a) Installation

5.2.4. PROPRIETARY PRODUCTS

If a suitable standard specification is not available, an item may be specified by naming at least two available commercial products, followed by the words, "or equal".

5.2.5. SUPPLEMENTAL REQUIREMENTS FOR PREPARING SPECIFICATIONS

These supplemental requirements for Contractors preparing special provisions (technical specifications) are in addition to the Authority's requirements outlined in this Chapter.

Per Exhibit A - Scope of Work of the Contractor's on-call consulting services agreement, the Contractor is responsible for thoroughly reviewing and checking all deliverable documents for quality, accuracy, and constructability prior to their submittal to the Authority. Special Provisions documents with spelling mistakes, grammatical errors, or not in conformance to these and other contractually identified requirements will not be accepted as a valid submittal.

5.2.5.1. AIRPORT AUTHORITY'S CONSTRUCTION CONTRACT PROVISIONS

1. Authority design-bid-build construction contracts consist of the following elements (in order of precedence):
    a. Front End Documents:
        i. Section 1A – Instructions to Bidders (Authority provided)
        ii. Section 1B – Bidder's Submission Documents (Authority provided)
            a) Bid Schedule – (Contractor provided)
    b. Specifications:
        i. Section 1C - General Conditions (Authority provided)
        ii. Section 1D - Special Conditions (Authority provided)
        iii. Special Provisions (Contractor provided technical specifications)
    c. Drawings (Contractor provided)
    d. Plans (Contractor provided)
2. Request and obtain copies of the most current versions of Authority construction contract Sections 1A, 1B, 1C, and 1D prior to starting any work related to the Special Provisions.
3. Ensure that there are no conflicts, duplications, or ambiguities between the Consultant provided documents and the Authority construction contract Sections 1A, 1B, 1C, and 1D. By contract order of precedence, the Authority's contract language in Sections 1A, 1B, 1C, and 1D will take precedence over all documents provided by the Contractor. Identify and notify the Authority of any instances where the project requires something that creates a conflict or ambiguity with Sections 1A, 1B, 1C, and 1D.
4. Sections 1A, 1B, and 1C contain general contract requirements that will not be changed for individual projects.
5. Section 1D contains more specific and specialty contract requirements that can be modified when necessary to accommodate project specific needs or to provide a betterment for the project. The Contractor may request or recommend modifications to Section 1D. All such recommendations must be consolidated into a single request and submitted to the Authority in writing no later than the Pre-Final (90%) construction documents submittal.

5.2.5.2. MEASUREMENT AND PAYMENT CLAUSES

5.2.5.2.1. GENERAL

1. Special provision measurement and payment clauses must conform to the Measurement and Payment Clauses section of this document and the appendices herein.

2. Bid item wording must match exactly between the special provisions, bid schedule, and plan call outs (includes capitalizations and abbreviations).

3. Units of measure must match exactly between the special provisions and bid schedule (includes capitalizations and abbreviations).

4. Refer to the Appendices within this Chapter for further information on measurement and payment clauses.

5. Proceed to Section 5.14. for Appendices which further outline requirements of the Measurement and Payment Clauses.

5.2.5.3. AUTHORITY OF THE ARCHITECT/ENGINEER

1. The word "Representative" shall be used to indicate the Architect and / or Engineer for all instances throughout the Technical Specifications. The General Conditions of the Construction Contract with the Contractor defines "Representative" as follows:

    a. "Representative" means the designated employee(s) of the Airport Authority or authorized individual(s), who shall be in charge of the Work and who is/are authorized to act on behalf of the Airport Authority.

2. The Architect/Engineer is not in privity of contract with the contractor. The Architect/Engineer's authority over the contractor, if any, is limited to that which is expressly delegated to that firm via a Task Authorization issued by the Authority.

3. A specification that states that the Architect/Engineer must approve an item that has been submitted or constructed by the contractor must be modified to say that the Representative must approve.

4. Technical Specifications must not reference the role or responsibilities of the Architect/Engineer.

5.2.5.4. DEFINITION OF TERMS

1. General Conditions Article 1C-1.2 of the Authority's design-bid-build construction contract establishes definitions for certain terms used within the Contract Documents. Special Provisions, Drawings, and Plans prepared by the Contractor must utilize

the same terms and associated definitions. The Contractor's Special Provisions, Drawings, and Plans must not change, expand upon, or otherwise modify the definitions contained in General Provisions Article 1C. The Contractor's Special Provisions, Drawings, and Plans must not create or use additional or abbreviated terms for the definitions contained General Provisions Article 1C.

2. The Contractor's Special Provisions, Drawings, and Plans may include additional terms and their associated definitions to the extent that they do not repeat, overlap, or otherwise conflict with the terms and definitions contained in General Provisions Article 1C.

    a. "Contract Documents" means everything contained in this Contract and any and all other written instruments and drawings of every kind and nature which are attached to or made a part hereof by reference or by operation of law; including, but not limited to, Request for Bids, Instructions to Bidder, Contractor's Bid, Bonds, Addenda, Specifications, Airport Authority approved Change Orders, Plans, and Drawings.

    b. "Drawings" means that portion of the Contract Documents that present the Work, or parts thereof, visually, graphically, symbolically or diagrammatically and which generally indicate the size, form, location and arrangement of the various elements of the Work including exhibits.

    c. "Plans" means the exhibits, sketches, working drawings and supplemental drawings, or reproductions thereof, approved by the Airport Authority, which show the location, character, dimensions or details of the Work and incorporated into the Contract Documents.

    d. "Specifications" means the general conditions, special conditions and special provisions.

5.2.5.5. GENDER SPECIFICITY

Do not use gender-specific terminology.

5.2.5.6. USE OF AND REFERENCES TO OTHER AGENCY SPECIFICATIONS (I.E., CALTRANS, GREENBOOK, WHITE BOOK)

1. Current technical specifications published by other public agencies may be used to prepare special provisions for Authority projects as deemed appropriate by the Contractor.

2. Do not include references to other agency general conditions, special conditions, or other terms and conditions. Ensure that the other

agency technical specifications, are properly coordinated with and do not conflict with the Authority's construction contract documents. General incorporation of other agency documents by reference is not permitted. Other agency technical specification requirements shall be fully included in the special provisions so that reference back to the source document is not required. Incorporation by reference places the burden and risk of version changes and understanding and interpreting intent and requirements on the Authority. Incorporations by reference, if allowed, must be limited to just those elements of the reference document that are clearly and specifically relevant.

3. Include applicable testing, inspection, and submittal requirements associated with the other agency or organization technical specification in the special provisions rather than by reference.

5.2.5.7. LEGAL ISSUES

Shall not be repeated in the technical specifications.

1. Do not restate or summarize something that is covered in either the General Conditions or the Special Conditions, because it can cause an ambiguity in the contract.
2. There is no need to state that the General Conditions and the Special Conditions apply. They always apply by virtue of the contract.
3. Items that are strictly legal include, but are not limited to:
    a. Indemnity;
    b. Termination;
    c. Dispute resolution.

5.2.5.8. GUARANTEES OR WARRANTIES

Shall not refer to the construction contractor's one-year guarantee on labor and materials. That is covered in the General Conditions, as follows:

1. 1C-3.4 GUARANTEE

    In addition to, but not in limitation of, the provisions of California Code of Civil Procedure Sections 337.1 and 337.15, all work shall be guaranteed by the Contractor against defective workmanship and materials for a period of one (1) year from **the later of** (a) the date of Substantial Completion, if any, (b) the date of Completion, if any, or (c) the date of termination of the Contract, if any. The Contractor shall promptly replace or repair, in a manner satisfactory to the Engineer,

any such defective work after notice to do so from the Engineer, and upon the Contractor's failure to make such replacement or repairs promptly, the Airport Authority may perform this Work and the Contractor and its sureties shall be liable for the cost thereof. For any Work which is replaced or repaired pursuant to this provision, a new one (1) year guarantee period shall begin after acceptance by the Airport Authority of the repaired or replaced Work.

5.2.5.9. EQUIPMENT AND SYSTEM WARRANTY REQUIREMENTS

All new or modified equipment and systems may include warranty requirements that are in excess of the construction contractor's standard 1-year guarantee. Make recommendations on and then coordinate Authority approval of any extended equipment and system warranty requirements to be included in the special provisions.

5.2.5.10. SYSTEM TURNOVER PACKAGE

An Operations & Maintenance (O&M) Package will be created and used for planning during the design phase, quality control during the construction phase, and then finally as a turnover package to the Authority.

1. An O&M Package matrix will be created during the design phase as an overview of each system and organized in a logical manner, i.e. HVAC (mechanical), HVAC (Automation), Lighting Controls, Electrical, Plumbing, Fire Alarm, Fire Mechanical, Emergency Generator, Roof, Glazing, etc. It will be further broken down by equipment/ components as applicable. The matrix will be reviewed and approved by the Authority no later than the 60% design or establishment of a Guaranteed Maximum Price (GMP), whichever milestone occurs first, and will contain the following as a minimum for each system and/or component/equipment type :

    a. Extended Warranty Recommendations/Requirements

    b. Training Requirements

    c. Commissioning Requirements

    d. Attic Stock Requirements

2. During Construction, the contractor will populate the training schedule and the commissioning schedule for each system in the matrix as a communication tool. The Authority will participate in both the commissioning and training for each system.

3. At project turnover, the O&M Package will be reviewed by the Authority for approval. It will be organized by

system/subsystem/equipment/ component, have an index, and be easy to navigate. The content for each system/subsystem/equipment/ component is below:

a. The O&M "manual" for each system will provide the following:
    i. System description
    ii. Equipment schedule
    iii. Sequence of operations (as applicable)
    iv. Shop Drawings
    v. Cutsheets for each equipment
    vi. O&M Manual for each equipment and system/ subsystem
b. The extended warranty documents per the specifications.
c. List of attic stock.
d. Commissioning documentation.

See Appendix 5.1.H. for sample matrix format.

5.2.5.11. COMMISSIONING AND ACTIVATION REQUIREMENTS

All new or modified equipment and systems must include requirements for commissioning and activation. Make recommendations on and then coordinate Authority approval of the commissioning and activation requirements to be included in the special provisions. Commissioning requirements must include identification of operations & maintenance documentation and Authority training.

5.2.5.12. MOCK UPS

Make recommendations on when mock ups should be requires and then coordinate Authority approval for what construction contractor mock ups will be included in the Special Provisions. The Special Provisions must clearly identify the requirements and type (fit & finish, aesthetic review, functional testing, etc.) for each mock up, when it must be provided, and whether it can be constructed in-place and used as part of the Work.

All required mock-ups shall be identified by the 60% phase of the project.

Consultants to coordinate product lead times to ensure mock-ups can be constructed in proper sequencing of the project.

5.2.5.13. PROCESSES AND SPECIFICATIONS

The specifications must not re-state, summarize, or contradict items where there is an established process or contractual specification. (ADDITIONAL information is acceptable, as long as it is clearly different and not covered in the Instructions to

Bidders, the General Conditions, or the Special Conditions.)

1. Common offenders include:

    a. Processes for approving substitution requests or submittals (Included in Contract sections 1D-09)

    b. Security (Included in Appendix 3)

    c. Contractor cooperation and coordination with others, including the Authority (Included in Contract section 1D-13, 1D-15, 1D-24, and 1D-25)

    d. Interactions between the contractor and the Authority or other agencies (e.g., the FAA) shall be coordinated through the "Representative". Specifications that state or imply that the contractor shall reach out directly to other entities shall be modified to state "Coordinate through Representative".

    e. Safety (Included in Appendix 4 and the Safety Manual)

    f. Airfield Safety (Included in Appendix 2)

    g. Measurement and Payment, including payment of retention (Included in Contract section 1C Article 9)

    h. RFIs, Bulletins, and Change Orders (Included in Contract section 1C-7)

    i. Instructions for submitting bids (included in Contract section 1A, "Instructions to Bidder")

    j. Evaluation or award of bids (included in Contract section 1A "Instructions to Bidder")

    k. Substantial completion and completion (included in Contract section1C-9).

5.2.2.14. PRODUCT BRAND NAMES

1. Pursuant to Board Policy 5.01 (7) (below), if the Authority is aware of an "equal" product manufactured in California, that product must be among those named in the specifications. (Knowledge of its agents, including Architects and Engineers, is imputed to the Authority.)

    a. All product references must either: Specify at least two alternative products followed by the words "or equal" (NOT "or approved equal", "or equivalent", or any other variation)

2. This is required by statute (Public Contract Code §3400) and Board policy 5.01, and must be followed in all instances.

    a. Public Contract Code section 3400.

(b) No agency of the state, nor … any public officer or person charged with the letting of contracts for the construction, alteration, or repair of public works, shall draft or cause to be drafted specifications for bids, in connection with the construction, alteration, or repair of public works, (1) in a manner that limits the bidding, directly or indirectly, to any one specific concern, or (2) calling for a designated material, product, thing, or service by specific brand or trade name unless the specification is followed by the words "or equal" so that bidders may furnish any equal material, product, thing, or service.

(c) Subdivision (b) is not applicable if the awarding authority, or its designee, makes a finding that is described in the invitation for bids or request for proposals that a particular material, product, thing, or service is designated by specific brand or trade name for any of the following purposes:

i. In order that a field test or experiment may be made to determine the product's suitability for future use.

ii. In order to match other products in use on a particular public improvement either completed or in the course of completion.

iii. In order to obtain a necessary item that is only available from one source.

b. Board Policy 5.01 (7)

(7) Specifications.

(a) Pursuant to Section 3400 of the California Public Contract Code, the Authority shall not draft RFPs, RFQs or specifications for bids (i) in a manner that limits the RFP or RFQ process or bidding, directly or indirectly, to any one specific concern, or (ii) calling for a designated material, product or service by specific brand or trade name unless the specification lists at least two brands or trade names of comparable quality or utility and is followed by the words "or equal" so that respondents may furnish any equal material, product or service. The Authority shall, if aware of an equal product manufactured in California, name that product in the specification. In those cases involving a unique or novel product application required to be used in the public interest, or where only one brand or trade name is known to the Authority, it may list only one.

c. (b) Paragraph 7(a) shall not be applicable if the Authority makes a finding that is described in the RFP, RFQ or invitation for bids that a

particular material, product or service is designated by specific brand or trade name for either of the following purposes: (i) in order that a field test or experiment may be made to determine the product's suitability for future use; or (ii) in order to match other products in use on a particular public improvement either completed or in the course of completion.

5.3. STRUCTURAL

(RESERVED)

5.4. ARCHITECTURAL

(RESERVED)

5.5. PLUMBING

22 11 16—DOMESTIC WATER PIPING

SUMMARY

1. Copper tubing only throughout the Airport.
2. This section includes under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
3. Comply with NSF 61 for potable domestic water piping and components.
4. Aboveground domestic water piping shall be Type L or K copper.
5. Underground domestic water piping shall be Type K copper.
6. Install copper tubing underground in PE encasement.

PRODUCTS

1. Copper Tube and Fittings:
    a. Clean and disinfect potable domestic water piping.
2. Piping Joining Materials:
    a. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

EXECUTION

1. Install piping rigid and secure to the building structure to prevent movement.
2. Seismic Performance: Support piping capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."
3. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
4. Support piping and tubing according to MSS SP-69 and manufacturer's written instructions.

22 13 16—SANITARY WASTE AND VENT PIPING

SUMMARY

1. Building type will dictate type of piping required. Consultant to confirm with AHJ.
2. This section includes pipe, tube, fittings and special pipe fittings.
3. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PRODUCTS

1. Hubless Cast-Iron Soil Pipe and Fittings
    a. Heavy Duty Shielded Couplings: assembly of stainless-steel corrugated shield or housing, stainless-steel bands, rubber sleeve with integral center pipe stop.
2. PVC Pipe and Fittings (for underground use only):
    a. Solid Wall PVC
    b. PVC Socket Fittings

EXECUTION

1. Seismic Performance: Support and installation of soil, waste, and vent piping shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."
2. Support piping and tubing according to MSS SP-69 and manufacturer's written instructions.
3. Waste piping 6 inch and larger, shall have additional bracing provided at every change in direction.
4. Install piping rigid and secure to the building structure to prevent movement.
5. Piping Applications:
    a. Aboveground, soil and waste piping shall be the following:
        i. Hubless cast-iron soil pipe and fittings with heavy duty shielded, stainless-steel couplings.
        ii. Copper DWV tube, copper drainage fittings, and soldered joints.
    b. Aboveground, vent piping shall be as follows:
        i. Hubless cast-iron soil pipe and fittings; heavy duty shielded, stainless-steel couplings.
    c. Underground, soil, waste, and vent piping:

i. Service class, hub and spigot cast-iron soil piping and gasketed joints.

ii. Solid Wall Schedule 40 PVC (Preferred) and Drainage Fittings with solvent cemented joints.

d. Sanitary cross sewer connection on urinals shall be as follows:

i. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

ii. Hubless cast-iron soil pipe and fittings; heavy duty shielded, stainless-steel couplings.

e. Clean interior of piping. Remove dirt and debris as work progresses.

22 13 29—SANITARY SEWAGE EJECTOR PUMPS

SUMMARY

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. UL Compliance: Comply with UL 778 for motor-operated water pumps.

3. Pump system and installation shall comply with ANSI/HI Pump Standards (Hydraulic Institute).

4. Aboveground pump stations (dry well) shall be preferred.

MANUFACTURERS

1. Vaughan;

2. Weil;

3. Or equal.

PRODUCTS

1. Duplex Sewage Lift Station complete with Chopper (or Grinder) pumps.

2. Dry Well Lift Station shall include:

a. Pump Casing, self-priming, ductile iron. Ceramic epoxy coated.

b. Impeller: Cast steel, heat treated semi-open type.

c. Shaft: Heat treated stainless steel.

d. Chopper System: Chopping. maceration of solids shall be accomplished by the action of two rotating knives moving across on fixed knife alternatively three fixed mounted by the pump inlet external of the pump casing. The chopping system shall be designed to prevent the pump inlet from clogging. Rotating and fixed knives shall be easily replaceable without the use of special tools or requirement of pump disassembly. Fixed and rotating knives shall be

stainless steel heat treated to 58-60 Rockwell C Hardness.

e. Bearings: Oil bath lubricated ball bearing. Shaft thrust taken by double row angular ball bearings. A single row radial bearing shall also be provided. L-10 Bearing Life rating of 100,000 hours.

f. Mechanical Seal: Cartridge type with silicon carbide faces. Elastomers shall be Viton. This cartridge seal shall be preassembled, and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a CF8M stainless steal seal gland.

g. Motor: FM Approved Air-filled, Insulated Class F, 4 Pole, rated for continuous duty and 10 starts per hour. Built-in Thermal Detector Overload Protection. Built-in mechanical seal leak detector. External seal probes will not be considered equal or approved. Motor shall be non-overloading at design point and across the entire curve.

3. Guide Lift Out Rail and Coupling System:

a. For permanent installation and ease of inspection a guide rail and coupling system shall be used to mount each pump. The system shall consist of a floor-mounted assembly with foot, discharge elbow and a coupling device for the pump. A guide rail shall ensure the pump is guided to the discharge elbow and correctly located in position to give a leak-free connection.

b. The bottom assembly shall be bolted to the floor of the tank and provide support for the guide rail.

c. An upper guide holder assembly shall secure the system to the tank wall, platform, or under a manhole/ hatch cover. It shall also provide the lateral support for the guide rail. The assembly shall contain a location to secure the electrical motor cable holder.

d. Guide Rail shall be stainless steel. The Coupling System shall be stainless steel.

4. Control Panel and Pump Level Controls:

a. Industrial grade UL listed, 508A control panel with NEMA 3R enclosure. Panel shall be factory wired in accordance with UL 508A procedures. All control switches, test buttons; alarm-silencing

switches shall be mounted on interior door and shall include the following:

i. Individual disconnects switches with lockout handles.

ii. Fused motor protection.

iii. Two magnetic starters with three leg overload protection.

iv. Two reverse magnetic contactors.

v. Reverse Start programmer with Fault Detection programming.

vi. Two Test—Off—Automatic selector switches.

vii. Two manual reverse override switches.

viii. Electric duplex alternator.

ix. Control circuit transformers.

x. Two green pump running lights.

xi. Two yellow reverse pump run lights.

xii. Current sensing fault relays.

xiii. Thermal sensors relays with cut -out and pilot lights.

xiv. Seal failure relays with pilot lights.

xv. Pump Failure Alarm circuit.

xvi. High Water Alarm circuit.

xvii. Alarm horn mounted and beacon on panel.

xviii. Alarm horn silencing switch.

xix. Dry contacts for remote alarm.

b. Level Controls: Provide four UL-listed mechanically activated float switches complete with stainless steel float mounting support pole. The cables shall be secured to the support pole in accordance with the manufacturer installation instructions.

c. Sewage Basin:

i. Pre-fabricated fiberglass, pre-cast concrete or poured-in-place concrete.

ii. Provide manufacturer's service weight frame and cover plate (Gas Tight) with single door hinged pump access door complete with hold open device suitable for removal of pumping equipment. Frame, cover plate, and hardware shall be minimum 1/2 –inch thick, Type 304 stainless steel.

iii. Provide embed crane hoist socket.

iv. Coordinate in field for location and installation.

5. Submersible Pumps:

a. Submersibles allowed for small drainage applications.

b. Manufacturers:

i. BJM Pumps;

ii. Hydra-Tech;

iii. Ebara;

iv. Or equal.

c. Stainless Steel casing with legs to elevate the pump. All parts in contact with water shall be stainless steel.

d. Pump and motor shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings, upper and lower bearings.

e. Seal: Double Mechanical Seal

f. Motor: Hermetically sealed, capacitor-start type; with built in overload protection; lifting eye or lug; and three conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

g. Provide pump system with guide lift out rails.

EXECUTION

1. Comply with HI 1.4 for installation.

2. After installation, charge the system and test for leaks. Repair leaks and retest the system until no leaks exist.

3. Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

5. Train Authority's maintenance personnel to adjust, operate, and maintain controls and pumps.

22 34 00—DOMESTIC WATER HEATERS

SUMMARY

1. This section includes commercial, power-vent, storage, gas water heaters, and light commercial electric water heaters.

2. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

3. Electrical Components, devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a nationally recognized testing agency, and marked for intended use.

4. Where indicated, fabricated and label commercial water heater storage tanks to ASME requirements.

MANUFACTURERS

1. A.O. Smith;

2. Rheem;

3. State;

4. Bradford White;

5. Or equal.

PRODUCTS

1. Natural Gas or Propane Gas Water Heaters:

    a. Commercial, Power Vent or Direct Vent, High Efficiency, Storage, Condensing, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.

    b. Minimum 95% thermal efficiency.

    c. Storage-Tank Construction: ASME-code steel with 150psig working-pressure rating.

    d. Standby heat loss meets ASHRAE/ IES 90.1.

    e. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

    f. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

    g. Power-Vent System: Exhaust fan, interlocked with burner. PVC or CPVC schedule 40 pipe Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.

2. Light Commercial Electric Water Heater:

    a. Light Commercial Electric Water Heater shall be UL 174 listed.

    b. Storage-Tank Construction: ASME-code steel with 150-psig working-pressure rating.

    c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

    d. Lining: Glass complying with NSF 61 barrier materials for potable water tank linings, including extending

lining into and through tank fittings and outlets.

e. Standby heat loss meets ASHRAE/ IES 90.1.

f. High temperature cutoff devise or system.

g. Tank shall contain anode rod.

h. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.

3. Instantaneous Electric Water Heater:

a. Instantaneous Electric Water Heater shall be UL 499 listed.

b. Heater shall be flow controlled or thermostat controlled.

c. Interior Construction: Comply with NSF 61 barrier materials for potable water without storage.

d. High temperature cutoff devise or system.

EXECUTION

1. Install storage tank water heaters on concrete pad or stand.

2. Route T&P relief valve drain line to floor drain or other code acceptable receptor. Use copper type "L" tubing for drain line.

3. Install all storage tank water heaters with master tempering valve. Limit hot water temperature to 110 degrees to hand washing lavatories. Install thermometer on outlet piping.

22 40 00—PLUMBING FIXTURES

SUMMARY

1. Section Includes:

a. Water Closets

b. Urinals.

c. Lavatories.

d. Sinks.

e. Toilet Seats.

f. Flush valves.

g. Faucets.

h. Sensor operated faucet, and devices.

2. All plumbing fixtures to be hardwired.

3. All flush values shall be concealed unless they are not installed within a chase. If no chase, valves are to be exposed.

4. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from single manufacturer.

5. Lavatory tempered supply water shall have circulating pump at end of pipe run to maintain hot water at fixture.

6. Install lavatory fixtures with removable trap arm.

7. Provide following clearances for plumbing chases:

    a. Back to back water closet: 48 inches.

    b. Back to back lavatory: 36 inches.

    c. Single water closet: 30 inches.

    d. Minimum clear space dimension within plumbing chase shall be 34".

PRODUCTS

1. The Authority's BOD Manufacturers / Products for Water Closets are as follows:

    a. Manufacturers:

        i. Sloan;

        ii. Or equal.

    b. Model Names:

        i. Elongated Wall-Mounted Water Closet ST-2469;

        ii. ST- 2029 (ADA) Floor Mounted - Water Closet;

        iii. ST- 2009 Floor Mounted - Water Closet;

        iv. Or equal.

2. The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Exposed Water Closet Flush Valves are as follows:

    a. Manufacturer:

        i. Sloan

    b. Model Name:

        i. Royal Sensor Flushometer, Royal 152 ESS Hardwired

    c. Code Number: 3451666

    d. Description: 1.28 gpf, Rough Brass Finish, Polished Chrome Wall Plate Finish, Single Flush, 2-10.75 L Dimension, True Mechanical Override, Hardwired, Sensor-Operated, Royal Concealed Sensor Water Closet Flushometer.

3. The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Concealed Water Closet Flush Valves are as follows:

    a. Manufacturer:

        i. Sloan

b. Model Name:

i. Royal 152 ESS Hardwired—Royal Sensor Flushometer

4. The Authority's BOD Manufacturers / Products for Urinals with Concealed Flush Valve are as follows:

a. Manufacturers:

i. Sloan;

ii. Or equal.

b. Model Name:

i. SU-1019: Retrofit Washdown Urinal;

ii. Or equal.

5. The Authority's BOD Manufacturers / Products for Urinals with Exposed Flush Valve are as follows:

a. Manufacturers:

i. Sloan;

ii. Or equal.

b. Model Name:

i. SU-1009: Washdown Urinal;

ii. Or equal.

6. The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Concealed Urinal Flush Valves are as follows:

a. Manufacturers:

i. Sloan

b. Model Name:

i. Royal Sensor Flushometer, Royal 195 ESS Hardwired

b. Code Number: 3453273

c. Description: 0.125 gpf, Dual-Filtered Bypass, Rough Brass Finish, Polished Chrome Wall Plate Finish, Single Flush, 2-10.75 L Dimension, True Mechanical Override, Hardwired, Sensor-Operated, Royal Concealed Sensor Urinal Flushometer.

7. The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Exposed Urinal Flush Valves are as follows:

a. Manufacturers:

i. Sloan

b. Model Name:

i. Royal 186 SFSM-0125-HW

8. The Authority's Sole Source Manufacturer / Product (required in order to match other products in use at the Airport) for Faucets are as follows:
    a. Manufacturer:
        i. Sloan
    b. Model Name:
        i. Optima Sensor Faucet, ETF-880 -4-PLG-TEE-CP-0.5GPM-MLM-IR-BT-FCT
    c. Code Number: 3365013BT
    d. Description: 4" Trim Plate, Plug Adapter Power Supply, Back-Check Tee, Polished Chrome Finish, 0.5 gpm, Multi-Laminar Spray, Infrared Sensor, Smart Faucet, Optima Hardwired-Powered Deck-Mounted Mid Body Faucet.
9. The Authority's BOD Manufacturers / Products for Soap Dispensers are as follows:
    a. Manufacturers:
        i. GOJO;
        ii. Or equal.
    b. Model Name:
        i. GOJO® CXT Counter Mount Dispenser
        ii. SKU: 8540-01 with 8501-AC-KIT-02 power adapter kit for 2 dispensers.
    b. Description: Polished Chrome Finish, Premium touch-free, battery-powered dispenser.
10. The Authority's BOD Manufacturers / Products for Lavatories are as follows:
    a. Manufacturers:
        i. American Standard;
        ii. Kohler;
        iii. Or equal.
    b. Products: Not specified.
11. The Authority's BOD Manufacturers / Products for Toilet Seats are as follows:
    a. Manufacturers:
        i. Bemis Co.:
        ii. Or equal.
    b. Products: Not specified.
12. The Authority's BOD Manufacturers / Products for Breakroom Sinks are as follows:
    a. Manufacturers:
        i. Elkay;
        ii. or equal.

b. Products: Not specified.

c. Description: Stainless steel sinks, 18 Gauge type 304 stainless steel, fully coated underside.

13. The Authority's BOD Manufacturers / Products for Service Sinks are as follows:

a. Manufacturers:

i. American Standard;

ii. Kohler;

iii. Or equal.

b. Products: Not specified.

c. Description: Stainless steel sinks, 18 Gauge type 304 stainless steel, fully coated underside.

14. The Authority's BOD Manufacturers / Products for Angle Supply Stops are as follows:

a. Manufacturer: Dahl

b. Model Name: Dahl #611-33-31

c. Description: 1/4 turn.

15. Silicone Sealants

a. Manufacturers: Not specified

b. Products: Not specified.

c. Description: 100% silicone rubber, clear, intended for use with toilet and restroom fixtures. Sealant to be waterproof, non-shrinking and mold/mildew resistant.

EXECUTION

1. Install off-floor supports, affixed to building substrate, for wall-mounted fixtures.

2. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork.

3. Apply continuous silicone sealant at joints between all fixtures and adjacent surface, such as lavatory tops, finish floor material and finish wall material.

4. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

5. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

a. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.

b. Remove sediment and debris from drains.

6. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes. Remove paint splatters and other spots, dirt, and debris. Replace items with damaged finishes.

22 47 00—DRINKING FOUNTAINS AND WATER COOLERS

SUMMARY

1. Section includes electric water coolers.

MANUFACTURERS

1. The Authority's Sole Source Manufacturer (required in order to match other products in use at the Airport) is:

   a. Elkay Manufacturing Co.;

PRODUCTS

1. The Authority's Sole Source Product (required in order to match other products in use at the Airport) for drinking fountains is:

   a. LZSTL8WSLK Water Refilling Station, Bi-Level Reversible, W/ Filter, Light Gray model;

2. Use floor mounted carrier supports for wall-mounted fixtures.

3. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

4. All new water coolers are to be a water cooler/bottle filling station combination unit with water filter.

5. Minimum capacity of 8 GPH at 50 deg. F for chilled water.

EXECUTION

1. Install floor mounter carrier supports, affixed to building substrate, for wall-mounted fixtures.

2. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.

3. Install escutcheons at piping wall penetrations in exposed, finished locations.

4. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant.

5. After completing installation of the fixture(s), inspect exposed finishes. Remove paint splatters and other spots, dirt, and debris. Replace items with damaged finishes.

5.6. MECHANICAL

23 05 00—COMMON WORK RESULTS FOR HVAC

SUMMARY

1. Section includes:
    a. Piping materials and installation instructions common to most piping systems.
    b. Transition fittings;
    c. Dielectric fittings;
    d. Mechanical sleeve seals;
    e. Sleeves;
    f. Escutcheons;
    g. Grout;
    h. HVAC Demolition;
    i. Equipment installation requirements common to equipment sections;
    j. Supports and anchorages; and
    k. Concrete bases.

MANUFACTURERS

1. Dielectric fittings:
    a. Capitol Manufacturing Co.;
    b. Central Plastics Company;
    c. Epco Sales, Inc.;
    d. Watts Industries, Inc.; Water Products Div;
    e. Lochinvar Corp;
    f. Perfection Corp;
    g. Victaulic Co. of America;
    h. Or equal.
2. Mechanical Sleeve Seals:
    a. Calpico, Inc.;
    b. Metraflex Co.;
    c. Pipeline Seal and Insulator, Inc.;
    d. Or equal.

PRODUCTS

1. Refer to individual Division 23 sections for pipe, tube, and fitting materials and joining methods.
2. Joining materials:
    a. Pipe-flange gasket materials: Suitable for chemical and thermal conditions of piping system contents.
    b. Flange Bolts and Nuts: Carbon steel.
3. Transition Fittings, Plastic-to-Metal: CPVC and PVC one-piece fitting with

manufacturer's Schedule 80 equivalent dimensions.

4. Dielectric Fittings: Combination fitting of copper allay and ferrous materials with threaded, solder-joing, plain, or weld-neck end connections that match piping system materials.

5. Mechanical Pipe Sleeves: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

6. Sleeves: Galvanized-Steel Sheet, Steel, Cast Iron, or PVC.

7. Grout: Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

EXECUTION

1. Demolition: Disconnect, and Remove HVAC systems, equipment, and components indicated to be removed.

2. Piping Systems: Install piping according to division 23 sections specifying piping systems.

3. Piping Connections:

    a. Install unions, in piping NPS 2-1/2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

    b. Install flanges, in piping NPS 3 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

4. Equipment Installation:

    a. Install equipment level and plumb

    b. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components.

5. Supports and Anchorages: Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

6. Grout: Mix and install for HVAC equipment base.

7. Concrete Base: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at project.

23 05 13—COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

SUMMARY

Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cade induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by

equipment manufacturer for field installation.

MANUFACTURERS

Not Applicable

PRODUCTS

1. Polyphase Motors: NEMA MG 1, Design B, medium induction motor
2. Single-Phase Motors
    a. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
        i. Permanent-split capacitor
        ii. Split phase
        iii. Capacitor start, inductor run
        iv. Capacitor start, capacitor run
    b. Motors 1/20 HP and smaller: shaded-pole type

EXECUTION

Not applicable.

23 05 16—EXPANSION FITTINGS

SUMMARY

1. Section includes:
    a. Metal-bellows packless expansion joints
    b. Alignment guides and anchors.

MANUFACTURERS

1. Packless Expansion Joints:
    a. Adsco Manufacturing LLC.;
    b. American BOA, Inc.;
    c. Badger Industries, Inc.;
    d. Expansion Joint Systems, Inc.;
    e. Flex-Hose Co., Inc.;
    f. Flexicraft Industries.;
    g. Flex Pression Ltd.;
    h. Flex-Weld, Inc.;
    i. Flo Fab Inc.;
    j. Hyspan Precision Products, Inc.;
    k. Metraflex, Inc.;
    l. Proco Products, Inc.;
    m. Senior Flexonics Pathway;
    n. Tozen Corporation;

o. Unaflex;

p. Unisource Manufacturing, Inc.;

q. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.;

r. U.S. Bellows, Inc.;

s. WahlcoMetroflex;

t. Or equal.

2. Alignment guides and anchors:

a. Manufacturers:

i. Adsco Manufacturing LLC.;

ii. Advanced Thermal Systems, Inc.;

iii. Flex-Hose Co., Inc.;

iv. Flexicraft Industries;

v. Flex-Weld, Inc.;

vi. Hyspan Precision Products, Inc.;

vii. Metraflex, Inc.;

viii. Senior Flexonics Pathway;

ix. Unisource Manufacturing, Inc.;

x. U.S. Bellows, Inc.;

xi. Or equal.

PRODUCTS

1. Packless Expansion Joints: Circular, corrugated bellows with external tie rods.

2. Alignment guides and anchors: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

EXECUTION

1. Packless Expansion Joints Installation:

a. Expansion joints of sizes matching sizes of piping in which they are installed.

b. Metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

c. Grooved-joint expansion joints to grooved-end steel piping

2. Alignment-Guide and Anchor Installation:

a. Alignment guides to guide expansion and to avoid end-loading and torsional stress.

b. Two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint

not more than four pipe diameters from expansion joint.

c. Guides to pipe and secure guides to building structure.

d. Anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

e. Anchor Attachments:

   i. Attachment to Steel Pipe by welding. complying with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

   ii. Anchor Attachment to Copper Tubing with pipe hangers using MSS SP-69, Type 24, U-bolts bolted to anchor.

f. Steel anchors fabricated and installed by welding steel shapes, plates, and bars complying with ASME B31.9 and AWS D1.1/D1.1M.

   i. Attachment to Steel Structural Members by welding.

   ii. Anchor Attachment to Concrete Structural Members by fasteners following fastener manufacturer's written instructions.

g. Grout used to form flat bearing surfaces for guides and anchors attached to concrete.

23 05 19—METERS AND GAGES FOR HVAC PIPING

SUMMARY

1. Section includes:

   a. Liquid in-glass thermometers;

   b. Thermowells;

   c. Dial-type pressure gauges;

   d. Gauge attachments;

   e. Test plugs;

   f. Test-plug kits; and

   g. Flow meters.

PRODUCTS

1. Liquid In-Glass Thermometers:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to:

      i. Flo Fab Inc.;

      ii. Miljoco Corporation;

iii. Palmer Wahl Instrumentation Group;

iv. Tel-Tru Manufacturing Company;

v. Trerice H.O. Co.;

vi. Weiss Instruments Inc.;

vii. Winters Instruments – US;

viii. Or equal.

2. Thermowells:

a. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.

b. Heat-Transfer Medium: Mixture of graphite and glycerin.

3. Pressure Gauges:

a. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges

b. Liquid filled gauges are required.

c. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be used include, but are not limited to:

i. AMETEK Inc; U.S. Gauge;

ii. Ashcroft Inc.;

iii. Ernst Flow Industries;

iv. Flo Fab Inc.;

v. Marsh Bellofram;

vi. Noshok;

vii. Palmer Wahl Instrumentation Group;

viii. REOTEMP Instrument Corporation;

ix. Tel-Tru Manufacturing Company;

x. Trerice H.O. Co.;

xi. Watts Regulator Co.; A Division of Watts Water Technologies Inc.;

xii. Weiss Instruments Inc.;

xiii. WIKA Instrument Corporation – USA;

xiv. Winters Instruments – U.S.;

xv. Or equal.

4. Gauge Attachments:

a. Snubbers: brass; with pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

b. Siphons: Loop-shaped section of stainless-steel pipe

c. Valves: Brass or stainless-steel needle, with pipe threads.

5. Test Plugs:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be used include, but are not limited to:

i. Flow Design Inc.;

ii. Miljoco Corporation;

iii. National Meter Inc.;

iv. Peterson Equipment Co. Inc.;

v. Sisco Manufacturing Company Inc.;

vi. Trerice H.O. Co.;

vii. Watts Regulator Co.; a Division of Watts Water Technologies Inc.;

viii. Weiss Instruments Inc.;

ix. Or equal.

b. Description: Test-station fitting made for insertion into piping tee fitting.

6. Test-Plug Kits:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be used include, but are not limited to:

i. Flow Design Inc.;

ii. Miljoco Corporation

iii. National Meter Inc.;

iv. Peterson Equipment Co. Inc.;

v. Sisco Manufacturing Company Inc.;

vi. Trerice H.O. Co.;

vii. Watts Regulator Co.; a Division of Watts Water Technologies Inc.;

viii. Weiss Instruments Inc.;

ix. Or equal.

b. Furnish one test-plug kit containing two thermometers, one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

7. Venturi Flowmeters:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be used include, but are not limited to:

i. Armstrong Pumps Inc.;

ii. Badger Meter Inc.; Industrial Division;

iii. Bailey-Fischer and Porter Co.;

iv. Flow Design Inc.;

v. Gerand Engineering Co.;

vi. Hyspan Precision Products Inc.;

vii. Leeds and Northrup;

viii. McCrometer Inc.;

ix. Preso Meters Corporation;

x. Vitaulic Co. of America;

xi. Or equal.

b. Description: Differential-pressure design for installation in piping: with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter and system fluid.

8. Pitot-Tube Flowmeters:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be used include, but are not limited to:

i. Dieterich Standard Inc.;

ii. Meriam Instruments Division Scott Fetzer Co.;

iii. Preso Meters Corporation;

iv. Taco Inc.;

v. Veris Industries;

vi. Or equal.

b. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute.

23 05 23—GENERAL DUTY VALVES

SUMMARY

1. Section includes:

a. Brass ball valves;

b. Bronze ball valves;

c. Iron ball valves;

d. Iron, single-flange butterfly valves;

e. Iron, grooved-end butterfly valves;

f. Bronze lift check valves;

g. Bronze swing check valves;

h. Iron swing check valves;

i. Iron, center-guided check valves; and

j. Chainwheels.

MANUFACTURERS

1. Brass Ball Valve:
   a. Crane Co.;
   b. DynaQuip Controls;
   c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.;
   d. Hammond Valve;
   e. Jamesbury; a subsidiary of Metso Automation;
   f. Jomar International, LTD;
   g. Kitz Corporation;
   h. Legend Valve;
   i. Marwin Valve; a division of Richards Industries;
   j. Milwaukee Valve Company;
   k. NIBCO Inc.;
   l. Red-White Valve Corporation;
   m. RuB Inc.;
   n. Or equal.
2. Bronze Ball Valve:
   a. American Valve, Inc.;
   b. Conbraco Industries, Inc.;
   c. Crane Co.;
   d. Hammond Valve;
   e. Lance Valves; a division of Advanced Thermal Systems, Inc.;
   f. Legend Valve;
   g. Milwaukee Valve Company;
   h. NIBCO INC;
   i. Red-White Valve Corporation;
   j. Watts Regulator Co.;
   k. Or equal.
3. Iron Ball Valves:
   a. American Valve, Inc.;
   b. Conbraco Industries, Inc.; Apollo Valves;
   c. Kitz Corporation;
   d. Sure Flow Equipment Inc.;
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.;
   f. Or equal.

4. Iron, single-flange butterfly Valves:
    a. BZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. Bray Controls; a division of Bray International.
    c. Conbraco Industries, Inc.; Apollo Valves.
    d. Cooper Cameron Valves; a division of Cooper Cameron Corp.
    e. Crane Co.; Crane Valve Group; Jenkins Valves.
    f. Crane Co.; Crane Valve Group; Stockham Division.
    g. DeZurik Water Controls.
    h. Hammond Valve.
    i. Kitz Corporation.
    j. Milwaukee Valve Company.
    k. NIBCO INC.
    l. Norriseal; a Dover Corporation company.
    m. Red-White Valve Corporation.
    n. Spence Strainers International.
    o. Tyco Valves & Controls.
    p. Watts Regulator Co.
    q. Or equal.
5. Iron, grooved-end butterfly Valves:
    a. Kennedy Valve; a division of McWane, Inc.
    b. Shurjoint Piping Products.
    c. Tyco Fire Products LP; Grinnell Mechanical Products.
    d. Victaulic Company.
    e. Or equal.
6. Bronze Lift Check Valves:
    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Or equal.
7. Bronze Swing Check Valves:
    a. American Valve, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Division.

e. Hammond Valve.

f. Kitz Corporation.

g. Milwaukee Valve Company.

h. NIBCO INC.

i. Powell Valves.

j. Red-White Valve Corporation.

k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

l. Zy-Tech Global Industries, Inc.

m. Or equal.

8. Iron Swing Check Valves:

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Jenkins Valves.

c. Crane Co.; Crane Valve Group; Stockham Division.

d. Hammond Valve.

e. Kitz Corporation.

f. Legend Valve.

g. Milwaukee Valve Company.

h. NIBCO INC.

i. Powell Valves.

j. Red-White Valve Corporation.

k. Sure Flow Equipment Inc.

l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

m. Zy-Tech Global Industries, Inc.

n. Or equal.

9. Iron, Center-Guided Check Valves:

a. Anvil International, Inc.

b. APCO Willamette Valve and Primer Corporation.

c. Crispin Valve.

d. DFT Inc.

e. Flo Fab Inc.

f. GA Industries, Inc.

g. Hammond Valve.

h. Metraflex, Inc.

i. Milwaukee Valve Company.

j. Mueller Steam Specialty; a division of SPX Corporation.

k. NIBCO INC.

l. Spence Strainers International; a division of CIRCOR International.

m. Sure Flow Equipment Inc.

n. Val-Matic Valve & Manufacturing Corp.

o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

p. Or equal.

10. Chainwheels:

a. Babbitt Steam Specialty Co.

b. Roto Hammer Industries.

c. Trumbull Industries.

d. Or equal.

PRODUCTS

1. Brass Ball Valve:

a. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim.

b. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim.

c. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim.

d. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim.

2. Bronze Ball Valve:

a. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

b. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

c. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

d. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

3. Iron Ball Valves:

a. Class 125, Iron Ball Valves.

4. Iron, Single-Flange Butterfly Valves

a. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc.

b. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc.

c. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc.

d. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc.

e. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc.

f. 150 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc.

g. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc.

h. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc.

i. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc.

j. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc

k. 200 CWP, Iron,. Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc.

l. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc.

5. Iron, rooved-end Butterfly Valves:

a. 175 CWP, Iron, Grooved-End Butterfly Valves.

b. 300 CWP, Iron, Grooved-End Butterfly Valves.

6. Bronze Lift Check Valves:

a. Class 125, Lift Check Valves with Bronze Disc.

b. Class 125, Lift Check Valves with Nonmetallic Disc.

7. Bronze Swing Check Valves:

a. Class 125, Bronze Swing Check Valves with Bronze Disc.

b. Class 125, Bronze Swing Check Valves with Nonmetallic Disc.

c. Class 150, Bronze Swing Check Valves with Bronze Disc.

d. Class 150, Bronze Swing Check Valves with Nonmetallic Disc.

8. Iron Swing Check Valves:

a. Class 125, Iron Swing Check Valves with Metal Seats:

b. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

9. Iron, Center-Guided Check Valves:

a. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat.

b. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat.

c. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat.

d. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat.

e. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat.

f. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat.

g. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat.

h. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat.

10. Chainwheels:

a. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

EXECUTION

1. Valve Installation:

a. Valves installed with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

b. Valves located for easy access and provide separate support where necessary.

c. Valves installed in horizontal piping with stem at or above center of pipe.

d. Valves installed in position to allow full stem movement.

e. Chainwheels installed on operators for ball and butterfly valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.

f. Check valves installed for proper direction of flow and as follows:

i. Swing Check Valves: In horizontal position with hinge pin level.

ii. Center-Guided Check Valves: In horizontal or vertical position, between flanges.

iii. Lift Check Valves: With stem upright and plumb.

23 05 29—HANGERS AND SUPPORT

SUMMARY

1. Section includes:

a. Metal pipe hangers and supports.

b. Trapeze pipe hangers.

c. Metal framing systems.

d. Thermal-hanger shield inserts.

e. Fastener systems.

f. Pipe stands.

g. Equipment supports.

h. Wire rope support systems.

MANUFACTURERS

1. Metal pipe hangers and supports:
   a. Cooper B-Line, Inc.;
   b. Anvil International;
   c. Or equal.
2. Trapeze pipe hangers:
   a. Cooper B-Line, Inc.;
   b. Anvil International;
   c. Or equal.
3. Metal framing systems:
   a. Erico International.;
   b. Cooper B-Line, Inc.;
   c. Clement Support Services.;
   d. Tolco Corp.;
   e. Thomas & Betts Corporation;
   f. Unistrut Corporation;
   g. Tyco International, Ltd.;
   h. Wesanco, Inc.;
   i. Or equal.
4. Thermal-hanger Shield Inserts:
   a. Carpenter & Paterson, Inc.;
   b. Clement Support Services;
   c. ERICO International Corporation;
   d. National Pipe Hanger Corporation;
   e. PHS Industries, Inc.;
   f. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.;
   g. Piping Technology & Products, Inc.;
   h. Rilco Manufacturing Co., Inc.;
   i. Value Engineered Products, Inc.;
   j. Or equal.
5. Fastener Systems:
   a. Hilti;
   b. Powers Fasteners;
   c. Red Head;
   d. Or equal.
6. Pipe stands:
   a. Pate Company;
   b. Roof Products and Systems (RPS);
   c. Tybar Corporation;
   d. Or equal.

7. Equipment Supports:
    a. Pate Company;
    b. Roof Products and Systems (RPS);
    c. Tybar Corporation;
    d. Or equal.
8. Wire rope support systems:
    a. Manufacturer shall be ISO 9002 / BSEN 9001 / ISO 14001.
    b. Or equal.

PRODUCTS

1. Metal pipe hangers and supports:
    a. Carbon-Steel Pipe Hangers and Supports.
    b. Copper Pipe Hangers
2. Trapeze pipe hangers:
    a. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.
3. Metal framing systems:
    a. MFMA Manufacturer Metal Framing Systems.
4. Thermal-hanger shield inserts:
    a. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
    b. Insulation-Insert Material for Hot Piping: ASTM C 533, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
5. Fastener systems:
    a. Powder-Actuated Fasteners
    b. Mechanical-Expansion Anchors
6. Pipe stands:
    a. Compact Pipe Stand
    b. Low-Type, Single-Pipe Stand
    c. High-Type, Single-Pipe Stand
    d. High-Type, Multiple-Pipe Stand
    e. Curb-Mounted-Type Pipe Stands
7. Equipment Supports:
    a. Description: field-fabricated equipment support made from structural carbon-steel shapes.

8. Wire Support Systems:

    a. Cable hangers may be used to suspend all static mechanical, electrical and HVAC services. Cable hangers consist of a pre-formed wire rope a factory fitted end fixing. This is secured and tensioned with a self-locking hanger grip at the other end.

EXECUTION

1. Metal pipe hangers and supports:

    a. Hangers, supports, clamps, and attachments shall be installed as required to properly support piping from the building structure.

2. Trapeze Pipe Hangers:

    a. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

3. Metal framing systems:

    a. Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

4. Thermal-Hander Shield Inserts:

    a. Shield inserts shall be installed in pipe hanger or shield for insulated piping.

5. Fastener Systems:

    a. Mechanical-expansion anchors shall be installed in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

    b. Powder-actuated fasteners shall be installed for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Fasteners shall be installed according to powder-actuated tool manufacturer's operating manual.

6. Pipe Stands:

    a. Pipe stands shall be installed on a smooth roof surface and shall not penetrate roof membrane.

7. Equipment Supports:

    a. Supports shall be fabricated from welded-structural-steel shapes.

8. Wire rope support systems:

    a. The hangers shall be fixed to any building structure.

    b. Cable hangers shall be installed in accordance with all the manufacturer's recommendations.

23 05 48—VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

SUMMARY

1. Section includes the following:
    a. Isolation pads.
    b. Isolation mounts.
    c. Restrained elastomeric isolation mounts.
    d. Freestanding and restrained spring isolators.
    e. Housed spring mounts.
    f. Elastomeric hangers.
    g. Spring hangers.
    h. Spring hangers with vertical-limit stops.
    i. Pipe riser resilient supports.
    j. Resilient pipe guides.
    k. Seismic snubbers.
    l. Restraining braces and cables.
    m. Steel and inertia, vibration isolation equipment bases.
2. Performance Requirements:
    a. Wind-Restraint Loading:
        i. Basic Wind Speed: 85 mph
        ii. Building Classification Category: Occupancy Category 1.25.
        iii. Minimum 10 lb./sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
    b. Seismic-Restraint Loading:
        i. Site Class as Defined in the CMC 07.
        ii. Assigned Seismic Use Group or Building Category as Defined in the IBC: Occupancy Category 1.25:
            a) Component Importance Factor: 1.0 or 1.5 if it is a system that has to operate after an earthquake event or if it contains hazardous materials.
            b) Component Response Modification Factor: per CMC.07.
            c) Component Amplification Factor: Refer to CMC 07, Table 13.6-1.

PRODUCTS

1. Vibration Isolators:

    a. Basis-of-Design Manufacturer: subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

        i. Ace Mountings Co., Inc.;

        ii. Amber/Booth Company, Inc.;

        iii. California Dynamics Corporation;

        iv. 4solation Technology, Inc.;

        v. Kinetics Noise Control;

        vi. M.W. Sausse;

        vii. Mason Industries;

        viii. Vibration Eliminator Co., Inc.;

        ix. Vibration Isolation;

        x. Vibration Mountings & Controls, Inc.;

        xi. Or equal.

    b. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

    c. Resilient Material: Oil- and water-resistant neoprene.

    d. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

    e. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

    f. Neoprene: Shock-absorbing materials compounded according to the standard for bridge- bearing neoprene.

2. Restrained Mounts:

    a. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment

hardware from contacting the housing during normal operation.

b. Neoprene: Shock-absorbing materials compounded according to the standard for bridge- bearing neoprene.

3. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

4. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

5. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

6. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

7. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

8. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

9. Vibration Isolation Equipment Bases (where applicable):

a. The Authority's BOD Manufacturers (Subject to compliance with requirements, provide the product indicated on Drawings) are one of the following:

i. Amber/Booth Company, Inc.;

ii. California Dynamics Corporation;

iii. Isolation Technology, Inc.;

iv. Kinetics Noise Control;

v. Mason Industries;

vi. Vibration Eliminator Co., Inc.;

vii. Vibration Isolation;

viii. Vibration Mountings & Controls, Inc.;

ix. Or equal.

10. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

a. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

i. Include supports for suction and discharge elbows for pumps.

b. Structural Steel: Steel shapes, plates, and bars complying with

ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

c. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

11. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

    a. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

        i. Include supports for suction and discharge elbows for pumps.

    b. Structural Steel: Steel shapes, plates, and bars. Bases shall have shape to accommodate supported equipment.

    c. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

    d. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

12. Seismic-Restraint Devices:

    a. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

        i. Amber/Booth Company, Inc.;

        ii. California Dynamics Corporation;

        iii. Cooper B-Line, Inc.; a division of Cooper Industries;

        iv. Hilti, Inc.;

        v. Kinetics Noise Control;

        vi. Loos & Co.; Cableware Division;

        vii. Mason Industries;

        viii. TOLCO Incorporated; a brand of NIBCO Inc.;

        ix. Unistrut;

        x. Tyco International, Ltd.;

        xi. Or equal.

13. Snubbers: Factory fabricated using welded structural-steel shapes and

plates, anchor bolts, and replaceable resilient isolation washers and bushings.

a. Anchor bolts for attaching to concrete shall be seismic-rated, drill -in, and stud-wedge or female-wedge type.

b. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

c. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

14. Channel Support System: shop- or field -fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

15. Restraint Cables: stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

16. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

17. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

18. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

19. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

20. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor. Minimum length of eight times diameter.

21. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor.

22. Factory Finishes:

    a. Finish: Manufacturer's standard prime-coat finish ready for field painting.

    b. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

        i. Powder coating on springs and housings.

        ii. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

        iii. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

23 05 53—IDENTIFICATION FOR HVAC PIPING

SUMMARY

1. Section includes:

    a. Equipment labels

    b. Warning signs and labels

    c. Pipe labels

    d. Duct labels

    e. Stencils

    f. Valve tags

    g. Warning tags

2. Coordination:

    a. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

    b. Coordinate installation of identifying devices with locations of access panels and doors.

    c. Install identifying devices before installing acoustical ceilings and similar concealment.

PRODUCTS

1. Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

2. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

3. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

4. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

5. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

6. Lettering Size: Minimum 1-1/2 inches high or proportionally larger based on pipe diameter.

    a. Valve tags if required.

    b. Warning signs and labels if required.

HYDRONIC PIPE COLORS:

1. Chilled water supply and return: blue

2. Heating hot water supply and return: red

3. Condenser water supply and return: green

Refer to the charts on the following page for further labeling information.

Labels:

Labels shall occur every six (6) meters (20 feet) or at that point at which the lines reappear after their routing was obscured. All lines shall be dimensioned as follows:

LABELS SHALL BE AS FOLLOWS:	COLORS SHALL BE AS FOLLOWS:	ABBREVIATION SHALL BE AS FOLLOWS:
HEATING HOT WATER RETURN	YELLOW BACKGROUND BLACK LETTERS	HHWR
HEATING HOT WATER SUPPLY	YELLOW BACKGROUND BLACK LETTERS	HHWS
CHILLED WATER RETURN	GREEN BACKGROUND WHITE LETTERS	CHWR
CHILLED WATER SUPPLY	GREEN BACKGROUND WHITE LETTERS	CHWS
CONDENSER WATER RETURN	BLUE BACKGROUND WHITE LETTERS	CWR
CONDENSER WATER SUPPLY	BLUE BACKGROUND WHITE LETTERS	CWS

OUTSIDE DIAMETER OF PIPE COVERING	ARROW LENGTH X WIDTH MM (INCHES)	SIZE OF LEGEND LETTERS AND NUMERALS MM (INCHES)	WIDTH OF COLOR BAND MM (INCHES)
Less than 40 (1-1/2)	40 x 10 (1-1/2 x 3/8)	10 (3/8)	200 (8)
40 to <90 (1-1/2 to < 3-1/2)	100 x 25 (4 x 1)	20 (3/4)	200 (8)
90 to <150 (3-1/2 to <6)	200 x 50 (8 x 2)	30 (1-1/8)	300 (12)
150 to <250 (6 to <10)	300 x 75 (12 x 3)	50 (2)	300 (14)
230 to 300 (10 to 12)	400 x 100 (16 x 4)	70 (2-3/4)	400 (16)
Greater than 300 (>12)	500 x 125 (20 x 5)	90 (3-1/2)	500 (20)

23 05 93—TESTING, ADJUSTING, AND BALANCING FOR HVAC

SUMMARY

1. Section Includes:
    a. Balancing Air Systems:
        i. Constant-volume air systems.
        ii. Variable-air-volume systems.
    b. Balancing Hydronic Piping Systems:
        i. Variable-flow hydronic systems.
        ii. Constant-flow hydronic systems.

MANUFACTURERS

1. Not Applicable.

PRODUCTS

1. Not Applicable.

EXECUTION

1. General Procedures for Balancing Air Systems:
    a. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
    b. Prepare schematic diagrams of systems' "as-built" duct layouts.
    c. For variable-air-volume systems, develop a plan to simulate diversity.
    d. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
    e. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
    f. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
    g. Verify that motor starters are equipped with properly sized thermal protection.
    h. Check dampers for proper position to achieve desired airflow path.
    i. Check for airflow blockages.
    j. Check condensate drains for proper connections and functioning.
    k. Check for proper sealing of air-handling-unit components.
    l. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

2. General Procedures for Hydronic Systems:

    a. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

    b. Prepare schematic diagrams of systems' "as-built" piping layouts.

    c. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

        i. Open all manual valves for maximum flow.

        ii. Check flow-control valves for specified sequence of operation, and set at indicated flow.

        iii. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.

    d. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

    e. Check air vents for a forceful liquid flow exiting from vents when manually operated.

23 07 00—INSULATION

SUMMARY

1. Section Includes:

    a. Insulation Materials:

        i. Flexible elastomeric.

        ii. Mineral fiber.

    b. Adhesives.

    c. Mastics.

    d. Lagging adhesives.

    e. Sealants.

    f. Factory-applied jackets.

    g. Field-applied jackets.

    h. Tapes.

    i. Securements.

MANUFACTURERS / PRODUCTS

1. Flexible Elastomeric:

    a. Aeroflex USA Inc.; Aerocel.

b. Armacell LLC; AP Armaflex.

c. Or equal.

2. Mineral Fiber:

a. Johns Manville; Microlite.

b. Knauf Insulation; Duct Wrap.

c. Or equal.

3. Phenolic, Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

a. Products: Subject to compliance with requirements, provide one of the following:

i. Childers Products, Division of ITW; CP-96.

ii. Or equal.

b. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and SCAQMD Rule #1168.

4. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

a. Products: Subject to compliance with requirements, [provide one of the following:

i. Aeroflex USA Inc.; Aeroseal.

ii. Armacell LCC; 520 Adhesive.

iii. Foster Products Corporation, H. B. Fuller Company; 85-75.

iv. RBX Corporation; Rubatex Contact Adhesive.

v. Or equal.

b. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and SCAQMD Rule # 1168.

5. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

a. Products: Subject to compliance with requirements, provide one of the following:

i. Childers Products, Division of ITW; CP-82.

ii. Foster Products Corporation, H. B. Fuller Company; 85-20.

b. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and SCAQMD Rule # 1168.

6. ASJ Adhesive, and FSK and Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

    a. Products: Subject to compliance with requirements, provide one of the following:

        i. Childers Products, Division of ITW; CP-82.

        ii. Foster Products Corporation, H. B. Fuller Company; 85-20.

        iii. Or equal.

    b. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and SCAQMD Rule # 1168.

7. PVC Jacket Adhesive: Compatible with PVC jacket.

    a. Products: Subject to compliance with requirements, provide one of the following:

        i. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

        ii. Speedline Corporation; Speedline Vinyl Adhesive.

        iii. Or equal.

    b. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), and SCAQMD Rule # 1168.

8. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

    a. Products: Subject to compliance with requirements, provide one of the following:

        i. Childers Products, Division of ITW; CP-35.

        ii. Foster Products Corporation, H. B. Fuller Company; 30-90.

        iii. Or equal.

9. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

    a. Products: Subject to compliance with requirements, provide one of the following:

        i. Childers Products, Division of ITW; CP-30.

        ii. Foster Products Corporation, H. B. Fuller Company; 30-35.

        iii. Or equal.

10. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
    a. Products: Subject to compliance with requirements, provide one of the following:
        i. Childers Products, Division of ITW; Encacel.
        ii. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
        iii. Marathon Industries, Inc.; 570.
        iv. Mon-Eco Industries, Inc.; 55-70.
        v. Or equal.
11. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
    a. Products: Subject to compliance with requirements, provide one of the following:
        i. Childers Products, Division of ITW; CP-10.
        ii. Foster Products Corporation, H. B. Fuller Company; 35-00.
        iii. Or equal.
12. Sealants:
    a. Childers Products, Division of ITW; CP-76.
    b. Foster Products Corporation, H. B. Fuller Company; 30-45.
    c. Or equal.
13. Field-Applied Jackets:
    a. PVC Jacket
        i. Johns Manville; Zeston.
        ii. Proto PVC Corporation; LoSmoke.
        iii. Or equal.
    b. Metal Jacket:
        i. Childers Products, Division of ITW; Metal Jacketing Systems.
        ii. RPR Products, Inc.; Insul-Mate.
        iii. Or equal.
14. Tapes:
    a. Avery Dennison Corporation, Specialty
    b. Tapes Division; Fasson 0827.
    c. Venture Tape; 1525 CW, 1528 C and 1528 CW/SQ.
    d. Fasson,

e. Or equal.

15. Securements:

a. Bands:

i. RPR Products, Inc.; Bands.;

ii. Or equal.

b. Insulation Pins and Hangers:

i. AGM Industries, Inc.; CWP-1;.

ii. GEMCO; CD.;

iii. Midwest Fasteners, Inc.; CD.;

iv. Or equal.

PRODUCTS

1. Flexible Elastomeric:

a. Closed-cell, sponge- or expanded-rubber materials.

2. Mineral Fiber:

a. Mineral or glass fibers bonded with a thermosetting resin.

b. High Temperature: mineral or glass fibers bonded with a thermosetting resin

3. Adhesive:

a. Phenolic Adhesive

b. Flexible Elastomeric Adhesive

c. Mineral-Fiber Adhesive

d. ASJ Adhesive and FSK Adhesive

e. PVC Jacket Adhesive

4. Mastic:

a. Vapor-Barrier Mastic: Water Based and Solvent based suitable for indoor and outdoor use

b. Breather Mastic

5. Sealants:

a. Joint Sealants

EXECUTION

1. General Installation Requirements:

a. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

b. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

c. Install accessories compatible with insulation materials and suitable for the service. Install accessories that

do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

d. Install insulation with longitudinal seams at top and bottom of horizontal runs.

e. Install multiple layers of insulation with longitudinal and end seams staggered.

f. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

g. Keep insulation materials dry during application and finishing.

h. Install insulation with tight longitudinal seams and end joints.

i. Install insulation with least number of joints practical.

j. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    i. Install insulation continuously through hangers and around anchor attachments.

    ii. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

    iii. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with sealing compound recommended by insulation material manufacturer.

    iv. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

k. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

l. Install insulation with factory-applied jackets as follows:

    i. Draw jacket tight and smooth.

    ii. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with vapor barrier mastic. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly

joined to indoor insulation ends. Seal joint with vapor barrier mastic.

iii. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

iv. Seal jacket to roof flashing with weatherproof mastic.

m. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

n. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

i. Seal penetrations with flashing sealant.

ii. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

iii. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

iv. Seal jacket to wall flashing with flashing sealant.

o. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

p. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

q. Insulation Installation at Floor Penetrations:

i. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation.

Overlap damper sleeve and duct insulation at least 2 inches (50 mm).

ii. Pipe: Install insulation continuously through floor penetrations.

iii. Seal penetrations through fire-rated assemblies.

23 07 19—HVAC PIPING INSULATION

High Density Insulation for any piping on the roof protected by aluminum sheeting and easy access to each side of pipe racks, for example: elevated piping or cross-over stairs.

23 08 00—COMMISSIONING OF HYDRONIC PIPING SYSTEM

SUMMARY

1. Section includes commissioning process requirements for hydronic piping systems and associated assemblies. The hydronic piping systems shall include chilled water and heating hot water system (PREINSUALTED underground and/or above ground).

MANUFACTURER

1. Not Applicable

PRODUCTS

1. Not Applicable

EXECUTION

1. General Testing Requirements:

   a. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

   b. Scope of testing shall include entire hydronic piping installation, as indicated on Drawings. Testing shall include measuring capacities and effectiveness of operation and control.

   c. The CxA along with the hydronic piping Subcontractor and testing Subcontractor shall prepare detailed testing plans, procedures, and checklists for hydronic piping systems and subsystems.

   d. Tests will be performed using design conditions whenever possible.

   e. If tests cannot be completed because of a deficiency outside the scope of the hydronic piping system, document the deficiency and report it to the Kiewit/Sundt QMP Administrator and the Airport. After deficiencies are resolved, reschedule tests.

f. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

2. Hydronic Piping Systems, and Subsystems Testing Procedures:

a. Pipe system cleaning, flushing, hydrostatic tests requirements and chemical treatment are specified in Division 23 piping Sections. Hydronic piping Subcontractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

i. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

ii. Description of equipment for flushing operations.

iii. Minimum flushing water velocity.

iv. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

b. Hydronic Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of hydronic distribution systems.

23 09 00—HVAC INSTRUMENTATION AND CONTROL

SUMMARY

1. General Requirements:

a. Section includes Building Automation System (BAS).

b. BAS system shall be designed and installed, commissioned and serviced by manufacturer employed personnel.

c. Graphics content, points, and functionality will match or exceed the Airport's current system. The design will require approval from the Authority.

d. Points required for robust energy management and troubleshooting will be available and trended. Equipment kW will be included if possible.

e. Detailed sequences of operations will be approved by the Authority and will be accessible from the BAS front end.

f. The chilled water plant sequence of operations will be updated to account for system changes and fully commissioned.

MANUFACTURERS

1. The Authority's Sole Source Manufacturer (required in order to match other products in use at the Airport) for BAS is Siemens Building Technologies.

EXECUTION

1. Warning Labels and Identification Tags:

    a. Permanent warning labels shall be affixed to all equipment that can be automatically started by the DDC system.

        i. Labels shall use white lettering (12-point type or larger) on a red background.

        ii. Warning labels shall read as follows: "C A U T I O N This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing".

    b. Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.

        i. Labels shall use white lettering (12-point type or larger) on a red background.

        ii. Warning labels shall read as follows: "C A U T I O N This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing".

23 09 93—SEQUENCE OF OPERATION

SUMMARY

1. This Section includes control sequences for HVAC systems, subsystems, and equipment.

2. Heating Control Sequences

    a. Control Tertiary Heating Water Pumps:

i. Input Device: DDC system.

ii. Output Device: DDC system command to starter relay.

iii. Action: Energize pump(s) at outdoor-air temperatures below 65 deg F, or as commanded by the DDC system.

iv. Display

a) Outdoor-air Temperature

b) Operating status of tertiary pumps

c) Hot water flow direction

23 20 00—PRECONDITION AIR UNITS

SUMMARY

1. This Section specifies point-of-use Preconditioned Air (PCA) Units and accessories.

MANUFACTURERS

1. FCX Systems, INC., Morgantown, WV;
2. Hobart Airport Systems Group, Troy, OH;
3. Inet Airport Systems, Inc., Anaheim, CA;
4. JBT AeroTech Jetway Systems, Ogden, UT;
5. Or equal.

PRODUCTS

1. Class 1 PCA shall be minimum 30 nominal ton unit.
2. Class 2 PCA shall be minimum 60 nominal ton unit.
3. Class 3 PCA shall be minimum 90 nominal ton unit.
4. Compressors: Minimum two per unit for Class I PCA, minimum of three per unit for Class II PCA, and minimum four?? per unit for Class III shall be serviceable, semi-hermetic or hermetic sealed scroll compressors with integral vibration isolators or shock loops. Refrigerant type shall be HCFC-22.
5. Air Filters: Air filters shall be factory fabricated by a company regularly engaged and specialized in filter manufacturing. Filters shall be encased in a metal holding frame, and rated for the application for which they are being used. As a minimum, filter media shall be at least 1 inch thick and constructed of aluminum woven and crimped steel screening. The metal frame shall be a least 20 gauge galvanized steel. Face velocity shall be no greater than 500 feet per minute, with an initial resistance not greater than 0.10 inch water gauge, and a final resistance of 1.0 inch water gauge.
6. Coils: Coils shall be comprised of aluminum plate fin and seamless

copper tube. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing. Coils shall be easily removable from the unit for maintenance. Coils shall be constructed and certified in accordance with ASHRAE 15 and ARI 10. Coils shall be proof tested to 450 PSIG and leak tested to 250 PSIG with air pressure under water, cleaned, dehydrated, and sealed with a holding charge of nitrogen until serviced with refrigerant. Contractor shall submit documentation confirming compliance with this requirement. Each compressor/coil section shall have as expansion valve and distributor.

7. Controls: Computerized controls shall be utilized. For standardization purposes, the controllers shall be "Automated Logic" or Beckhoff BC 9000 PLC. The controller shall The controller shall monitor and report functions and stages of the unit monitor and report unit safety faults.

8. Remote Control Station: The control station operating on 24 volts or less shall be located on the bridge left column (aircraft side of the bridge), accessible from ground level. The station shall include, at minimum, a "START/STOP" push-button, an "ON" light, and a "SUMMARY FAULT" light, and push buttons for starting PCA unit in RJ, Narrow body and wide body modes. Provide in combination with 400 Hz and cable hoist control station.

9. Cabin Temperature Sensor: The PCA shall have a cabin temperature probe, which originates from the right side of the cab looking out towards the ramp.

10. Hose Basket: The PCA unit shall be equipped with an independent hose storage basket that is mounted directly to the PBB lifting column cross beam.

11. Condensate Disposal: Condensate water shall be directed into drains (provided and located by owner) adjacent to building or in building wall. A condensation pumping system utilizing lift pumps shall be included in the PCA unit.

12. Corrosion Protection: The PCA unit shall be resistant to or protected from, corrosion caused by rain, deicing fluid and chemicals, and contaminated moisture blown or splashed from the ground. Fasteners shall be of stainless steel material or plated to prevent corrosion. Controls exposed to the weather shall be weatherproof.

EXECUTION

1. PCA units and associated components shall be installed on new or existing passenger boarding bridges.

2. The instructions and recommendations of the PCA unit equipment manufacturer shall be followed.

3. All installations shall comply with all applicable codes and standards.

23 21 13—HYDRONIC PIPING

SUMMARY

1. This Section includes the following:

    a. Hot-Water Heating and Chilled Water Piping Material.

    b. Condensate-drain Piping Material.

    c. Air-Vent Piping.

    d. Safety-valve-inlet and -outlet piping.

MANUFACTURERS

1. Copper Pipe and Fittings:

    a. Anvil International, Inc.;

    b. S.P. Fittings; a division of Star Pipe Products;

    c. Victaulic Company of America;

    d. Or equal.

2. Transition Fittings:

    a. Charlotte Pipe and Foundry Company;

    b. IPEX Inc.;

    c. KBi;

    d. Aquatherm;

    e. Or equal.

3. Dielectric Fittings:

    a. Capitol Manufacturing Company;

    b. Central Plastics Company;

    c. Hart Industries International, Inc.;

    d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.;

    e. Zurn Plumbing Products Group;

    f. AquaSpec Commercial Products Division;

    g. Or equal.

4. Air Control Devices:

    a. Amtrol, Inc;

    b. Armstrong Pumps, Inc;

    c. Taco;

    d. Or equal.

PRODUCTS

1. Hot-water heating piping, aboveground, NPS 2-1/2(DN 50) and smaller, shall the following:

a. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

2. Hot-water heating piping, aboveground, NPS 3 (DN 65) and larger, shall be the following:

   a. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

3. Chilled-water piping, aboveground, NPS 2-1/2 (DN 50) and smaller, shall be the following:

   a. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

4. Chilled-water piping, aboveground, NPS 3 and larger, shall be the following:

   a. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

5. Condensate-Drain Piping: Type L (B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

6. Air-Vent Piping:

   a. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

   b. Outlet: Type L, annealed-temper copper tubing with soldered or flared joints.

7. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

EXECUTION

1. Piping shall be installed above accessible ceiling to allow sufficient space for ceiling panel remove.

2. Piping shall be installed to permit valve servicing.

3. Piping shall be installed free of sags and bends.

4. Valves shall be installed according to General-Duty Valves for HVAC Piping.

5. Unions in piping shall be installed for pipe sizes 2-1/2 inches and smaller.

6. Flanges in piping shall be installed for pipe sizes 3 inches and larger.

7. Install hangers for drawn-temper copper tubing with the following

maximum spacing and minimum rod sizes:

a. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 3/8 inch (10 mm).

b. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8 inch (10 mm).

c. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).

d. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

e. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

f. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 1/2 inch (12 mm).

g. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (12 mm).

8. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

23 21 23—HYDRONIC PUMPS

SUMMARY

1. Section includes base mounted and inline; close coupled and separated coupled hydronic pumps; single speed or Variable Frequency Drive (VFD) application type.

2. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

MANUFACTURERS

1. Aurora Pump;

2. Bell & Gossett;

3. PACO;

4. Peerless Pumps;

5. Or equal.

PRODUCTS

1. Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump designed for installation with pump and motor shafts mounted vertically.

2. Pump Casing: Cast Iron, Suction and discharge connections shall be flanged and same size; drilled and tapped for seal flush and gauge connections.

3. Impeller: Bronze, fully enclosed type; dynamically balanced; two-plane

balancing is required where installed impeller diameter is less than six times impeller width.

4. Shaft: Stainless steel.

5. Coupling: Rigid spacer type of high tensile aluminum alloy; designed to be easily removed on site to reveal space between pump and motor shafts sufficient to remove mechanical seal components for servicing and to be replaced without disturbing pump or motor.

6. Mechanical Seals: Stainless steel multi-spring outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat; Type 316 stainless steel gland plate. Provide factory installed flush line with manual vent.

7. Motor: Single speed or multi-speed compatible with variable frequency drive (VFD) where applicable; premium efficiency type, with permanently lubricated ball bearings; rigidly mounted to pump casing with lifting eye and supporting lugs in motor enclosure.

EXECUTION

1. Pump Installation:

    a. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

    b. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

    c. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

    d. Equipment Mounting:

        i. Install base-mounted pumps on cast-in-place concrete equipment bases.

        ii. Comply with requirements for vibration isolation and seismic control devices.

    e. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.

        i. Comply with requirements for seismic-restraint devices.

        ii. Comply with requirements for hangers and supports.

23 23 00 BRAZE FITTINGS

Braze all the fittings on high pressure refrigerant lines, Zoomlock compression fittings are allowed.

23 31 13 METAL DUCTS

SUMMARY

1. This Section includes the following:
    a. Single-wall rectangular ducts and fittings.
    b. Single-wall round ducts and fittings.
    c. Sheet metal materials.
    d. Sealants and gaskets.
    e. Hangers and supports
    f. Seismic-restraint devices.

MANUFACTURERS

1. Seismic-restraint devices:
    a. Cooper B-Line, Inc; a division of Cooper Industries.;
    b. Ductmate Industries, Inc.;
    c. Hilti Corp.;
    d. Kinetics Noise Control;
    e. Loos and Co.;
    f. Mason Industries;
    g. Tolco;
    h. Or equal.

PRODUCTS

1. Single-wall rectangular ducts and fittings shall comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible"
2. Single-wall round ducts and fittings shall comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible"
3. Sheet metal materials shall comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible"
4. Sealants and gaskets characteristics shall have a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Hangers and supports shall comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible", "Rectangular Duct Hangers", "Hanger Sizes for Round Duct".
6. Rated strengths, features, and applications for seismic-restraint devices shall be defined by the engineer.

EXECUTION

1. Ducts shall be installed according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible".

2. Ducts shall be sealed for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible".

3. Fire dampers shall be installed where ducts pass through fire-rated interior partitions and exterior walls.

4. Hanger and supports shall be installed according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Chapter 4, "Hangers and Supports".

5. Ducts shall be installed with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes.

6. Duct connections to equipment shall comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

23 33 00 AIR DUCT ACCESSORIES

SUMMARY

1. This Section includes the following:

    a. Manual Volume Dampers

    b. Control dampers

    c. Combination fire and smoke dampers

    d. Flange connectors

    e. Turning Vanes

    f. Duct-mounted access doors

    g. Flexible Connectors

    h. Flexible ducts

    i. Duct accessory hardware

    j. Duct Silencers

MANUFACTURERS

1. American Warming and Ventilating; a division of Mestek, Inc.;

2. Duro Dyne Inc.;

3. Flexmaster U.S.A., Inc.;

4. Greenheck Fan Corporation;

5. Nailor Industries Inc.;

6. Ruskin Company;

7. Ductmate Industries;
8. Or equal,

PRODUCTS

1. Manual Volume Dampers:
    a. Standard Leakage Rating
    b. Suitable for horizontal or vertical applications
    c. Blades shall be opposed-blade design and galvanized -steel, 0.064 inch thick
2. Control Dampers:
    a. Low leakage rating
    b. Blades shall be opposed-blade design and galvanized -steel, 0.064 inch thick
3. Combination fire and smoke dampers:
    a. Static and dynamic type
    b. Curtain type frame with blades outside airstream except when located behind grille where blades may be inside airstream
    c. Damper Motors: two-position action
    d. Class II leakage
    e. Integral, factory wired for single-point connection smoke detector
4. Flange Connectors:
    a. Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components, or formed on to duct
    b. Galvanized steel
    c. Shape to match ductwork
5. Turning Vanes:
    a. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible", Figures 2-3, "Vanes and Vane Runners", and 2-4, "Vane Support in Elbows"
6. Access Doors:
    a. Fabricated according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible", "Duct Access Doors and Panels," and, "Access Panel-Round Duct"
7. Flexible Connectors:
    a. Materials: Flame-retardant or noncombustible fabrics
    b. Glass fabric double coated with neoprene for indoor use
    c. Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone for outdoor use

8. Flexible Ducts:
    a. Insulated, multiple layers of aluminum laminate supported by helically wound, spring-steel wire
9. Duct Accessory Hardware:
    a. Includes instrument test holes and adhesives.
10. Duct Silencers:
    a. Rectangular Shape
    b. Outer Casing: galvanized sheet steel, 22 gauge minimum thick
    c. Inner Casing: Galvanized Sheet Metal, 26 gauge minimum thick

EXECUTION

1. Duct accessories shall be installed according to applicable details in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for metal ducts
2. Volume dampers shall be installed at points on supply, return, and exhaust systems where branches extend from larger ducts.
3. Fire and smoke dampers shall be installed according to UL listing.
4. Duct access doors shall be installed on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment.
5. Flexible connectors shall be installed to connect ducts to equipment.
6. Flexible ducts shall be connected to metal ducts with adhesive tape plus sheet metal screws.

23 34 23 POWER VENTILATORS

SUMMARY

1. This Section includes the following:
    a. Upblast roof exhaust fans
    b. In-line centrifugal fans

MANUFACTURERS

1. Acme Engineering & Mfg. Corp.;
2. Greenheck;
3. Penn Ventilation;
4. Cook;
5. Or equal.

PRODUCTS

1. Upblast Roof Exhaust Fans:
    a. Fan wheel: aluminum, backward inclined centrifugal; Statically and dynamically balanced in accordance to AMCA Standard 204-05

b. Motor: totally enclosed fan cooled, mounted on vibration isolators, accessible for maintenance

c. Shafts and Bearing: Fan shaft polished solid steel with an anti corrosive coating, bearing shall be selected for a minimum L10 life in excess of 100,000 hours

d. Housing: constructed of heavy gauge aluminum

e. Drive Assembly: Belts to be static free and oil resistant

f. Roof curb shall be included

g. Birdscreen option shall be included to protect fan discharge

2. In-line centrifugal fans:

a. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

b. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

c. Direct-Driven Units: Motor mounted in airstream, factory-wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

d. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

EXECUTION

1. All fan ventilators shall be installed level and plumb

2. Roof-mounted fans shall be secured to roof curbs with cadmium-plated hardware.

3. Fans suspended from structure shall be supported using threaded steel rods an spring hangers where required.

23 36 00—AIR TERMINAL UNITS

SUMMARY

1. Section includes single-duct air terminal units (VAV box) and fan-powered air terminal units.

2. Structural Performance: Hangers and supports and seismic restraints shall withstand effects of gravity and seismic loads and stresses

3. Submit available factory options for review and approval by the Authority with 30 percent review phase submittal.

MANUFACTURERS

1. Carrier;
2. Krueger;
3. Titus;
4. Or equal.

PRODUCTS

1. Series Fan-Powered Air Terminal Units:
    a. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside protective metal shroud for installation above ceilings.
2. Parallel Fan-Powered Air Terminal Units:
    a. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with control components inside a protective metal shroud.
3. Single-Duct Air Terminal Units:
    a. Configuration: Volume-damper assembly inside unit casing with control components outside unit in a protective metal shroud.

EXECUTION

1. Hanger and Support Installation:
    a. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
        i. Where practical, install concrete inserts before placing concrete.
        ii. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
        iii. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
        iv. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
        v. Do not use powder-actuated concrete fasteners for seismic restraints.
    b. Hangers Exposed to View: Threaded rod and angle or channel supports.

c. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2. Seismic-Restraint-Device Installation:

a. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes.

b. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

c. Install cables so they do not bend across edges of adjacent equipment or building structure.

d. Install cable restraints on air terminal units that are suspended with vibration isolators.

e. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service, the Office of Statewide Health Planning and Development for the State of California or an agency acceptable to the Authority.

f. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

3. Identification:

a. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows.

23 37 13 DIFFUSERS, REGISTERS, AND GRILLES

SUMMARY

1. This Section includes the following:

a. Rectangular and square ceiling diffusers

b. Linear slot diffusers

c. Fixed face registers and grilles

MANUFACTURERS

a. Carnes;

b. Price Industries;

c. Titus;

d. Krueger;

e. Hart & Cooley Inc.;

f. Or equal.

PRODUCTS

1. Rectangular and Square Ceiling Diffusers:
    a. Designed for variable-air-volume flows
    b. 24x24 inches
    c. Mounting: T-bar and Hard ceiling
    d. Baked Enamel finish or approved by architect
2. Linear Slot Diffusers:
    a. Designed for variable-air-volume flows
    b. Baked Enamel finish or approved by architect
    c. Slot dimensions shall be based on design
3. Fixed face registers and grilles:
    a. Mounting: Lay-in
    b. Baked Enamel finish or approved by architect

EXECUTION

1. Diffusers, registers, and grilles shall be installed level and plumb, and shall be installed with airtight connections to ducts and to allow service and maintenance.
2. Units installed in lay-in ceiling panels shall be in the center of the panel.

23 64 16—CENTRIFUGAL WATER CHILLERS

SUMMARY

1. Section includes packaged, water-cooled, electric-motor-driven centrifugal chillers and packaged, portable refrigerant recovery units.
2. Hermetic and open; direct and gear drives; water..
3. Provide variable frequency drives on all chillers.

MANUFACTURERS

1. Carrier;
2. Mcquay;
3. Trane;
4. Or equal.

PRODUCTS

1. Manufactured Unit Characteristics:
    a. Factory-assembled and -tested chiller complete with compressor, compressor motor, compressor motor controller, lubrication system evaporator, condenser, controls, interconnecting unit piping and wiring, and indicated accessories.

b. Disassemble chiller into major assemblies as required by installation after factory testing and before packaging for shipment.

c. Fabricate chiller mounting base with reinforcement strong enough to resist chiller movement during seismic event when chiller is anchored to field support structure.

d. Provide interface controller with microprocessor-based platform capable of full diagnostics.

EXECUTION

1. Chiller Installation

   a. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

   b. Coordinate sizes, locations, and anchoring attachments of structural -steel support structures.

   c. Install chillers on support structure.

   d. Equipment Mounting:

      i. Install chillers on cast-in-place concrete equipment bases.

      ii. Comply with requirements for vibration isolation and seismic-control devices.

   e. Maintain manufacturer's recommended clearances for service and maintenance.

   f. Maintain clearances required by governing code.

   g. Chiller manufacturer's factory-trained service personnel shall charge chiller with refrigerant and fill with oil if not factory installed.

   h. Install separate devices furnished by manufacturer and not factory installed.

      i. Chillers shipped in multiple major assemblies shall be field assembled by chiller manufacturer's factory-trained service personnel.

23 73 13—CUSTOM AIR HANDLING UNITS

SUMMARY

1. Section includes.

   a. Agency Listing

   b. Unit Nameplates and Labels

   c. Casing Performance

   d. Bases and Floors

   e. Walls

   f. Access Doors

g. Roofs

h. Shipping Splits

i. Unit Paint

j. Dampers

k. Outside and Return Airflow Measuring Stations

l. Air Filters

m. Cooling Coils

n. Chilled Water Coils

o. Primary Drain Pans

p. Intermediate Drain Pans

q. Fans

r. Un-housed Plenum Fans-Direct Drive

s. Fan Motors

t. Fan Airflow Measurement Systems

u. Trane Catalytic Cleaner System: This is a photo-catalytic oxidation system utilizing genesis as manufacturer of system. Trane is utilizing this system and calling it, "Trane Catalytic Cleaner System."

v. Protection of Polymeric Materials

w. Safety

x. Vibration Isolation

y. Unit Acoustics

z. Marine Lights

aa. Marine Light Switches

bb. 120volt Receptacle

cc. Variable Frequency Drives

2. Structural Calculations:

   a. Provide structural calculations for the following:

      i. Structural Supports

      ii. Structural Platforms

3. Calculations to include, at a minimum:

   a. Operational weight of new equipment.

      i. Equipment location relative to center of gravity.

      ii. Point of anchorage to the existing structure if applicable.

MANUFACTURERS

1. Energy Labs;

2. Pace;

3. Temtrol;

4. Trane;

5. Or equal.

PRODUCTS

1. IBC Seismic Certification:

    a. All AHU's shall be certified for seismic applications in accordance with the latest International Building Code (IBC) or California Building Code or San Diego Building Code, whichever is more stringent.

    b. Structural floors, housekeeping pads, supporting curbs and supporting steel must be seismically designed and approved by the Project or Building Structural Engineer of Record to withstand the seismic anchor loads.

2. Bases and Floors:

    a. Base shall be constructed from welded minimum 10-gauge galvanized steel channels around the perimeter and welded minimum 10-gage galvanized steel cross members. The height of each base channel shall be no less than the height indicated in the drawings. Each shipping section shall be provided with removable lifting lugs. Structural framework shall fully support the unit casing and all component during installation such that no section deflects more than L/1000 during rigging of that section, where L is defined as the distance between lifting lugs.

    b. Floor shall be constructed from 16 gage smooth 316 stainless steel. The floor surface shall be welded and all spaces and joints completely sealed with dams around all bottom penetrations. Floor deflection shall not exceed L/200 under a point load of 200 pounds, where L is defined as the floor span.

    c. Insulation that meets a minimum R-value of 1.25 shall be provided underneath the entire unit floor. Insulation shall be closed-cell foam to prevent wicking of moisture. If fiberglass insulation is provided, it shall be completely wrapped with long-strand fiberglass cloth to limit the entrainment of moisture into the insulation. The long-strand fiberglass cloth shall also incorporate an anti-microbial coating to suppress microbial growth. Insulation shall completely fill the panel cavity in all directions so that no voids exist.

    d. Safety grates that provide a walking surface shall be provided across all bottom air openings. Safety grates shall support a minimum 300-pound load.

3. Walls:

    a. Wall assemblies shall be double-wall construction with aluminum solid exterior and stainless steel interior. The entire unit shall have a solid wall liner on the interior. All spaces and joints of wall assemblies shall be completely sealed. Wall shall meet the casing deflection limits contained herein.

    b. A Class "B" thermal break shall be provided throughout the entire wall assembly.

    c. Insulation that meets a minimum R-value of 12.5 shall be provided throughout all unit wall assemblies. Insulation shall be injected foam. Foam shall be closed cell to prevent wicking of moisture. If fiberglass insulation is provided, it shall be completely wrapped with long- strand fiberglass cloth to limit the entrainment of moisture into the insulation. The long- strand fiberglass cloth shall also incorporate an anti-microbial coating to suppress microbial growth. Insulation shall completely fill the panel cavity in all directions so that no voids exist and settling of insulation is prevented.

    d. Removable wall access panels shall be provided in coil sections for service removal of components. A Class "B" thermal break shall be provided throughout all removal wall access panels.

4. Access Doors:

    a. Access doors shall be provided throughout units as indicated on the schedules and drawings. Access doors shall be double-wall construction. Interior and exterior door panels shall be of the same construction as the interior and exterior wall panels, respectively.

    b. A Class "A" thermal break shall be provided on all door assemblies downstream of the cooling coil.

    c. Insulation that meets a minimum R-value of 12.5 shall be provided throughout all door assemblies. Insulation shall be injected foam. Foam shall be closed cell to prevent wicking of moisture. If fiberglass insulation is provided, it shall be completely wrapped with long- strand fiberglass cloth to limit the entrainment of moisture into the insulation. The long- strand fiberglass cloth shall also incorporate an anti-microbial coating to suppress microbial growth. Insulation shall completely fill the panel cavity in all directions so that no voids exist and settling of insulation is prevented.

d. All doors shall be a minimum of 60" high if sufficient height is available, or the maximum height allowed by the unit height. All doors shall open against pressure to ensure an airtight seal and to prevent a safety hazard.

e. Door hinges shall be stainless steel type.

f. Door handles shall be Allegis design for minimized leakage and to provide a Class "A" thermal break. Handles shall fasten against the door frame with a roller cam to eliminate wear of the door frame. On indoor units, if Allegis handles are not provided, Ventlok 310 handles shall be provided on all doors to ensure positive seal of the door and to avoid wear of the door frame. All door handles shall be operable from both the unit exterior and interior.

g. Windows shall be provided in doors as indicated on the schedule and drawings. Windows shall be provided on all PCO accessible doors and shall be UV rated, with safety glass. For any instance where a window cannot fit in a door, a narrower window 8" tall may be provided. Windows in doors with a thermal break shall be thermal, double-pane type.

5. Roofs:

   a. Roof assemblies shall be double-wall construction. Exterior roof panels and interior ceiling panels shall be of the same construction as the exterior and interior wall panels, casing construction shall ensure that all roofs slope away from door openings as much as feasible. This limits exposure to maintenance staff from rain cascading onto them while doing maintenance. For perforated liners, a triple-wall panel shall be provided. This triple- wall panel shall be constructed such that two layers of the panel are solid, with the aforementioned class of thermal break between them to isolate the supply air from contact with the outside panel. The third, inner liner shall be perforated. All spaces and joints of roof assemblies shall be completely sealed. In addition to meeting the casing deflection limits contained herein, roof deflection shall not exceed L/200 under a point load of 200 pounds, where L is defined as the roof panel span.

   b. A Class "B" thermal break shall be provided throughout the entire roof assembly.

   c. Insulation that meets a minimum R-value of 12.5 shall be provided throughout all roof assemblies.

Insulation shall be injected foam. Foam shall be closed cell to prevent wicking of moisture. If fiberglass insulation is provided, it shall be completely wrapped with long- strand fiberglass cloth to limit the entrainment of moisture into the insulation. The long- strand fiberglass cloth shall also incorporate an anti-microbial coating to suppress microbial growth. Insulation shall completely fill the panel cavity in all directions so that no voids exist.

6. Shipping Splits:

    a. Shipping splits shall be provided as indicated on the schedule and drawings. Heavy-gage gussets shall be provided in the corners of each split on the unit interior to minimize the opportunity for racking of the section during shipping and rigging. Structural members shall be provided at the base of the unit exterior to enable pull together of each shipping split.

7. Unit Paint:

    a. External surfaces of all indoor and outdoor unit casings shall be prepared and painted. Paint shall be able to withstand a salt spray test Paint shall be AHU manufacturer's standard color.

8. Dampers:

    a. Ultra low-leak modulating dampers shall be provided, sized, and located as indicated on the schedule and drawings. Blade arrangement (parallel or opposed) and orientation (horizontal blades or vertical blades) shall also be provided as indicated on the schedule and drawings. Damper blades shall be aluminum double-skin airfoil design for minimal pressure drop. Leakage rate shall not exceed 3 cfm/square foot at 1" w.g. All leakage testing and pressure ratings shall be based on Air Movement and Control Association (AMCA) Standard 500-D. All dampers, except external bypass and multizone dampers, shall be mounted on the AHU interior. The damper actuator/ controllers shall be provided and installed by the control company (Siemens).

    b. Outside and Return Airflow Measuring Stations

    c. Airflow measurement stations shall be provided, sized, and located in the outside and/or return air paths as indicated on the schedule and drawings to measure airflow.

    d. The airflow measurement station shall measure up to 100% of the

total outside and/or return air. The airflow measuring device shall adjust for temperature variations. Output shall be provided from station as a 2-10 VDC signal. Signal shall be proportional to air velocity. The accuracy of the measuring station shall be no greater than +/- 5%. Airflow measuring stations shall be mounted on the AHU interior.

9. Air Filters:

    a. All filters shall be 12" x 24", 24" x 24", or 24" x 12" nominal sizes to minimize the number of sizes required to be stocked by the Authority. Filters of other nominal sizes will not be acceptable.

    b. High Efficiency Cartridge Filters

        i. Rigid cartridge filters 12" deep shall be provided as indicated on the schedule and drawings. The Minimum Efficiency Reporting Value (MERV) rating shall be 13 when tested in accordance with ANSI/ American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 52.2. Filters shall consist of high density glass fiber media enclosed in galvanized steel frames with diagonal supports on both the entering and leaving sides.

        ii. Filters shall be UL Class 2 when tested in accordance with UL Standard 900.

        iii. High efficiency cartridge filters shall be provided with 2" deep pleated media pre-filters, MERV rating shall be 8. Pleated media pre-filters shall conform to the "Medium Efficiency Pleated Media Filters" specifications contained herein.

        iv. Filters shall be provided with side-loading frames. Filter holding frames shall be constructed of stainless steel and equipped with foam gaskets to seal filters against filter frames. Frame seams shall be sealed to eliminate air bypass. Filter holding frames shall be of a universal type to accommodate standard filters of the same nominal size as well as appropriate fasteners. Filter access shall be as indicated on the schedule and drawings.

10. Cooling Coils:

    a. Coil performance shall be provided as indicated on the schedule and drawings. Coil capacities, pressure drops and selection procedures shall be certified to Air-Conditioning Heating and Refrigeration Institute (AHRI) Standard 410.

b. Coils shall have same-end header connections. Water coils shall have non-ferrous headers. Water coils shall have vent and drain taps and MPT connections. Connection locations (handing) shall be as indicated on the drawings. Grommets shall be provided at coil casing penetrations around the coil piping. Grommets shall be designed to seal the opening under positive and negative pressure.

11. Chilled Water Coils:

a. Chilled water coils shall be provided as indicated on the schedule and drawings.

b. Chilled water coils shall have 0.0045" thick copper fins. Fins shall be mechanically bonded to 5/8" OD seamless copper tubes with 0.020" thick walls. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion. Coils shall be circuited for counter-flow heat transfer. Coil casings shall be constructed of stainless steel.

c. Chilled water coils shall be proof and leak tested under water. Proof test shall be at 300 psig and leak test shall be at 200 psig.

12. Primary Drain Pans:

a. Primary condensate drain pans shall be provided in cooling coil sections as detailed in the drawings. Drain pans in cooling coil sections shall be stainless steel. Primary drain pans shall extend under each entire coil bank, including headers and return bends. Primary drain pans shall extend downstream of the coil bank for a minimum distance as indicated in the drawings. Primary drain pans shall be sloped a minimum of 1/8" per foot, shall be a minimum of 2" deep, and shall be double-sloped (sloped in 2 planes) to positively drain. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum of 1-1/2" beyond the base to ensure adequate room for field piping of condensate drain traps. Drain connection locations (handing) shall be as indicated on the schedule and drawings. Any coil support member located inside a primary drain pan shall be of the same material as the drain pan.

13. Intermediate Drain Pans:

a. For cooling coil sections requiring stacked coils, sloped intermediate drain pans constructed of stainless steel shall be provided under each upper-level coil in the coil bank and

shall extend under the entire coil, including headers and return bends. Intermediate drain pans shall extend downstream of the leaving face of the coil bank for a minimum of 4". Stainless steel pipe with a minimum diameter of 1" shall be connected to each end of all intermediate drain pans, and shall be piped to the primary drain pan of the coil section. Any coil support member located inside an intermediate drain pan shall be of the same material as the drain pan.

14. Fans:

    a. All fans shall be tested, rated and certified in accordance with ANSI/ AMCA Standard 210 for air delivery and in accordance with AMCA Standard 300 for sound power levels and shall bear the AMCA seal. The fan balancing process, including vibration limits and documentation, shall be performed in accordance with ANSI/AMCA Standard 204. Fan and motor performance requirements shall be as shown on the schedule and drawings. Maximum rated speed of the fans shall not exceed 75% of the first critical speed.

15. Un-housed Plenum Fans-Direct Drive:

    a. Fans shall be un-housed, SWSI plenum type with high efficient AF blades as indicated on the schedule and drawings. Fans shall be direct driven. Fan wheels shall be aluminum. The Hp characteristic of the fans shall be non-overloading. Fans shall be furnished with protective enclosures around the fan wheels. Fans shall be furnished with inlet collars.

16. Fan Motors:

    a. Locations of motors shall be as indicated on the schedule and drawings.

    b. All motors shall conform to ANSI/ NEMA MG 1 as well as all applicable requirements of NEC and shall be UL Listed. Motors shall be inverter ready, ODP and of the voltage, phase, frequency, and Hp indicated on the schedule and drawings. Motors shall be premium efficient, exceeding the EPAct efficiency requirements. The motor shall be provided with a heavy duty, adjustable, steel base.

    c. Nameplate motor horsepower for all fans, including dual fans, shall be at least 10% greater than design brake horsepower of each fan.

    d. Motors shall be NEMA Design B, with Class B insulation.

17. Fan Airflow Measurement Systems:

    a. Fan airflow measurement systems shall be provided as indicated on the schedule and drawings to measure fan airflow directly or to measure differential pressure that can be used to calculate fan airflow. The accuracy of the devices shall be no worse than +/-5% when operating within stable fan operating conditions. Devices shall not affect the submitted fan performance and acoustical levels. Devices that obstruct the fan inlet or outlet shall not be acceptable. Devices shall be connected to transducers with selectable 4-20 mA or 2-10 VDC output. Signal shall be proportional to air velocity.

18. Trane Catalytic Air Cleaner System (TCACS):

    a. The TCACS shall be factory engineered and factory installed in the air handler by the air handler manufacturer. Field-installed fixtures shall not be allowed.

    b. The TCACS shall be a two-part integral assembly for treatment of air by: (1) Ultraviolet Germicidal Irradiation (UVGI) using UV-C lamps and fixtures; and (2) Photocatalytic Oxidation (PCO) using titanium dioxide (TiO2) media. Assembly shall be housed in steel casing.

    c. The TCACS shall contain UV-C lamps and ballasts designed specifically to provide type-C ultraviolet light with a wavelength at or near 2537 Angstroms. Lamps shall be non-ozone producing. Sufficient lamps shall be provided and positioned so as to achieve a minimum coverage of 5 milliwatts per square inch of UVC light across all exposed surfaces of the PCO media.

    d. The TCACS shall consist of six-inch non-metallic PCO media pleated at one pleat per inch (nominal), with a 40-200 nanometer TiO2 coating. PCO media shall be placed perpendicular to the air stream in the unit casing. Maximum velocity across the PCO media shall be 500 feet per minute.

    e. Fixtures shall meet the UL drip proof design criteria. Component enclosures shall be constructed of galvanized steel or stainless steel to resist corrosion. Fixtures shall have been tested and recognized by UL/C-UL under Category Code ABQK (Accessories, Air Duct Mounted), UL Standards 1995.

    f. The TCACS shall be configured to operate with the scheduled voltage at 60 Hz. For line voltage applications, the TCACS shall be provided with a UL 508 listed panel

for power distribution and over-current protection. UV-C lamps and fixtures shall be positioned to provide an equal distribution of UV-C energy and to minimize shadowed areas. The fixture assembly shall be designed and installed such that the sum of the lamp arc lengths in a row is a minimum of 90% of the irradiated surfaces total width. The lamps shall not produce ozone.

19. Protection of Polymeric Materials:

    a. All polymeric materials that come into direct or indirect (reflected) contact with UV-C light shall be tested and certified as UV-C tolerant. Any polymeric material in direct or indirect contact with UV-C light not certified as UV-C tolerant shall be completely shielded from the UV-C light using a certified UV-C tolerant material such as metal. UV-C tolerance is defined as being capable of performing its intended duty for a minimum of 20 years.

20. Safety:

    a. Access doors shall be provided at the location of each TCACS as indicated on the plans and schedule. All points of access to sections of the air handler where the TCACS may pose a risk for direct exposure shall have a mechanical interlock switch that disconnects power to the lights when the door or access panel is opened.

    b. In addition to the mechanical interlock switch, each unit shall be equipped with an externally mounted on-off/disconnect/shut off switch that disconnects power to the TCACS. The switch shall be equipped with a lock-out/tag-out to prevent unwanted operation of the TCACS.

    c. A viewing window shall be provided on each air handler to allow viewing of the TCACS to confirm proper operation. The viewing window shall be treated and tested to assure the UV- C energy emitted through it is below the threshold limits specified by NIOSH and ACGIH.

    d. Units shall have a safety warning label applied to the exterior of each. Warning labels shall be UV tolerant, yellow in color with black lettering.

    e. Complete safety, maintenance and servicing instructions for the TCACS shall be incorporated into the air handler manufacturer's standard installation, operating and maintenance manuals.

21. Vibration Isolation:

    a. All fan and motor assemblies shall be mounted on vibration isolators which have a 2" deflection to isolate the assembly from the unit housing. The discharge of housed fan assemblies and the inlet of plenum fan assemblies shall be connected to the pressure- bulkhead panel (wall, floor, or roof) with flexible duct to prevent transmission of vibration to the unit casing. No metal-to-metal contact will be permitted between fixed and floating parts. Thrust restraints shall be provided as required to limit horizontal movement of fan assembly at design conditions. Fan bases shall be rigidly tied to the unit base during shipment to prevent damage from shipping vibrations. Shipping restraints shall be field removable with a common tool.

    b. Each fan assembly shall be vibration tested prior to shipment. Measurements shall include both radial and axial displacement at each bearing using magnetic accelerometers connected to a vibration analyzer. Vibration shall not exceed limits specified herein.

22. Unit Acoustics:

    a. Acoustical performance (example shown below) shall be provided with final submittal data and based on AHRI Standard 260 fan in unit testing. Provide units as listed below with the following maximum sound power levels in dB, re 10-12 W. Data provided in Sones or Bels is not acceptable.

		Octave Band Center Frequency, Hz						
Unit Tag	D/I*	63	125	250	500	1000	2000	4000
AH U#	D	#	#	#	#	#	#	#
	I	#	#	#	#	#	#	#

23. Marine Lights:

    a. Marine lights shall be provided throughout AHUs as indicate on the schedule and drawings. Lights shall be fluorescent type to minimize amperage draw and shall produce lumens equivalent to a minimum 64 W, instant-start bulb. Lights shall be constructed of safety glass. Lights shall be suitable for wet locations.

24. Marine Light Switches:

    a. All lights on a unit shall be wired in the factory to a single on-off switch. On outdoor units, the light switch shall be mounted inside the unit at the fan access door. On indoor units, the light switch shall be mounted on the casing exterior in a NEMA 1 enclosure next to the fan access door. Lighting circuit(s) shall be

wired by the AHU manufacturer to a common junction box separate from the VFD or starter so the lights can remain on when the main disconnect to the unit is on or off.

25. 120v Receptacle:

    a. The receptacle shall be mounted on the outside of the unit approximately centered on the long dimension and on the door side of the unit. Receptacle circuit shall be wired by the AHU manufacturer to a common junction box separate from the VFD or starter so the receptacle can remain on when the main disconnect to the unit is on or off.

    b. Receptacle shall be housed in a rainproof enclosure.

    c. Receptacle shall be a GFCI protected device.

26. Variable Frequency Drives (VFDs):

    a. All motors which will be connected to VFDs shall be furnished with ground rings.

    b. Combination VFDs (with bypass for each VFD paired to a belt-driven fan) shall be provided, mounted, and wired by the AHU manufacturer as indicated on the schedule and drawings. Combination VFDs shall be properly sized, mounted, wired to the fan motors, and commissioned by the AHU manufacturer. Combination VFDs shall include the VFD, a circuit breaker disconnect, bypass circuitry, a Hand-Off-Bypass Auto-Bypass Hand switch, manual speed control, and a control transformer.

    c. VFDs shall be high-performance PWM AC drives that generate a sine -code, variable voltage/frequency, three phase output for optimum speed control. VFDs shall be digitally based using a common microprocessor control logic circuit board for the Hp ratings. All programming shall be maintained in non-volatile RAM memory so the program will be maintained when power is removed.

    d. Output current overload shall be rated at 110% of motor FLA for one minute. VFDs shall have the following minimal protective features: current limited stall prevention, auto restart after momentary power loss, speed search for starting into rotating motor, anti-windmill, phase-to-phase short circuit protection, and ground fault protection. The VFD shall have an ambient service temperature rating of -10 to 120 F, and humidity rating to 95% non-condensing. The VFD shall be UL508 listed and shall conform to

applicable NEMA, NFPA, and International Electrotechnical Commission (IEC) standards.

e. Digital operator keypads and displays shall be provided with each VFD and shall provide local control and readout for: run/stop, speed, reset, volts, amps, kilowatts, and diagnostics.

f. Factory-Installed Motor Wire Termination, VFD, Combination Starter/Disconnect, and Fan Disconnect Switch Enclosures.

   i. VFDs shall be factory-mounted on the drive-side of the fan section on the interior of the unit, accessible from the unit exterior through an access door, for outdoor units and on the casing exterior in a NEMA Type 12 enclosure for indoor units.

   ii. Any welds shall be properly finished with no rough edges. Enclosures shall house circuit breaker disconnects, bypass circuitry, Drive-OFF-BypassAuto -BypassHand switches, manual speed controls, and control transformers. VFDs, starter/ disconnects, and fan disconnect switches shall have a manual shut down switch located on the outside of the access door.

g. Factory Wiring of Lights, VFDs, Combination Starters/Disconnects, and Fan Disconnect Switches

   i. VFDs shall be wired per NEC, UL, and NFPA 90 A requirements.

   ii. All power wiring for voltages greater than 24V shall be contained in an enclosed, metal, power-wiring raceway or EMT. When a power-wiring raceway is used, access panels shall be provided in the raceway at each shipping split to enable access to the wiring during installation. Wiring sections less than 6 in length may be contained in Flexible Metal Conduit (FMC).

   iii. The AHU manufacturer shall provide one single-point power connection for all motors, VFDs, control end devices, on each AHU.

h. Factory Commissioning of VFDs and Combination Starter/ Disconnects

   i. After mounting and wiring of VFDs, on the AHUs, trained factory personnel shall ensure proper operation of each VFD, through a thorough factory test. Testing shall include a Hypot test of unit wiring to ensure that

no weaknesses exist in wiring or motor.

23 74 13—PACKAGED, CENTRAL-STATION AIR-HANDLING UNITS

SUMMARY

1. Section includes packaged, outdoor, central-station air-handling units with following components and accessories:
    a. Chilled water coil.
    b. Heating hot water coil.
    c. Economizer section.
    d. Supply fan section.
    e. Return fan section.
    f. Dampers.
    g. Roof curbs.
    h. 120v convenience outlet.
2. Provide extended lubrication tubes.
3. Provide viewing ports on all unit sections.
4. Provide marine lights in all sections.
5. Provide convenient power outlets at each unit.
6. Provide primary (60 percent) and secondary (90 percent) efficient filter for all air handling units. Provide charcoal after filters where applicable.
7. Install units for maximum ease of maintenance. For ease of maintenance install units inside fan rooms, closets, or on roof top. Units shall not be installed above ceilings.
8. Provide floor drains in all fan rooms.
9. Submit available factory options for review and approval by the Authority with 30 percent review phase submittal.

MANUFACTURERS

1. Carrier;
2. Energy Laboratories, Inc;
3. Pace;
4. Trane;
5. Or equal.

EXECUTION

1. Single zone horizontal, draw-through type. Units shall include supply and return plenum sections with isolation dampers, supply and return attenuator sections, supply and return fan sections, heating and cooling coils with matching cross sectional areas, motors and drives, pre, and final filter sections with filters, economizer sections with dampers, and accessories. Units shall

be built on structural steel channel bases with removable lifting lugs.

2. Casing: Double-wall standing seam constructed of minimum 16 gauge steel, bolted together with cadmium plated bolts (drive screw attachment is unacceptable). Allowable air leakage is 1 percent of the total CFM at 125 percent of the total static pressure or 10 inches whichever is less; provide factory performance test.

    a. Provide solid 20-gauge (galvanized steel) liner over insulation in all sections except provide 20-gauge perforated (galvanized steel) sheet metal liner over insulation in all fan sections.

    b. Insulation:

        i. 2 inches thick, 3 pounds per cubic foot density; glued and pinned to inside of unit and cover walls, ceilings and under floors.

        ii. Meet NFPA 90A smoke and flame spread requirements.

        iii. All floors shall be double walled.

        iv. Panel system shall consist of individually insulated panels designed such that removal of single panel does not disturb any insulation or adjacent panels.

    c. Man-sized access doors:

        i. Same thickness as wall.

        ii. Provide along one side and enter into each section.

        iii. 16 gage steel, double skin with one-piece unitary aluminum frame.

        iv. Provide heavy duty stainless steel hinges.

        v. Size suitable for man to walk through.

        vi. Provide replaceable airtight seals.

        vii. Design to swing against fan pressure.

        viii. Include minimum 12-inch by 12-inch viewing double pane window in fan access door.

    d. Entire floor shall be lined on inside with minimum 12 gauge checker plate fully seam welded steel. Floor and base shall have maximum 1/8-inch deflection, provide reinforcing and/or heavier gauge flooring, as required.

    e. Units shall have standing seam construction.

    f. All panels shall be caulked watertight.

g. Paint Finish: After final assembly, unit exterior shall be coated with marine grade polyurethane paint. Fan bases, springs and structural steel supports shall be coated with same finish.

3. Fans:

a. Fan sections shall include fully welded aluminum wheels.

b. Direct-drive, extruded aluminum SWSI air foil blade plug fans. Formed blades will not be acceptable.

c. Fan inlet cone and wheel: Aluminum construction with extruded aluminum blades. Provide L-10 operating life bearings with relief plugs and lubrication.

d. Fan shaft: Stainless steel.

e. Ensure fan and motor are mounted on structural steel, vibration isolation base inside cabinet. Rolled or formed galvanized bases will not be acceptable.

f. Vibration isolation base shall have earthquake restraints to retain fan assembly in vertical and horizontal direction.

g. Spring isolators: Un-housed stable type with minimum 2 inches deflection.

h. Fan steel and shaft assembly: Statically and dynamically balanced prior to and after assembly with motor and drive in place. Shafting of fan shall be sized not to exceed 75 percent of first critical speed for maximum RPM of class required (critical speed will refer to top of speed range of fans' AMCA class). Lateral static deflection shall not exceed 0.003-inch per foot of length of shaft. Shaft and wheel shall be dynamically balanced in two planes as a complete unit to maximum residual unbalance of 0.15 ounce, at 95 percent of fan radius in each plane.

i. Unit manufacturer shall provide catalog ratings of fan performance with fans running inside cabinets. Fan performance shall be based on tests performed in AMCA certified lab in accordance with AMCA 210.

j. Motors shall be premium efficiency motors type with totally enclosed fan cooled enclosures with standard NEMA frame rigid ball bearing type motors and rated for variable speed drives. Pre-wire motors to variable speed drives.

k. Motors shall be furnished with a ground ring.

l. Provide factory mounted and wired variable speed drives for filter load

compensation. Variable speed drives shall be mounted in compartments which are part of air handling unit. Access shall be through louvered access door that is flush with outside of the unit. Ensure that 2-inch diameter cold air pipe is connected from downstream of supply fan to each VFD enclosure.

m. Provide factory engineered and manufactured motor removal rail system in each fan section.

n. Fans shall be supplied with complete flow measuring system capable of supplying 0-10 volts dc output signal to EMCS system that is proportional to air flow. Flow measuring station and flow transmitter will be factory mounted and plumbed. Flow measuring station shall consist of total and static pressure pick-ups located in inlet cone(s) of each fan. Pick ups shall not obstruct inlet air flow.

o. Provide magnehelic gauge with CFM scale on external side of each fan section which indicates fan volume.

p. Provide electronic flow transmitter mounted on exterior of fan section. Transmitter shall be capable of receiving signals of total and static pressure from flow element, of amplifying, extracting square root, and scaling to produce 0-10 Volts dc for all control signals which is linear and scaled to air volume or velocity. Flow transmitter shall be capable of following performance and application criteria:

   i. Calibrated spans from 0 - 896 FPM, in eight flow range increments.

   ii. Control signals: 0-10 Volts dc for all

   iii. Integral zeroing means three-way zeroing valve with manual switch.

   iv. Temperature effect plus or minus 2 percent of full span from 40 degrees F to 120 degrees F.

q. Transmitter shall be capable of withstanding over-pressurization up to 200 times greater than span without damage, and shall be furnished with a factory calibrated span and integral zeroing means.

r. Transmitter shall be housed in NEMA 12 enclosure with external signal tubing, power, and output signal connections.

s. Electronic differential pressure transmitter shall be Air Monitor VELTRON Series.

4. Coil Sections:

    a. All coil frames shall be Type 316 stainless steel.

    b. Include IAQ double-sloped drain pan of double wall construction type with internal insulation, 1-inch, 1-1/2 pound density, neoprene coated fiberglass insulation and 16 gage under liner and Type 316 stainless steel liner.

    c. Provide intermediate drain pan, separately piped with stainless steel piping to lower drain pan for multiple height coil banks.

    d. Pitch drain pan toward coil as well as toward drain connection provided on access side of the unit.

    e. Coil return bends and headers shall be insulated with foil-faced insulation arranged so that any condensation shall be directed into drain pan.

    f. Area around coil return bends and headers shall be blanked off upstream and downstream of coil to isolate from air stream.

    g. Drain pan shall continue under coil; coil shall not sit in pan.

5. Coils:

    a. Seamless 5/8-inch outside diameter copper tubes, 0.020-inch minimum tube wall thickness with copper plate fins of 0.008-inch thickness and shall be placed no closer than 12 fins per inch.

    b. Extended surface type.

    c. Provide brazed return bends of 0.025-inch wall thickness.

    d. Coils shall be reinforced for all coils over 60 inches long and shall have seamless copper headers with 1/8-inch vent and drain connections.

    e. Coils shall be certified in accordance with ARI 410.

    f. Coils shall have stainless steel casings and blank offs.

    g. Coil piping shall be combined internal to unit; piping to each coil shall be made equidistant from single unit coil connection and piped reverse return for self balancing.

    h. Coils shall be counterflow construction.

    i. Use of internal restrictive devices to obtain turbulent flow will not be acceptable.

j. Casing shall be minimum 16 gage, Type 304 stainless steel with double formed 1/2-inch stacking flanges and 3/4-inch flanges on side plates.

k. Flanged tube sheets shall have extruded tube holes.

l. Reinforcing rods shall be furnished so that unsupported length is not over 60 inches.

m. Ensure coil assemblies are tested under water at 300 psig and rated for 150 psig working pressure.

n. Provide diverter plates at ends of coil to divert condensate drip from headers and return bends into drain pan.

o. Locate headers inside cabinet casing with only pipe connections extending through casing.

p. End of coils shall be carefully blanked to ensure all air passes through coil.

q. Intermediate condensate pans shall be furnished on multiple coil units with copper down tubes to main drain panel.

r. Type 316 stainless steel recessed drain pans shall be provided as integral part of unit base in all cooling coil sections.

i. Pans shall be 16 gage minimum with 1 inch, 1/2 pound density, neoprene coated fiberglass insulation and 16 gage under liner.

ii. Provide stainless steel condensate connections on sides of unit.

6. Filter Sections:

a. Factory fabricated as part of air-handling unit.

b. Filters shall be arranged for face loading.

c. Filter manufacturers frames shall be used.

d. All frames shall be Type 316 stainless steel construction, welded in place and caulked airtight.

e. Provide units with filter gauge across filter sections.

f. Flush mount gauges on exterior of unit.

7. Mixing or Economizer Section:

a. Include damper for return air, exhaust air, and outside air as required.

b. Include full size access door for damper service.

c. All dampers shall be opposed blade.

d. Damper housing and collars shall be minimum 16 gage with bronze or nylon bearing, plated pivot rods and extruded aluminum blades with replaceable edge seal, stainless "arc" end seals, or compression type end seals.

8. Provide factory flush mounted and wired single point 480V connection electrical panel, unit mounted and pre-wired to variable frequency drives and motors. Panel shall be UL labeled as an assembly and be specifically designed for outdoor use.

9. Provide separate factory flush mounted and wired single point 120 volts connection electrical panel, unit mounted and pre-wired to lights as well as provide controls transformer in order to provide source of power to low voltage control devices within unit. Panel shall be UL labeled as an assembly and be designed for outdoor use.

10. Provide door interlocks on fan section doors to shutdown fans when door is unlocked.

11. Lighting:

    a. Separate 120V circuit for lighting.

    b. Provide vapor-proof marine service interior florescent lighting in access sections with single switch with timer for all on outdoor units only.

12. Receptacle:

    a. Separate 120v circuit for convenience outlet.

    b. Provide 120v GFCI receptacle approximately centered on the length of the unit on the door side of the unit.

EXECUTION

1. Installation:

    a. Roof Mounted Units:

        i. Install on roof structure or concrete base, level and secure. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

    b. Grade Mounted Units:

        i. Install unit level on structural curbs or steel supports. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.

23 81 23—COMPUTER-ROOM AIR-CONDITIONERS (CRACS)

SUMMARY

1. CRAC shall be duplex systems utilizing chilled water and dx system technology.

2. Section includes split-system air-conditioning units and mini-split air-conditioning systems consisting of separate evaporator-fan and compressor-condenser components intended for use in computer rooms, electrical meter rooms, elevator/ escalator rooms, and mechanical rooms.

3. Use the Design and Construction Standards Chapter 9 document for specifying CRACs duplex systems are required.

4. Floor, wall, and, ceiling-mounted console, air cooled computer room units. Provide air cooled independent split air conditioning units with 100 percent redundancy for IT rooms, main electrical room, and elevator machine rooms.

MANUFACTURERS

1. Data Aire;

2. Liebert Corporation;

3. Mitsubishi;

4. Stulz ATS;

5. Or equal.

PRODUCTS

1. Evaporator Cabinet and Chassis: Heavy gauge galvanized steel, serviceable from one side. Mounting brackets shall be factory attached to cabinet.

2. Fan Motor Assembly:

    a. Fan: Centrifugal type, double width, double inlet.

    b. Shaft: Heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours.

    c. Fan motor: 1750 rpm, mounted on adjustable base.

    d. Drive package shall be equipped with adjustable motor pulley.

    e. Fan/motor assembly shall be mounted on vibration isolators.

    f. System shall be suitable for ducted air distribution.

3. Microprocessor Control:

    a. Control system shall be microprocessor based.

    b. Wall-mounted control enclosure shall include 2-line by 16-character LCD display providing continuous

display of operating status and alarm condition.

c. A 7-key membrane keypad for setpoint/program control and unit on/off shall be located below display.

d. Temperature and humidity sensors shall be located in wallbox, capable of being located up to 300 feet from evaporator unit.

e. LCD display shall provide on/off indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity (if applicable) indication.

f. Monitoring system shall be capable of relaying unit operating parameters and alarms to the Liebert SiteScan® monitoring system.

    i. Control Setpoint Parameters:

    ii. Temperature Setpoint: 65 to 75 degrees F.

    iii. Temperature Sensitivity: 1 to 5 degrees F.

    iv. Humidity Setpoint: 20 to 80 percent relative humidity.

    v. Humidity Sensitivity: 1 to 10 percent relative humidity.

g. Compressor Short-Cycle Control: Control system shall prevent compressor short-cycling by 3-minute timer from compressor stop to next start.

h. Provide common alarm relay shall to provide contact closure to remote alarm device. Provide two terminals for remote on/off control. Individual alarms shall be “enabled” or “disabled” from reporting to the common alarm.

i. Control shall be programmable on daily basis or on

j. 5-day/2-day program schedule. It shall be capable of accepting two programs per day.

k. Control shall include capabilities to calibrate temperature and humidity sensors and adjust sensor response delay time from 1 to 90 seconds. Control shall be capable of displaying temperature values in degrees F or degrees C.

l. For start-up after power failure, system shall provide automatic restart with programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at wall mounted controller or from central site monitoring system.

4. Alarms:
    a. Control system shall monitor unit operation and activate audible and visual alarm in the event of following factory preset alarm conditions:
        i. High Temperature
        ii. Low Temperature
        iii. High Humidity
        iv. Low Humidity
        v. High Water Alarm - Lockout Unit Operation
        vi. High Head Pressure
        vii. Loss of Power
        viii. Compressor Short Cycle
    b. Custom Alarms (2x)
        i. Humidifier Problem
        ii. Filter Clog
        iii. Water Detected
        iv. Smoke Detected
        v. User customized text can be entered for the two custom alarms.
    c. Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate common alarm (except for high head pressure).
    d. Audible alarm shall annunciate any alarm that is enabled by the operator.
    e. Provide programmable common alarm to interface user selected alarms with a remote alarm device.
5. Direct Expansion Coil:
    a. Evaporator section shall include evaporator coil, thermostatic expansion valve, and filter drier.
    b. Provide coil with stainless steel drain pan, with internally trapped drain line.
6. Air-Cooled Prop Fan Condensing Unit:
    a. Condenser coil shall be constructed of copper tubes and aluminum fins with direct-drive propeller-type fan, and shall include scroll compressor, high pressure switch, and lee-temp receiver.
    b. Components shall be factory assembled, charged with R-407c or R-410A refrigerant and sealed.
    c. No internal piping, brazing, dehydration, or charging shall be required.
    d. Condensing unit shall be designed for 95 degrees F ambient and be

capable of operation to minus 30 degrees F.

e. Components shall include scroll compressor, high-pressure switch, Lee-temp refrigerant receiver, head pressure control valve, and liquid line solenoid valve, if required by manufacturer's design.

f. Baked phenolic coated condensing unit.

7. Steam Generating Humidifier:

a. Environmental control system shall be equipped with steam generating humidifier that is controlled by microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, steam distributor, and electronic controls. Need to change canister shall be annunciated on microprocessor wallbox control panel.

b. LED light on humidifier assembly shall indicate cylinder full, over-current detection, fill system fault, and end of cylinder life conditions.

8. Electric Reheat:

a. Low-watt density, Type 304 stainless steel, finned-tubular.

b. Reheat section shall include Nationally Recognized Testing Laboratory (NRTL) -approved safety switch to protect system from overheating.

9. Disconnect Switch, Non-Locking:

a. Non-automatic, non-locking, molded case circuit breaker shall be factory mounted in high voltage section of electrical panel.

b. Switch shall be accessible from front of unit.

10. Smoke Detector:

a. Smoke detector shall immediately shut down environmental control system and activate alarm system when activated.

b. Sensing element shall be located in return air compartment or in close proximity, in accordance with smoke detector manufacturer's instructions.

EXECUTION

1. Installation:

a. Computer-Room Air-Conditioner Mounting: Install using elastomeric pads, elastomeric mounts or restrained spring isolators. Comply with requirements for vibration isolation devices.

b. Suspended Computer-Room Air Conditioners: Install using continuous-thread hanger rods and elastomeric hangers, spring hangers, or spring hangers with vertical-limit stop of size required to support weight of computer-room air conditioner.

c. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads, elastomeric mounts or restrained spring isolators on concrete base.

2. Connections:

a. Where installing piping adjacent to computer-room air conditioners, allow space for service and maintenance.

b. Water and Drainage Connections: Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

c. Condenser-Water Piping: Provide shutoff valves in water inlet and outlet piping on water-cooled units.

d. Refrigerant Piping: Provide shutoff valves and piping.

23 82 19—FAN COIL UNITS

SUMMARY

1. This section includes hydronic fan-coil units and accessories

MANUFACTURERS

1. Trane;
2. Carrier;
3. McQuay;
4. York;
5. Or equal.

PRODUCT

1. Description : Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995. 18 gauge galvanized steel.
2. Coil Section Insulation: 1-inch thick, 2.0lb/cu. ft. density, foil-covered, R-Value of 4.3, glass fiber. and attached with adhesive complying with ASTM C 916.
3. Main and Auxiliary Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004. Drain pans shall be removable.

4. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units if used, shall have leveling screws.

5. Cabinet: 18-gauge galvanized steel with baked-enamel finish in manufacturer's standard paint color.

6. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

7. Fan: Forward curved, centrifugal, steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.

8. Fan Coil Unit shall interface with the buildings' automation system.

EXECUTION

1. Fan coil units shall be installed level and plumb.

2. Fan coil units shall comply with NFPA 90A.

3. Fan coil units shall suspend from structure with elastomeric hangers.

4. New filters shall be installed in each fan coil unit within two weeks after substantial completion, if not clean.

5.7. ELECTRICAL

26 05 00—BASIC ELECTRICAL REQUIREMENTS

The following requirements apply to all electrical sections contained herein.

APPLICABLE CODE REFERENCES

CBC latest edition;

CEC latest edition;

ETL;

NFPA;

San Diego Electrical Newsletter latest edition;

NETA;

NECA:NEIS;

NEMA

UL

California Title 24;

CAL OSHA;

FAA;

IEEE;

ASTM

BASIC REQUIREMENTS

All work shall be done in a workman like manner.

All conduit runs shall be plumb and parallel.

As-builts shall be up-dated as work progresses.

Monthly payment is linked to completed as -builts.

As-built drawings shall include Contractor shop drawings.

As-built drawings shall include correct conduit and wire sizes.

As-built drawings shall include exact locations for junction and pull boxes.

As-built drawings shall include correct panel schedules.

On existing work, Contractor shall update panel schedules.

Contractor shall match existing equipment manufacturers.

UNDERGROUND RACEWAYS / BOXES

Schedule 40 PVC is acceptable for underground raceways.

All vertical risers shall be GRC with 20 mil tape wrap, minimum or PVC coated.

All sweeps shall be long radius.

All sweep risers shall flush out to finish floor with a GRC coupling.

All 12kV conduit shall be completely encased with red concrete minimum 3000 PSI.

All communications/security ductbanks shall be completely encased with orange concrete minimum 3000 PSI.

All low voltage (less than 600 volts) ductbanks that are below parking or roadway areas shall be encased in non-colored concrete.

All ductbanks shall have traceable marking tape installed 12" above the ductbank.

All conduit installed below slab shall be installed at least 6" below the bottom of slab.

All underground vaults and manholes shall have waterproofing material installed on the exterior prior to delivery.

All damaged surfaces shall be repaired prior to backfill.

All underground vaults and manholes shall have fiberglass racking installed.

All conduit entering vaults or manholes shall have compression plugs to prevent moisture intrusion.

All conduits shall be mandrelled prior to sign off.

Mandrell shall be 1/4" smaller than the inside diameter of the conduit for Schedule 40.

Mandrell shall be 1/2" smaller than the inside diameter of the conduit for Schedule 80.

All conduits shall have mule tape installed.

Conduit terminations in manholes shall have ID tags advising next destination.

RACEWAYS AND BOXES

Minimum conduit size is 3/4".

EMT fittings shall be steel compression type.

FMC allowed inside, 6'-0" maximum steel.

LFMC allowed for exterior and wet environments.

MC is acceptable for fixture whips only 6'-0" maximum.

EMT interior, not subject to damage.

GRC exterior and where subject to damage.

All GRC threads shall be coated with a conductive compound.

All GRC stubs from underground shall have ground bushings installed.

All conduit shall be concealed when possible.

All empty, future conduits shall have mule tape installed.

For two or more conduits install a rack with provisions for 25% expansion.

Single conduits may be supported by individual wires or rods, depending on size.

All conduits shall be color coded for the system they supply.

All boxes installed in walls shall have the correct size plaster ring installed.

Exterior exposed boxes shall be cast steel.

Interior exposed boxes, subject to damage shall be cast steel.

Interior exposed boxes not subject to damage can be cast aluminum.

ALL boxes shall have conductor circuit numbers identified on the inside of the box.

All junction and pull boxes shall have conductor circuit numbers identified on the cover.

ALL boxes shall be identified with the correct color coding of the system they supply.

CONDUCTORS

All 600 volt conductors shall be copper THHN/THWN or XHHW.

All underground conductors including below buildings, shall be XHHW.

All conductors shall be color coded per The Authority Color Chart for conductors.

Conductors shall be installed with the use of a conductor lubricant. Ideal yellow 77 is not permitted.

Conductors #2 and above splices shall be kept to a minimum. All splice points shall be as-built and IR scanned.

All conductors in a conduit shall be installed at the same time. NO CONDUCTORS may be spliced. NO CONDUCTORS shall be slipped.

All conductors shall be properly trained pull boxes, junction boxes and switchgear.

All conductors shall circuit numbers installed at all junction, pull boxes and terminations.

All conductors shall have the ends covered until terminated, to prevent moisture damage.

DEVICES

All devices shall be minimum 20 amp rated.

All devices shall be installed per the latest edition of ADA.

SWITCHGEAR / TRANSFORMERS

All freestanding switchgear and transformers shall be mounted on housekeeping pads.

All switchboards and panelboards shall have non pre-punched tops and bottoms.

26 05 04—BASIC ELECTRICAL MATERIALS AND METHODS

PRODUCTS

1. Molded Case Circuit Breaker Thermal Magnetic, Low Voltage:
    a. General:
        i. 100A and larger: locking provisions for padlocking breaker in open position.
    b. Molded-Case Circuit Breakers with Solid State Trip:
        i. Breakers 200-Ampere and above: Main and Branch Feeder Protective Devices: Individually mounted, suitable for use with 75 C wire at full 75 C ampacity when mounted in switchboard.
        ii. Arrangement: Fully rated as shown.

iii. Interrupting Rating: as shown with amperes rms symmetrical at rated voltage as shown.

iv. Breakers 2,000-Ampere through 3,000-Ampere Frame: Mechanical interlock to prevent opening compartment door while breaker is in closed position.

c. Short Circuit Interrupting Ratings: Equal to, or greater than, available fault current or interrupting rating shown.

d. Ground Fault Interrupter (GFI): Where indicated, equip breaker as specified with ground fault sensor. Ground Fault Sensor to be set and tested per IEEE Standard 243.

i. Ground fault sensor shall be rated same as circuit breaker.

ii. Not to exceed 1200 Amperes maximum setting.

e. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.

f. Connections:

i. Mechanical wire lugs, except crimp compression lugs where shown.

ii. Lugs removable/replaceable for breaker frames greater than 100 amperes.

iii. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.

iv. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.

g. Enclosures for Independent disconnect or circuit breaker mounting:

i. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.

ii. Interlock: Enclosure and switch or circuit breaker shall interlock to prevent opening cover with switch in the ON position.

2. Fused Switch, Individual, Low Voltage:

a. Short Circuit Rating: 200,000 amps RMS symmetrical.

b. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD)

type with external markings clearly indicating ON/OFF positions.

i. Connections:

ii. Mechanical lugs, except crimp compression lugs where shown.

iii. Lugs removable/replaceable.

iv. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.

c. Fuse Provisions:

i. Interlock: Enclosure and switch to prevent opening cover with switch in ON position.

3. Non-fused Switch, Individual, Low Voltage:

a. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

b. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.

c. Auxiliary Contact, if required:

i. Operation: Make before power contacts make and break before power contacts break.

ii. Contact Rating: 7,200VA make, 720VA break, at 600V,

d. Interlock: Enclosure and switch to prevent opening cover with switch in ON position.

4. Fuses, 250-Volt and 600-Volt:

a. Power Distribution, General:

i. Current-limiting, with 200,000 ampere rms interrupting rating.

ii. Provide to fit mountings specified with switches.

b. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:

i. Type: Dual element, with time delay.

c. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps:

i. Double O-rings and silver links.

d. Cable Limiters:

i. 600V or less; crimp to copper cable, bolt to bus or terminal pad.

5. Pushbutton, Indicating Light, and Selector Switch:

a. Contact Rating: 7,200VA make, 720VA break, at 600V,

b. Selector Switch Operating Lever: Bat lever.

c. Indicating Light: Push-to-test. LED, full voltage.

d. Pushbutton Color:

i. ON or START: Green

ii. OFF or STOP: Red.

e. Pushbutton and selector switch lockable in OFF position where indicated.

f. Legend Plate:

i. Material: Aluminum.

ii. Engraving: Enamel filled in high contrasting color.

g. Text Arrangement: Per Labeling Specification, 26 05 53.

6. Terminal Block, 600 Volts

a. Size components to allow insertion of necessary wire sizes.

b. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.

c. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.

d. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

e. Yoke shall guide all strands of wire into terminal.

f. Current bar shall ensure vibration-proof connection.

g. Terminals:

i. Capable of wire connections without special preparation other than stripping.

ii. Capable of jumper installation with no loss of terminal or rail space.

iii. Individual, rail mounted.

h. Marking system, allowing use of preprinted or field-marked tags.

7. Time Delay Control Relay:

a. Industrial relay with contacts rated 5 amps continuous, 3,600VA make, and 360VA break.

b. Solid-state electronic, field convertible ON/OFF delay.

c. One normally open and one normally closed contact (minimum).

d. Repeat accuracy plus or minus 2 percent.

e. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on Drawings.

8. Reset Timer:

a. Drive: Synchronous motor, solenoid -operated clutch.

b. Mounting: Semi-flush panel.

c. Contacts: 10 amps, 120 volts.

9. Magnetic Contactor:

a. Electrically operated, electrically held.

b. Main Contacts:

i. Power driven in one direction with mechanical spring dropout.

ii. Silver alloy with wiping action and arc quenchers.

iii. Continuous-duty, rated as shown.

iv. Poles: As shown.

c. Control: As shown.

d. Auxiliary Contacts: Quantity as shown, rated 7200VA make, 720VA break, at 600V

10. Phase Monitor Control Relay:

a. Features:

i. Voltage and phase monitor relay shall drop out on low voltage, voltage unbalance, loss of phase, or phase reversal.

ii. Contacts: Single-pole, double-throw, 10 amperes, 120/240V ac. Where additional contacts are shown or required, provide magnetic control relays.

iii. Adjustable trip and time delay settings.

iv. Transient Protection: 1,000V ac.

v. Mounting: Multipin plug-in socket base.

11. Support and Framing Channels:

a. Steel Framing Channel:

i. Material: Rolled, mild strip steel, 12-guage minimum.

ii. Finish: Hot-dip galvanized after fabrication.

b. Extruded Aluminum Framing Channel, where allowed:

i. Material: Extruded from Type 6063 T6 aluminum alloy.

ii. Fittings fabricated from Alloy 5052 H32.

12. Switchboard Matting:

    a. Provide matting having a breakdown of 20 kV minimum.

13. Firestops:

    a. General:

        i. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.

        ii. Sealants and accessories shall have fire-resistance ratings

        iii. Assembly shall be appropriate for the installation, engineered and stamped by a registered engineer.

    b. Firestop System:

        i. The following locations within the building, unless otherwise specified, require installation of through-penetration firestop systems, joint systems, perimeter fire containment systems, and/or combinations of materials as described herein and approved in advance to achieve a tight seal that will maintain the fire-resistive rating and prevent the passage of smoke through the assembly containing through-penetrations or voids:

            a) Pipe, tube, duct, conduit, cable bundles, cable trays, or similar through- or membrane-penetrations of fire resistive

            b) Walls, floors, floor-ceiling assemblies, and roof-ceiling assemblies.

            c) In areas requiring a liquid-tight floor, seal floor firestopping assemblies at the top, level with the floor surface, with a silicone-based firestopping sealant in addition to the required firestopping materials.

        ii. The void (gap) at the intersection of a fire-resistive floor or floor- ceiling assembly and the interior face of the exterior wall system. A Perimeter Fire Containment System specified as having movement capabilities shall be used.

    c. Seismic joints and expansion joints in the fire resistive walls, floors and floor-ceiling or roof-ceiling assemblies. Joint Systems specified as having movement capabilities shall be used.

    d. The void (gap) at the intersections of fire resistive walls with fire resistive

floors, floor-ceiling assemblies, or roof-ceiling assemblies. Joint Systems specified as having movement capabilities shall be used.

e. Any of the materials identified in this Section may be used as a part of a listed firestopping system or individually when specifically, approved in advance, except that only firestopping sealant, as specified this section, shall be used where the material is installed in exterior or other locations exposed to the outside environment or direct contact with moisture.

f. Fire Stop Devices: See Section 26 05 33, Raceway and Boxes, for raceway, cable and cable tray fittings.

14. Enclosures:

a. Finish: Sheet metal structural and enclosure parts shall be completely powder-painted epoxy painted so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.

b. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown or a specified for outdoor enclosures.

c. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

Enclosure Selections: Except as shown otherwise, provide electrical enclosures according to the following table.

Enclosures			
Location	**Finish**	**Environment**	**NEMA 250 Type**
Indoor	Finished	Dry	1
Indoor	Unfinished	Dry	1
Indoor	Unfinished	Industrial Use	12
Indoor and Outdoor	Any	Wet	4
Indoor and Outdoor	Any	Denoted "WP"	3R
Indoor and Outdoor	Any	Wet and Corrosive	4X 316 Stainless Steel, or by Authority approval polycarbonate
Indoor and Outdoor	Any	Wet, Dust or Oil	13
Indoor and Outdoor	Any	Hazardous Gas	7
Indoor and Outdoor	Any	Hazardous Dust	9

EXECUTION

1. Pushbutton, Indicating Light, and Selector Switch:

    a. Unless otherwise shown, install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations.

    b. Unless otherwise shown, install heavy-duty, watertight and corrosion- resistant type in nonhazardous, outdoor, or normally wet areas.

2. Support and Framing Channel:

    a. Install where required for mounting and supporting electrical equipment, raceway, and auxiliary gutter and wireway systems.

    b. Channel Type:

        i. Interior Dry (Noncorrosive) Locations: Steel Raceway and Other Systems Not Covered: Hot dipped galvanized steel.

        ii. Interior Wet (Noncorrosive) Locations: Steel Raceway and Other Systems Not Covered: Hot dipped galvanized steel or Extruded Aluminum channel with Authority written permission

        iii. Outdoor Locations: Steel Raceway: Hot dipped galvanized channel or Extruded Aluminum channel with Authority written permission.

    c. Paint cut ends prior to installation with the following:

        i. Carbon Steel Channel: Zinc-rich primer.

    d. Provide insulating material or coating to separate surface of Aluminum channel from concrete and dissimilar materials.

3. Switchboard Matting:

    a. Install 36-inch width at switchgear, switchboard, motor control centers, control panels, server and data cabinets, and panelboards.

    b. Matting shall run full length of all sides of equipment that have operator controls.

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

SUMMARY

1. Section Includes:

    a. Building wires and cables rated 600 V and less.

b. Connectors, splices, and termination rated 600 V and less.

PRODUCTS

1. Conductors and Cables:

   a. Copper Conductors

   b. Conductor Insulation

   c. Multi-conductor Cable: metal-clad cable, Type MC with ground wire.

   d. Fire Rated Cable: Compliant with application, rated for 120 minutes.

2. Connectors and Splices:

   a. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

EXECUTION

1. Conductor Material Applications:

   a. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

   b. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

2. Conductor Insulation and Multiconductor Cable Applications and Wiring Methods:

   a. Service Entrance: Type XHHW-2, single conductors in raceway.

   b. Exposed Feeders and Branch Circuits: Type THHN-THWN, single conductors in raceway.

   c. Feeders and Branch Circuits Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

   d. Feeders and Branch Circuits Concealed in below grade concrete walls, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

   e. Feeder and Branch Circuits exposed above roofing: XHHW-2.

   f. Fire Rated Feeders: Mineral-insulated, metal-sheathed cable, Type MI. Installed within the limitations of the product listing and in accordance with manufacturer's instruction. Routing shall provide access for maintenance. Rigidly secure manufacturer's cable supports to structure.

   g. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-

mesh, strain relief device at terminations to suit application.

h. VFC Output Circuits: Type XHHW in metal conduit.

3. Installation of Conductors and Cables:

a. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

b. Complete raceway installation between conductor and cable termination points according to Section 260533 Raceways and Boxes prior to pulling conductors and cables.

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

d. Support cables according to Section 260529 Electrical Support and Seismic Restraints.

e. Complete cable tray systems installation according to Section 260536 Cable Trays prior to installing conductors and cables.

4. Connections:

a. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

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

i. Use oxide inhibitor in each splice, termination, and tap.

ii. Aluminum conductors not allowed.

c. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

5. Field Quality Control:

a. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

b. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

c. Perform the following tests and inspections:

i. After installing conductors and cables and before electrical circuitry has been energized,

test service entrance and feeder conductors for compliance with requirements.

ii. Perform each visual and mechanical inspection and electrical test stated. Certify compliance with test parameters.

iii. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 2 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

a) Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.

b) Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c) Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

d. Test and Inspection Reports: Prepare a written report to record the following:

i. Procedures used.

ii. Results that comply with requirements.

iii. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

e. Cables will be considered defective if they do not pass tests and inspections.

26 05 26—GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PRODUCTS

1. Ground Rod:

a. Material: Copper-clad steel.

b. Diameter: Minimum 3/4 inch.

c. Length: 10 feet.

2. Ground Bus Bars:

    a. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.

        i. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.

        ii. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.

        iii. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

    b. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

3. Connectors:

    a. Exothermic Weld Type (in areas where approved in writing by the Authority.

        i. Outdoor Weld: Suitable for exposure to elements or direct burial.

        ii. Indoor Weld: Utilize low-smoke, low-emission process.

4. Compression Type:

    a. Compress-deforming type; wrought copper extrusion material.

    b. Single indentation for conductors 6 AWG and smaller.

    c. Double indentation with extended barrel for conductors 4 AWG and larger.

    d. Barrels prefilled with oxide-inhibiting and anti-seizing compound and sealed.

5. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy or bi-metallic material for aluminum conductors where permitted.

6. Grounding Wells:

    a. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

EXECUTION

1. General:

    a. All new buildings shall have an exterior ground mat “ring.”

b. Bond electrical service neutral at service entrance equipment to grounding electrode system consisting of Authority approved grounding electrodes all bonded together.

c. Bond each separately derived system neutral to grounding electrode system. Bond metal piping systems in the area served by the separately derived system to the neutral and to the grounding electrode system.

d. Bond metallic enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, to the grounding system.

e. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer. Carry ground wires separately to ground bus, no "piggyback" of ground wires allowed.

f. Shielded Instrumentation Cables:

   i. Ground shield to ground bus at control panel which receives (monitors) the instrument signal. Ground instrument shield and drain wires to control panel common instrument ground bus. For instruments not monitored by a control panel, ground instrument shield and drain wire at power supply for instrument analog signal.

   ii. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.

   iii. Do not ground any single instrumentation cable shield at more than one point.

2. Wire Connections:

   a. Ground Conductors: Install in raceways containing power conductors and control circuits above 50 volts.

   b. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

   c. Connect ground conductors to raceway grounding bushings.

   d. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

   e. Bond equipment enclosures containing ground bus to that bus.

f. Bolt connections to equipment ground bus.

g. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

h. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding screws mounted directly on box, or with 3/8-inch machine screws.

3. Ground Rods:

a. Install full length with conductor connection at upper end.

b. Install with connection point below finished grade, unless otherwise shown.

c. Space multiple ground rods by one rod length.

d. Install rods with Manufacturer mark and UL mark visible.

4. Grounding Wells:

a. Install inside buildings, asphalt, and paved areas.

b. Install riser ring and cover flush with surface.

c. Place 6 inches of crushed rock in bottom of each well.

d. Ground rod connection shall be by bolted connector listed for grounding and bonding use.

5. Connections:

a. General:

i. Above grade Connections: Install exothermic weld (Written permission required unless utilized in areas pre-approved by the Authority or compression -type connectors.

ii. Below grade Connections: Install exothermic weld (Written permission required unless utilized in areas pre-approved by the Authority or compression type connectors.

iii. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.

iv. Notify the Authority prior to backfilling ground connections.

b. Exothermic Weld Type (Written permission required unless utilized in pre-approved areas by the Authority:

i. Wire brush or file contact point to bare metal surface.

ii. Use welding cartridges and molds in accordance with manufacturer's recommendations.

iii. Avoid using badly worn molds.

iv. Mold to be completely filled with metal when making welds.

v. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

c. Compression Type:

i. Install in accordance with connector manufacturer's recommendations.

ii. Install connectors of proper size for grounding conductors and ground rods specified.

iii. Install using connector manufacturer's compression tool having proper sized dies.

d. Mechanical Type:

i. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.

ii. Install in accordance with connector manufacturer's recommendations.

iii. Do not conceal mechanical connections.

6. Metal Structure Bonding:

a. Bond metal sheathing and exposed metal vertical structural elements to grounding system.

b. Bond electrical equipment supported by metal platforms to the platforms.

c. Provide bonding contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

7. Manhole and Handhole Grounding:

a. Install one ground rod inside each.

b. Ground Rod Floor Protrusion 4 to 6 inches above floor.

c. Make connections of grounding conductors fully visible and accessible.

d. Connect all noncurrent-carrying metal parts, and any metallic raceway grounding bushings to ground rod with No. 6 AWG copper conductor.

8. Transformer Grounding:

    a. Bond neutrals of transformers within buildings to grounding system, and to any additional indicated grounding electrodes. Ref. 26 05 26-3.1 C & D.

    b. Bond neutrals of pad-mounted (outdoor) transformers to locally driven ground rods and buried ground wire encircling transformer and grounding electrode system.

9. Surge Protection Equipment Grounding

    a. Connect surge arrestor ground terminals to equipment ground bus.

26 05 29—HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

SUMMARY

1. Section Includes:

    a. Hangers and supports for electrical equipment and systems.

    b. Concrete base construction requirements.

    c. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

2. Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements below.

    a. Design supports for multiple raceways capable of supporting combined weight of supported systems and its content.

    b. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

    c. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

    d. Design supports for seismic restraint loading according to International Building Code Site Class, Use Group or Building Category and the Office of Statewide Planning and Development for the State of California.

3. Coordinate size and location of concrete bases. Cast anchor bolt inserts into bases.

PRODUCTS

1. Steel Slotted Support Systems:
    a. Metallic Coatings: Interior Locations - Hot-dip galvanized after fabrication.
    b. Outdoor Locations – Stainless Steel.
    c. Channel Dimensions: Selected for applicable load criteria.
    d. Material for Channel, Fittings, and Accessories: Interior Locations - Galvanized steel. Outdoor Locations – Stainless Steel.
2. Raceway and Cable Supports
3. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
4. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
5. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
    a. Concrete Inserts: Steel or malleable -iron, slotted support system units
    b. Clamps for Attachment to Steel Structural Elements: type suitable for attached structural element.
    c. Through Bolts: Structural type, hex head, and high strength.
    d. Toggle Bolts: All-steel springhead type.
    e. Hanger Rods: Threaded steel.
    f. Mechanical Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
6. Hardware Corrosion Protection:
    a. Bolts, nuts, studs, washers, pins, terminal, springs, hangers, and other fastenings and fittings shall be of a corrosion resisting material or treated to render hardware resistant to corrosion.
    b. Hardware for Exterior Use: Stainless steel.

c. Provide galvanized ferrous metalwork.

7. Housekeeping Pad:

a. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base. Minimum concrete base height shall be 4 inches.

b. Use 3000-psi, 28-day compressive-strength concrete.

c. Anchor equipment to concrete base.

i. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

ii. Install anchor bolts to elevations required for proper attachment to supported equipment.

iii. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

d. Structural floors, housekeeping pads, supporting curbs, and supporting steel must be seismically designed and approved by the Project or Building Structural Engineer of Record to withstand the seismic anchor loads. Installation details such as special inspection, attachment to curb, or attachment to non-building structure must be outlined and approved by the engineer of record for the project or building. The installing contractor shall be responsible for the proper installation of the equipment and must observe the seismic installation requirements set forth by the Engineer of Record.

EXECUTION

1. Application:

a. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

b. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Minimum rod size shall be 1/4 inch in diameter.

c. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

i. Secure raceways and cables to these supports with two-bolt conduit clamps.

d. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

2. Support Installation:

a. Mounting and Anchorage of Surface -Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

i. To Wood: Fasten with lag screws or through bolts. Horizontal placement only.

ii. To New Concrete: Bolt to concrete inserts.

iii. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

iv. To Existing Concrete: Expansion, stainless steel anchor fasteners.

v. To Steel: Welded threaded studs with lock washers and nuts.

vi. To Light Steel: Sheet metal screws.

vii. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

b. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

c. Anchor equipment to concrete base.

i. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

ii. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3. Painting:

    a. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting.

        i. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

    b. Touchup: Comply with requirements in 4.2.2.4 and 4.2.2.5 for "Interior Painting" and "High Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

    c. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint.

26 05 33—RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

SUMMARY

1. Section Includes:

    a. Metal conduits, tubing, and fittings.

    b. Nonmetal conduits, tubing, and fittings.

    c. Surface metal raceways.

    d. Boxes, enclosures, and cabinets.

    e. Metal wireways and auxiliary gutters.

PRODUCTS

1. Metal Conduits, Tubing, and Fittings:

    a. GRC - Rigid Metal Conduit

    b. PVC Coated GRC – Galvanized Rigid Steel Conduit PVC coated

    c. ARC – Aluminum Rigid Conduit

    d. IMC – Intermediate Metal Conduit

    e. EMT – Electrical Metallic Tubing

    f. FMC – Flexible Metal Conduit

    g. LFMC - Liquid tight Flexible Metal Conduit

    h. Cast fittings shall not be allowed

    i. Fittings for EMT

    j. Joint Compound for IMC or GRC: compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

    k. No die cast fittings allowed.

2. Nonmetallic Conduits, Tubing, and Fittings:

    a. RNC—Rigid PVC Conduit

3. Metal Wireways and Auxiliary Gutters:

    a. Auxiliary Gutters shall not be installed above or below switchboards or panelboards without Authority approval.

    b. Sheet metal, complying with UL 870 and NEMA 250, NEMA 4x/SS unless otherwise indicated, and sized according to NFPA 70.

    c. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

    d. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

    e. Wireway Covers: For interior locations not subject to water intrusion - screw-cover type unless otherwise indicated. For exterior locations – flanged and gasketed.

    f. Finish: Manufacturer's standard enamel finish.

    g. Auxiliary gutters shall not be used above or below panelboards or switchboards, for convenience, without approval from The Authority.

4. Surface Metals Raceways:

    a. Galvanized steel with snap-on covers, listed and labeled as defined by NFPA 70.

5. Boxes, Enclosures, and Cabinets:

    a. When installed in wet locations: Listed for use in wet locations.

    b. Sheet Metal Outlet and Device Boxes:

    c. Device boxes dimensions shall be 4 inches square by 2 1/8 inches deep.

    d. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

    e. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

    f. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

    g. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

    h. Gangable boxes are prohibited.

i. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

i. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

ii. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

j. Cabinets:

i. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

ii. Hinged door in front cover with flush latch and concealed hinge.

iii. Key latch to match panelboards.

iv. Metal barriers to separate wiring of different systems and voltage.

v. Accessory feet where required for freestanding equipment.

EXECUTION

1. Outdoors – Apply raceway products as indicated below unless noted other wise.

a. Exposed Conduit, exterior locations including below canopies, overhangs and on roofs: GRC – Rigid Metal Conduit.

b. Concealed Conduit Above Ground: IMC -Intermediate Metal Conduit.

c. Connection to Vibrating Equipment including transformers, solenoids, motors, etc. LFMC - Liquid Tight Flexible Metal Conduit.

d. Underground Conduit: RNC – Rigid PVC Conduit.

2. Indoors - Apply raceway products as indicated below unless noted other wise.

a. Exposed, not subject to physical damage; above eight feet from finished floor in mechanical rooms, in baggage handling areas, in loading docks, in material handling rooms and in corridors: Electrical Metallic Tubing– EMT.

b. Exposed, subject to physical damage, below eight feet from finished floor in mechanical rooms, in baggage handling areas, in loading docks, in material handling rooms and in corridors: GRC – Rigid Metal Conduit.

c. Concealed above ceilings, interior walls and partitions: EMT – Electrical Metallic Tubing.

d. Connections to vibrating equipment, including transformers, solenoids, and motor-driven equipment: Flexible metal conduit – FMC, except in damp or wet locations use LFMC.

e. Minimum raceway size: ¾-inch diameter.

3. Raceway fittings:

a. GRC and IMC: Use threaded rigid steel conduit fittings.

b. EMT: Use compression steel fittings.

c. ARC and boxes shall not be in contact with concrete or earth.

4. Installation:

a. Maintain a minimum of 6 inches of separation between conduits and parallel runs of flues, steam or hot water piping.

b. Raceway installation shall be complete before commencing installation of conductors.

c. Conceal conduits within finished walls, ceilings and floors unless otherwise indicated.

d. Provide a minimum of 2-inch cover in all directions for conduits embedded in concrete.

e. Provide expansion fittings at all crossings of expansion joints.

f. Before rising from above the ground or concrete slab, change from RNC to PVC Coated GRC 90˚ elbows.

g. Provide insulating bushings to terminate conduit stub-ups when not terminated in a box or enclosure.

h. Terminate threaded conduits with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1 ¼ -inch trade size and insulated throat metal bushings on 1 ½ -inch trade size and larger. Install insulated throat metal grounding bushings on feeder conduits.

i. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200 pounds of tensile strength. Leave a minimum of 18 inches of slack at each end of the pull wire.

j. Horizontally separate recessed boxes mounted on opposite sides of walls by a minimum of 6 inches edge-to-edge.

k. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are

allowed. Support within 12 inches of changes in direction.

l. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

m. Support conduit within 12 inches (300 mm) of enclosures to which attached.

n. Raceways Embedded in Slabs:

   i. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.

o. Stub-Ups to Above Recessed Ceilings:

   i. Use EMT, IMC, or RMC for raceways.

   ii. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

p. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

r. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

s. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

t. Locate boxes so that cover or plate will not span different building finishes.

u. Install firestopping at penetrations of fire-rated walls and floors.

26 05 36—CABLE TRAYS FOR ELECTRICAL SYSTEMS

SUMMARY

1. This section includes steel and aluminum cable trays and accessories.

PRODUCTS

1. Materials and Finishes:
    a. Tray shall be continuous, rigid, welded wire mesh consisting of a welded wire mesh bottom with integrated welded wire mesh side rails.
    b. Damp Locations: Cable Trays, Fittings, and Accessories: Steel,
        i. Hot dip galvanized after fabrication
    c. Dry Locations: Cable Trays, Fittings, and Accessories: Aluminum, for rails, rungs, and cable trays.
    d. Sizes and Configurations: Refer to the Cable Tray Description on Drawings for specific requirements for types, sizes, and configurations.
    e. Center-hanger supports may be used only when specifically indicated.
2. Cable Tray Accessories:
    a. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
    b. Barrier Strips: Same materials and finishes as cable tray.
    c. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
3. Warning Signs:
    a. Lettering: 1-1/2-inch-high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

EXECUTION

1. Cable Tray Installation:
    a. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
    b. Remove burrs and sharp edges from cable trays.

c. Fasten cable tray supports to building structure.

   i. Place supports so that spans do not exceed maximum spans recommended by manufacturer.

   ii. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

   iii. Support tray assembly to prevent twisting from eccentric loading.

   iv. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.

d. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.

e. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions Recommendations. Space connectors and set gaps according to applicable standard..

f. Make changes in direction and elevation using standard or hinged fittings.

g. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

h. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

i. Workspace: Install cable trays with enough space to permit access for installing cables.

j. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600 V, 5000 V, and 15,000 V.

k. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

2. Cable Installation:

   a. Install cables only when cable tray installation has been completed and inspected.

b. Fasten cables on horizontal runs with cable clamps or cable ties as recommended. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

c. On vertical runs, fasten cables to tray every 18 inches. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

3. Connections:

a. Ground cable trays according to manufacturer's written instructions.

b. Cable trays shall have an integral grounding system.

4. Field Quality Control:

a. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

i. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.

ii. Verify that the number, size, and voltage of cables in cable tray do not exceed limits permitted. Verify that communication or data-processing circuits are separated from power circuits by barriers.

iii. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.

iv. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.

v. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.

vi. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.

vii. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

b. Report results in writing.

5. Protection:
    a. Protect installed cable trays.
        i. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
        ii. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

26 05 43—UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

SUMMARY

1. Section Includes:
    a. Direct buried and concrete-encased conduit, ducts, and duct accessories.
    b. Handholes and boxes.
    c. Manholes.

PRODUCTS

1. Conduit:
    a. Rigid Steel Conduit: Galvanized.
    b. Coated Steel Conduit: PVC-coated GRC. Minimum coating thickness of 0.040. inch.
    c. RNC: Type EPC-40-PVC, with matching fittings by same manufacturer as conduit.
2. Nonmetallic Ducts and Duct Accessories:
    a. Underground Plastic Utilities Duct: Type EPC-40, with matching fittings.
    b. Underground Plastic Utilities Duct for SDG&E ductbanks only: Type DB -60 PVC, with matching fittings.
    c. Duct Accessories:
        i. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
        ii. Warning Tape: Underground-line warning tape shall comply with products indicated in Section 260553 "Identification for Electrical Systems."

3. Precast Concrete Handholes and Boxes:

    a. Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

    b. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

    c. Cover Finish: Nonskid finish shall have minimum coefficient of friction of 0.50.

    d. Cover Legend: Molded lettering, "ELECTRIC" or as indicated.

4. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

    a. Type and size shall match fittings to duct or conduit to be terminated.

    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

    c. Conduit terminations shall fit flush with the interior wall of the handhole.

5. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

6. Precast Manholes:

    a. Shall be waterproofed before delivery.

    b. Comply with structural design loading requirements specified for project requirements with interlocking mating sections, complete with accessories, hardware, and features.

    c. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

        i. Type and size shall match fittings to duct or conduit to be terminated.

        ii. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

        iii. Conduit terminations shall fit flush with the interior wall of the manhole.

d. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

e. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground -water level at grade.

7. Utility Structure Accessories:

a. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

i. Frame and Cover: Weatherproof, gray cast iron complying with milled cover-to-frame bearing surfaces; diameter, 26 inches.

ii. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

iii. Cover Legend: Cast in. Selected to suit system.

iv. Legend: "ELECTRIC" for duct systems with power wires and cables for systems operating at 120 V or greater.

b. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.

c. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt. Working load embedded in 6-Inch, 4000-psi concrete, 13,000-lbf minimum tension.

d. Pulling-In and Lifting Irons in Concrete Floors:

i. 7/8-inch-diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

ii. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

e. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments:

i. 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.

ii. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

f. 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.

g. Cable Rack Assembly: Nonmetallic; components fabricated from nonconductive, fiberglass-reinforced polymer.

   i. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of nine holes for arm attachment.

   ii. Arms: Arranged for secure, drop -in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.

h. Inflatable seals for all ducts that have cabling.

8. Duct Bank Encasement:

   a. Concrete: 3000 psi.

   b. Color: Red for medium voltage (over 2000 volts) or higher ducts.

   c. Color: Orange for telecommunications.

EXECUTION

1. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Owner if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

2. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Owner.

3. Ducts for electrical cables over 600 V: Rigid non-metallic conduit, PVC in concrete encased duct bank.

4. Ducts for electrical feeders: Rigid non-metallic conduit, PVC in direct buried duct bank.

5. Ducts for electrical branch circuits: Rigid non-metallic conduit, PVC in direct buried duct bank.

6. Ducts for telephone, data, communications, service cables: Rigid non-metallic conduit, PVC in concrete encased duct bank.

7. Underground ducts for telephone, data and communications circuits: Rigid non-metallic conduit, PVC in direct buried duct bank.

8. Underground ducts under driveways, roadways, aircraft apron: Rigid non-metallic conduit, PVC in concrete encased duct bank.

9. Handholes and boxes in roadways, driveways, aircraft apron and other deliberate traffic areas: Precast concrete.

10. Handholes in sidewalks and similar applications for non-deliberate loading by vehicles: Precast concrete.

11. Precast Manholes in roadways and other deliberate vehicular traffic:.

12. Excavation and backfill: restore surface features and re-establish original grades, restore vegetation to match previously existing conditions.

13. Use 5-degree angle couplings for small changes in direction. Use manufactured long-sweep bends with a minimum radius of 48 inches, both horizontally and vertically.

14. Use solvent-cemented joints and make water-tight according to manufacturer's instructions. Grout end bells into structure walls from both sides to provide watertight entrances. Stagger couplings so those of adjacent ducts do not lie in the same plane.

15. Duct Entrances to Manholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

16. Seal spare ducts at terminations. Use plugs to withstand at least 15-psig hydrostatic pressure.

17. Install labels inside each manhole, handhole and vault, directly over the incoming and outgoing conduits. Label shall identify the location at which the conduit starts or the location at which the conduit ends. Labeling needs to be waterproof, since water intrusion is common.

18. Install 2500lbs 3/4" polyester unspliced taping with markings in spare ducts.

19. Concrete-Encased Ducts: Support ducts on duct separators. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during

concreting. Stagger separators 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. No steel or EMT to be used as stake downs.

20. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 36 inches below finished grade in deliberate traffic paths for vehicles.

21. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

22. Excavate trench bottom to provide firm and uniform support for duct bank.

23. Install ducts with a minimum of 3 inches between ducts for like services and 12 inches between power and signal ducts.

24. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

25. Precast Concrete Handhole and Manhole Installation: Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

26. Unless otherwise indicated, support units on a 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.

27. Field Quality Control: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

28. Pull aluminum test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

29. Cleaning of ducts: 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.

30. Clean internal surfaces of manholes, including sump. Remove foreign material.

31. Provide a stable bottom in the event water is encountered in the excavation.

26 05 53—IDENTIFICATION FOR ELECTRICAL SYSTEMS

SUMMARY

1. Section Includes:
    a. Identification for raceways.
    b. Identification of power and control cables.
    c. Identification for conductors.
    d. Underground-line warning tape.
    e. Warning labels and signs.
    f. Equipment identification labels.
2. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
3. Underground conduits-Line Warning Type: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Provide warning tape for underground concrete -encased ducts and duct banks as **required by section 260543** Underground Ducts and Raceways
4. Conduits and outlet boxes for special systems including emergency power, fire alarm, and communications systems shall be color coded for identification throughout.
5. Conduits shall be spray painted with system color code at 3-foot intervals.
6. Outlet and junction boxes shall be spray painted with system color code on exterior of box, except boxes which are flush mounted in walls, ceilings, or floors shall be painted on box interior.
7. System color codes shall be as indicated in the Color Code Chart shown on the following page.

COLOR CODE FOR ALL ELECTRICAL CONDUITS AT SDCRAA

BROWN	HVAC
YELLOW	277/480V
YELLOW with white stripes	Lighting Control
ORANGE	EMERGENCY/UPS
ORANGE with blue stripes	Emergency 120/208V
ORANGE with yellow stripes	Emergency 277/480V
PINK	ACS/SECURITY
RED	FIRE ALARM
WHITE	TELEPHONE/DATA/DAS
YELLOW/BLACK	12KV
BLUE	120/208V
PURPLE	LOADING BRIDGE
GRAY	FIDS/RIDS/BIDS/VISUAL DISPLAY
BLACK	PAGING/PA/Intercom
GREEN	GROUND

RACEWAYS OVER 600V HAVE BLACK LETTERS IN AN ORANGE FIELD.

PRODUCTS

1. Power and Control Cable Identification Materials:

    a. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

    b. Spacing shall be at 10 feet on center.

2. Conductor Identification Materials: Heat -shrink, pre-printed tubing type wire markers. Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies.

3. Floor Marking Tape: 2-inch wide, 5-mil pressure sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

4. Underground-Line Warning Tape:

    a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.

    b. Printing on tape shall be permanent and shall not be damaged by burial operations.

    c. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

    d. Tape shall be reinforced detectable type, 4 inches wide.

    e. Color and Printing:

        a) Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

        b) Inscriptions for Yellow-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,

5. Warning Labels and Signs

    a. Baked-Enamel Warning Signs:

        i. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

        ii. 1/4-inch grommets in corners for mounting.

        iii. Nominal size, 7 by 10 inches.

    b. Warning label and sign shall include, but are not limited to, following legends:

i. Multiple Power Source Warning: "DANGER -ELECTRICAL SHOCK HAZARD -EQUIPMENT HAS MULTIPLE POWER SOURCES."

ii. Workspace Clearance Warning: "WARNING -OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

iii. Comply with NFPA 70E for arc-flash warning labels.

iv. Multiple power source warning: "DANGER -ELECTRICAL SHOCK HAZARD –EQUIPMENT HAS MULTIPLE POWER SOURCES."

6. Equipment Identification Nameplates: Engraved, three-layer laminated plastic with black letters on a white background. Minimum letter height shall be 3/8 inch. Secure with rivets or screws.

7. General-Purpose Cable Ties: Fungus inert, self extinguishing, one-piece, self locking, Type 6/6 nylon. Minimum width shall be 3/16-inch. Color shall be black except when color coding the system.

EXECUTION

1. Apply identification devices to surfaces that require finish after completing finish work.

2. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

3. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

4. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50- foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

5. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

6. Emergency Power.

7. Power.

8. UPS.

9. Power-Circuit Conductor Identification, 600 Volts or Less: For conductors in vaults, pull and junction boxes,

manholes, and handholes, use color-coding conductor tape to identify the phase.

10. Color-Coding for Phase and Voltage Level Identification, 600 Volts or Less: Use colors listed below for ungrounded service and feeder conductors.

11. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

12. Colors for 208/110-Volt Circuits:

    a. Neutral: White

    b. Phase A: Black.

    c. Phase B: Red.

    d. Phase C: Blue

13. Colors for 480/277-Volt Circuits:

    a. Neutral: Grey

    b. Phase A: Brown.

    c. Phase B: Orange.

    d. Phase C: Yellow.

14. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

15. Power-Circuit Conductor Identification, more than 600 Volts: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

16. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

17. Labeling Instructions: Indoor Equipment - Engraved, laminated acrylic or melamine label. provide a single line of text with 1/2-inch high letters on 1-1/2-inchhigh label; where two lines of text are required, use labels 2 inches high.

18. Outdoor Equipment: Engraved, laminated acrylic or melamine label 4 inches high.

19. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

20. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the rating of the enclosure.

21. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be [self-adhesive, engraved] [engraved], laminated acrylic or melamine label.

    b. Enclosures and electrical cabinets.

    c. Access doors and panels for concealed electrical items.

    d. Switchgear.

        i. Switchgear and Distribution equipment shall have a mimic buss attached to the exterior of the gear.

    e. Switchboards.

    f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

    g. Substations.

    h. Emergency system boxes and enclosures.

    i. Motor-control centers.

    j. Enclosed switches.

    k. Enclosed circuit breakers.

    l. Enclosed controllers.

    m. Variable-speed controllers.

    n. Push-button stations.

    o. Power transfer equipment.

    p. Contactors.

    q. Remote-controlled switches, dimmer modules, and control devices.

    r. Battery-inverter units.

    s. Battery racks.

    t. Power-generating units.

    u. Monitoring and control equipment.

    v. UPS Equipment.

26 05 73—OVERCURRENT PROTECTIVE DEVICE AND SYSTEM ANALYSIS

SUMMARY

1. This Section includes computer-based, fault-current and overcurrent protective device coordination studies and arc flash analysis. Protective devices shall be set based on results of the protective device coordination study.

PRODUCTS

1. Performance Requirements: Overcurrent protective device settings and operation:

    a. Selective Coordination:

        i. The following systems shall selectively coordinate as required by code:

            a) Emergency Systems

            b) Life Safety Systems

            c) Legally Required Standby Systems

            d) Multibank elevators

            e) Designated Critical Operations Power Systems

        ii. If the "system" or branch cannot be determined, the components shall be selectively coordinated.

        iii. Requirements for selective coordination take priority over other aspects of the drawings and specifications. Adjust equipment sizes, methods of construction, frame sizes, current sensing, and device trip characteristics to achieve overcurrent device coordination

    b. Selective coordination for faults extending beyond 0.1 seconds:

        i. Requirements for coordination take priority over other aspects of the drawings and specifications. Adjust equipment sizes, methods of construction, frame sizes, current sensing, and device trip characteristics to achieve overcurrent device coordination.

        ii. Auxiliary gutters shall not be used above or below panelboards or switchboards, for convenience, without approval from the Authority.

    c. Optimize settings of overcurrent devices to achieve time current coordination to the extent possible:

        i. Where new selectively coordinated systems tie to an existing device,

        ii. "Normal" power.

iii. Other electrical systems

d. Equipment Ratings: Verify indicated equipment ratings are congruent with the results of the study:

i. Short circuit current withstand ratings for the number of cycles determined by overcurrent protective device settings.

ii. Ampere interrupting capacity of overcurrent protective devices.

iii. X/R ratios in compliance with NEMA standards for the ampacity of the device.

iv. Where the study reveals the need for changing equipment ratings revise the equipment to comply with the rating determined by the study.

e. Series-rated devices are not permitted.

2. Computer Software Developers:

a. Available Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

i. Eaton (CYME)

ii. EnergoBit Group (EDSA)

iii. Operation Technology Inc. (etap)

iv. SKM Systems Analysis, Inc.

v. EasyPower, LLC

3. Computer Software Program Requirements:

a. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots. Computer software program shall plot diagramming time-current-characteristic curves keyed to overcurrent protective devices.
1. Additional fault current reports:

i. Arcing faults.

ii. Simultaneous faults.

iii. Explicit negative sequence.

iv. Zero sequence.

b. Arc flash calculations: Software program shall calculate Arc Flash Incident Energy levels and flash protection boundary distances.

i. Arc flash energy shall be based on the worst case exposed bus or cable termination in each switchgear/switchboard vertical section and panelboard.

4. Arc Flash Warning Labels:

    a. Vinyl: 4 mil thick with tapered edge. Full resin thermal print on a multi-layer scratch resistant substrate.

    b. Label shall identify the following:

        i. Equipment Identification

        ii. Who performed the study

        iii. Date of the study

        iv. Approach Distances

        v. Flash Hazard

            a) Boundary

            b) Incident heat energy

        vi. Additional warnings appropriate to arc flash safety for the particular item of equipment

        vii. Requirements of owner's safety program, relative to arc flash hazards

EXECUTION

1. Examination:

    a. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

        i. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

    b. Provide the study based on the actual electrical equipment supplied for the project.

2. Power System Data:

    a. Gather and tabulate the following input data to support coordination study:

        i. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

        ii. Impedance of utility service entrance.

iii. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

a) Circuit-breaker and fuse-current ratings and types.

b) Relays and associated power and current transformer ratings and ratios.

c) Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.

d) Generator kilovolt amperes, size, voltage, and source impedance.

e) Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.

f) Busway ampacity and impedance.

b. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

i. Special load considerations, including starting inrush currents and frequent starting and stopping.

ii. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

iii. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

iv. Generator thermal-damage curve.

v. Ratings, types, and settings of utility company's overcurrent protective devices.

vi. Special overcurrent protective device settings or types stipulated by utility company.

vii. Time-current-characteristic curves of devices indicated to be coordinated.

viii. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

ix. Manufacturer and type, ampere -tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

x. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3. Fault-Current Study:

a. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

i. Switchgear and switchboard bus.

ii. Medium-voltage controller.

iii. Motor-control center.

iv. Distribution panelboard.

v. Branch circuit panelboard.

b. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

c. Calculate momentary and interrupting duties on the basis of maximum available fault current.

d. Study Report:

i. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

ii. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium- voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

e. Equipment Evaluation Report:

i. For 600-Volt overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

ii. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

iii. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

4. Coordination Study:

a. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study.

i. Calculate the maximum and minimum 1/2-cycle short-circuit currents.

ii. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.

iii. Calculate the maximum and minimum ground-fault currents.

iv. Plot time current characteristic curves and tabulate manufacturer tested combinations of equipment

b. Transformer Primary Overcurrent Protective Devices:

i. Device shall not operate in response to the following:

a) Inrush current when first energized.

b) Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

c) Permissible transformer overloads

ii. Device settings shall protect transformers.

c. Motors served by voltages more than 600 Volts shall be protected

d. Conductor Protection: Protect cables against damage from fault currents and conductor melting curves. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

e. Coordination-Study Report: Prepare a written report indicating the

following results of coordination study:

i. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a) Device tag.

b) Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c) Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.

d) Fuse-current rating and type.

e) Ground-fault relay-pickup and time-delay settings.

ii. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a) Device tag.

b) Voltage and current ratio for curves.

c) Three-phase and single-phase damage points for each transformer.

d) No damage, melting, and clearing curves for fuses.

e) Cable damage curves.

f) Transformer inrush points.

g) Maximum fault-current cutoff point.

f. Completed data sheets for setting of overcurrent protective devices.

5. Overcurrent Protective Device Setting:

a. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to set overcurrent protective devices within equipment.

b. Testing: Engage a qualified testing agency to perform the following device setting and to prepare test reports.

c. Testing: Perform the following device setting and prepare reports:

i. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:

a) Verify that overcurrent protective devices meet parameters used in studies.

b) Adjust devices to values listed in study results.

6. Arc Flash Study:

a. Study shall model worst-case arc flash conditions, and the final report shall describe, when applicable, how these conditions differ from worst case bolted fault conditions.

b. Provide study results in tabular form, and include:

i. Device or bus name

ii. Bolted fault and arcing fault currents levels

iii. Arc Flash Incident Energy Level in cal/cm2

iv. Shock and Flash Hazard boundary distances

c. Furnish and apply arc flash warning labels to the following items of equipment:

i. Switchgear

ii. Switchboards

iii. Transformers

iv. Panelboards

v. Generators

vi. Transfer Switches

vii. Individually mounted overcurrent protective devices

viii. Elevator control panels

ix. Utilization equipment rated 60 amps and above.

26 08 00—COMMISSIONING OF ELECTRICAL SYSTEMS

(RESERVED)

26 09 23—LIGHTING CONTROL DEVICES (CBC TITLE 24 REQUIREMENT)

SUMMARY

1. This Section includes the following lighting control devices:

a. Snap switches and wall box dimmers

b. Indoor occupancy sensors

c. Outdoor motion sensors

d. Outdoor photocell switches

e. Time switches

f. Multi-pole contactors

g. Control Relays

2. This Section includes the following daylighting control devices:

a. Dimmed control of electronic dimming ballasts and drivers with photo sensor(s).

COORDINATION

1. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies

WARRANTY

1. Manufacturer's Warranty: The manufacturer shall provide a written warranty agreeing to provide parts to replace any portion of the lighting control system equipment that fails due to material or workmanship for a period of twelve months after the date of Substantial Completion.

2. Warranty Commencement: Warranty shall begin at the point of substantial completion of the system installation, which is defined as the date when commissioning and owner training has been completed and the owner obtains beneficial use of the system.

3. Warranty Replacement Parts: The manufacturer shall be able to ship replacement parts within 24 hours for any component that that fails due to material or workmanship during the warranty period.

PRODUCTS

1. Toggle Switches :

a. Switches, 120/277 Volts, 20 A:

i. Single Pole:

ii. wo Pole:

iii. Three Way:

iv. Four Way:

b. Pilot-Light Switches, 20 A:

i. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

c. Key-Operated Switches, 120/277 Volts, 20 A:

i. Description: Single pole, with factory-supplied key in lieu of switch handle.

d. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 Volts, 20 A; for use with mechanically held lighting contactors.

e. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center -off Switches: 120/277 Volts, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2. Decorator-Style Devices:

a. Toggle Switches, Square Face, 120/277 Volts, 15 A.

b. Lighted Toggle Switches, Square Face, 120 Volts, 15 A:

i. Products: Subject to compliance with requirements,

ii. Description: With neon-lighted handle, illuminated when switch is "off."

3. Wall-Box Dimmers:

a. Subject to compliance with the contract documents.

b. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

c. Control: Continuously adjustable slider with single-pole or three-way switching.

d. Where two or more devices are ganged together, a single faceplate without visible fasteners will cover all devices.

e. Incandescent Lamp Dimmers: 120 Volts; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

i. 600 Watt; dimmers shall require no derating when ganged with other devices. Illuminated when "off."

f. Fluorescent and LED Lamp Dimmer Switches: Modular; compatible with dimmer ballasts and drivers; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

4. Indoor Occupancy Sensors:

a. Subject to compliance with the contract documents,

b. General Operation

i. The Occupancy Sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the loads automatically. Sensors shall turn on the load within 2 feet of entrance and shall not initiate "on" outside of entrance.

ii. Sensing technologies shall be as indicated on the plans.

iii. Upon detection of human activity by the detector, a Time Delay shall be initiated to maintain the light on for a field adjustable pre-set period.

iv. Mounting

a) Sensor: Suitable for mounting in any position on a standard outlet box.

b) Relay (when required): Externally mounted through a 1/2 inch knockout in a standard electrical enclosure or integral to the sensor.

c) Time Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

v. Line Voltage Sensors

a) Sensor shall be a self-contained dual voltage device capable of directly switching loads upon detection of human activity.

b) Sensor must be rated for 800 watts at 120 VAC, suitable for incandescent light fixtures, fluorescent light fixtures with electronic ballasts, or 1/6 hp motors or rated for 1000 watts at 277 VAC, suitable for LED light fixtures with electronic drivers, or 1/3 hp motors minimum. Sensor shall be capable of parallel wiring for 3-way switching applications.

c) Sensor Time Delay shall be factory set for typical applications, and field adjusted during commissioning. Sensor must provide a LED motion indicator.

vi. Low Voltage Sensor

a) Sensors must be designed to work in conjunction with remote power packs, relays, or other control systems. Sensors must operate with a

Class 2, low voltage wiring strategy. Sensors must be capable of being parallel wired for multi-sensor applications.

b) Sensor must provide a transistor output, returning the voltage input rectified to DC, to control remote power packs, relays, or other control systems. Sensor must be available with an optional single pole, double throw signal relay capable of being wired open on occupancy, or closed on occupancy. Sensor Time Delay shall be factory set for typical applications, and field adjusted during commissioning. Sensor must provide a LED motion indicator.

c. Switch –Box Occupancy

i. General

a) Sensor must not protrude out from the cover plate more than 0.37 inches, and recess into the switch box more than 1 inch. Sensor must surface mount to single gang switch box, and accept accessory plates for multi-gang installations. Sensor must provide an Off/ Auto override switch, (2 switches if 2-pole device).

b) Optional 2-Pole units must be available. Manual or Auto ON shall be configurable for both poles.

ii. Passive Infrared (PIR) Technology

a) PIR sensing, incorporating a combination of heat and movement sensing to detect occupancy in the area of coverage.

iii. Dual Technology (DT)

a) Sensing must incorporate PIR with ultrasonic monitoring. Both PIR and Ultrasonic motion sensing shall initiate an ON condition and either technology sensing motion shall keep the ON state.

b) Either technology shall be able to be disabled during commissioning if necessary for the specific application.

iv. Ultrasonic

a) Ultrasonic sensing incorporating an omni-directional Doppler

technology to detect occupancy in the area of coverage.

v. Switch Type:

a) Single pole

b) Single pole, dual circuit.

c) Single pole, manual "on," automatic "off."

d) Single pole, field selectable automatic "on," or manual "on" automatic "off."

e) Single pole, dual circuit, manual “on”, automatic “off”.

f) Single pole, dual circuit, field selectable automatic "on," or manual "on" automatic "off."

vi. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

vii. Ambient-Light Override: Where indicated on drawings provide concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch shall prevent the lights from turning on when the light level is higher than the set point of the sensor.

d. Ceiling Occupancy Sensors

i. General

a) Sensor shall be ceiling mounted device, mounted to either a single gang enclosure, or surface mounted to a round surface raceway pancake box.

b) Time delay shall be set during commissioning and field adjustable.

c) Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

d) Bypass Switch: Override the "on" function in case of sensor failure.

e) Ambient-Light Override: Where indicated on drawings provide concealed, field-adjustable, light-level sensor from 2 to 200 fc (21.5 to 2152 lux). The switch shall prevent the lights from turning on when the light level is higher than the set point of the sensor.

f) Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either

a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

g) Detection Coverage:

1) Small Room: Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2) Standard Room: Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

3) Large Room: Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.

4) Corridor: Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

ii. Passive Infrared (PIR) Technology

a) PIR sensing, incorporating a combination of heat and movement sensing to detect occupancy in the area of coverage.

b) PIR sensing must utilize a high density Fresnel domed lens, providing a circular view pattern of 360 degrees.

c) Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in.

iii. Dual Technology (DT)

a) Sensing must incorporate PIR with Ultrasonic. Both PIR and Ultrasonic motion sensing shall initiate an ON condition and either technology sending motion shall keep the ON state.

e. Wall Mount Occupancy Sensors (low voltage)

i. General

a) Sensor must be designed for large spaces where the occupants work area is up to 40 feet from the sensor. Sensor must be mounted 8 to 10 feet above the floor,

out of occupants reach. Sensor shall be mounted either flat against the wall or in a corner. For pendant mount fixture applications, sensor must be mounted below the level of the fixture.

b) Sensor time delay shall be set during commissioning and shall be capable of being field modified if necessary.

c) Sensors must be capable of parallel wiring for multi-sensor applications.

5. Power Packs and Slave Packs:

   a. Power Packs and Slave Packs must be designed to power and accept signals from remote Low Voltage Sensors, or other control devices, and directly switch the line voltage of the desired load controlled.

   b. Power Packs must accept 120, 240, or 277 VAC utilizing a dual tap transformer.

   c. Power Pack and Slave Pack relay switching shall not require more than 3 milliamps of current at 15 to 30 VDC.

   d. Power Pack and Slave Pack relay switching shall be performed with a mechanical relay in parallel with an AC Semiconductor to allow relay contacts to switch under a no load condition. Switching capacity shall be 20 amps of all types of loads: Incandescent, Electronic Ballast, Magnetic, or Motor.

   e. Power Packs shall be available in combination 2-Pole units capable of switching two independent loads, 20 amps each.

6. Daylight-Harvesting Switching Controls:

   a. Manufacturer: Subject to compliance with the contract documents,

   b. Photocell shall control the light level in the space by monitoring both the electric light as well as available daylight. Switch controls shall automatically turn lamps/fixtures ON and OFF in response to light levels within the space.

   c. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack to detect changes in indoor lighting levels that are perceived by the eye. Power pack to be mounted on luminaire where indicated in fixture schedule.

   d. Electrical Components, Devices, and Accessories:

i. Marked for intended location and application.

ii. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

iii. Sensor Output: Contacts rated to operate the associated power pack. Sensor is powered by the power pack.

iv. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.

v. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.

vi. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc
(10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.

vii. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.

viii. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.

ix. Test Mode: User selectable, overriding programmed time delay to allow settings check.

x. Control Load Status: User selectable to confirm that load wiring is correct.

xi. Indicator: Two digital displays to indicate the beginning of on-off cycles.

7. Daylight-Harvesting Dimming Controls:

a. Manufacturer: Subject to compliance with the contract documents,.

b. System Description: Sensing daylight and electrical lighting levels, the system shall adjust the indoor electrical lighting levels. As daylight increases, the lights shall be dimmed.

i. Lighting control set point is based on two lighting conditions:

a) When no daylight is present (target level).

b) When significant daylight is present.

ii. Provide system programming with two hand-held, remote-control tools.

a) Initial setup tool.

b) Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

c. Photo sensors shall provide an ON set point and a separate OFF set point, thereby creating a dead band to prevent unnecessary cycling of the electric lights. Set point setting shall be verified with a digital volt meter connected to test leads provided by the sensor. Sensor shall send an electronic, low voltage signal to a remote power pack or other control device which is directly connected to the load. Foot-candle level shall be set 50 fc (300 lux) or as noted on the drawings.

d. Dimming sensors shall interface with the lighting fixture(s) in one of the following ways:

i. The photo sensor shall interface with a 0 to 10 VDC controllable electronic dimming ballast. Dimming sensor shall connect directly to the ballast with 2 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control.

ii. The photo sensor shall interface with a control module that operates one or more 0 to 10 VDC controllable electronic dimming ballasts.

iii. Dimming sensor shall connect directly to the control module with 2 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control

8. Stand Alone Room Automatic Controls:

a. Manufacturers: Subject to compliance with the contract documents.

b. Intelligent Room Controllers

i. Room Controllers must be designed to power and accept signals from remote low voltage sensors, or other control devices, and directly switch the line voltage of the desired load controlled.

ii. Room Controllers must accept 120, 240, or 277 VAC utilizing a dual tap transformer.

iii. Room Controllers shall allow power for auxiliary devices, depending on model.

iv. Room Controller shall employ Zero Cross Circuitry for each load, and shall be capable of switching a 20A load and dimming 0-10V loads. In addition, controllers shall be capable of dimming alternate methods, including but not limited to incandescent dimming, magnetic low voltage, forward phase electronic low voltage and LED drivers, and dimmable two-wire and three-wire fluorescent loads.

v. Room Controllers shall have 1, 2, or 3 switch legs, but no more than a 20A load per device.

c. Ceiling Mounted Occupancy Sensors

i. Ceiling mounted dual technology digital (passive infrared and ultrasonic or microphonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.

9. Photo Sensors:

a. The photo sensor shall interface with multi-input digital addressable dimming ballasts. Dimming sensor shall connect directly to the ballast or module with 4 low voltage wires. Photo sensing element shall be a photoelectric sensor. Sensors shall be closed loop for single zone control or open loop for multi-zone control.

10. Outdoor Motion Sensors:

a. Subject to compliance with the contract documents.

b. General Description: Suitable for operation in ambient temperatures ranging from minus 40 deg F (-40 deg C) to 130 deg F (54 deg C).

i. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

ii. Sensor Output: Suitable for switching 300 W of tungsten load at 120-or 277-Volts ac. Lamp holders for wet locations.

iii. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from relay unit.

iv. Relay Unit: Dry contacts rated for 20A ballast load at 120 and 277 Volt ac, for 13A tungsten at 120 Volt ac, and for 1 hp at 120 Volt ac. Power supply to sensor shall be 24 Volt dc, 150 MA, Class 2 power source.

v. Mounting:

a) Sensor: Suitable for mounting in any position on a standard outdoor junction box.

b) Relay: Internally mounted in a standard weatherproof electrical enclosure.

c) Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

vi. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

vii. Bypass Switch: Override the on function in case of sensor failure.

viii. PIR sensing, incorporating a combination of heat and movement sensing to detect occupancy in the area of coverage.

c. Detection Coverage: Up to 100 feet, with a field of view of 60 degrees. Up to 52.5 feet, with a field of view of 270 degrees or as indicated on drawings.

11. Outdoor Photocell Switches:

a. Subject to compliance with the contract documents.

b. Solid state with SPST dry contacts rated for 1800 VA tungsten or 1000 VA inductive, to operate connected relay, contactor coils, microprocessor input.

i. Light-Level Monitoring Range: 10 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.

ii. Time Delay: variable, to prevent false operation.

iii. Surge Protection: Metal-oxide varistor type.

iv. Mounting: Twist lock with base-and-stem mounting or stem-

and-swivel mounting accessories as required to direct sensor to the North sky exposure.

12. Time Switches (Time Clocks):

    a. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.

        i. Contact Configuration: SPST

        ii. Contact rating: 20A ballast load, 120/ 240 Vac

            a) Program: Single channel, 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.

            b) Circuitry: Allow connection of a photoelectric relay to substitute for on and off function of a program.

            c) Astronomical Time: All channels.

            d) Battery Backup: For schedules and time clock.

13. Multipole Contactors:

    a. Manufacturer: Subject to compliance with the contract documents.

    b. Description: Electrically operated and electrically held, complying with NEMA ICS 2 and UL 508.

        i. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballasts (ballast with 15 percent or less total harmonic distortion of normal load current).

        ii. Control-Coil Voltage: Match low voltage lighting control power source.

14. Control Relays:

    a. Industrial Control Relays: Rated 600Volt, 20A convertible contacts.

    b. General Purpose Relays: Rated 120/ 240 volt, 10A.

15. Conductors and Cables:

    a. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Section 260519 - Low Voltage Conductors and Cables.

b. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 22 AWG, complying with Section 260519 -Low Voltage Conductors and Cables. Provide plenum rated as required.

c. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG, complying with Section 260519 -Low Voltage Conductors and Cables. Provide plenum rated as required.

d. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 260519 - Low Voltage Conductors and Cables. Provide plenum rated as required.

EXECUTION

1. Sensor Installation:

   a. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

   b. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Install sensors in accordance with manufacturer's instructions. Do not exceed coverage limits specified in manufacturer's written instructions.

   c. Where sensors are integral to light fixtures, coordinate orientation and location of fixture with sensor position.

2. Device Installation:

   a. Dimmers:

      i. Install dimmers within terms of their listing.

      ii. Verify that dimmers used for fan speed control are listed for that application.

      iii. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

   b. Arrangement of Devices: Group adjacent switches under single, multigang wall plates.

3. Wiring Installation:

   a. Wiring Method: Comply with Section 260519 - Low Voltage Electrical Power Conductors and Cables.

b. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

c. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

d. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

4. Field Quality Control:

a. Perform the following field tests and inspections and prepare test reports:

i. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with manufacturers' commissioning checklist and section 260126 Maintenance and Testing of Electrical Systems.

ii. Operational Test: Verify actuation of each sensor and adjust time delays.

b. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

c. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

26 09 33—DISTRIBUTED DAYLIGHTING CONTROL

SUMMARY

1. Section Includes:

a. Distributed Digital Lighting Control System: System includes

i. Digital Lighting and Plug Load Controls

ii. Relay Panels

iii. Emergency Lighting Control.

2. Design/Performance Requirements:

a. Digital Lighting Management System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit

the required lighting and electrical system parameters.

b. System shall be an expansion/ extension of the existing Airport's Wattstopper/Legrand Distributed Digital Lighting Control system.

3. Pre-Installation Meetings:

a. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

b. Review installation procedures and coordination required with related Work and the following:

i. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.

ii. Review the specifications for low voltage control wiring and termination.

iii. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.

iv. Discuss requirements for integration with other trades

c. Inspect and make notes of job conditions prior to installation:

i. Record minutes of the conference and provide copies to all parties present.

ii. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.

iii. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

WARRANTY

1. Manufacturer shall provide a 5 year limited warranty, from the date of Substantial Completion, on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

PRODUCTS

1. Distributed Digital Lighting Control System:

a. System General: Provide Digital Lighting Management System (DLM) complete with all necessary enclosures, wiring, and system

components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified, between the Drawing and this Specification, contact the Architect for clarification prior to proceeding.

2. Digital Load Controllers (Room, Plug Load and Fixture Controllers):

    a. Digital Load Controllers: Digital controllers for lighting zones, fixtures and/or plug loads automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting and plug load control requirements. Controllers are simple to install, and do not have dip switches/potentiometers, or require special configuration for standard Plug n' Go applications.

3. Digital Wall or Ceiling Mounted Occupancy Sensor:

    a. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation.

4. Digital Wall Switch Occupancy Sensors:

    a. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation.

    b. Units shall not have any dip switches or potentiometers for field settings.

    c. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

5. Digital Wall Switches:

    a. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration.

    b. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.

    c. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.

6. DLM Handheld User Interface Remotes:

    a. Battery-operated handheld devices in 1, 2 and 5 button configurations for remote switching or dimming control.

b. Provide with a wall mount holster and mounting hardware for each remote.

7. Digital Daylighting Sensors:

   a. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.

8. DLM Segment Network:

   a. Provide a segment network using linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.

9. Network Bridge:

   a. Network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. Network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.

10. LMCP Lighting Control Panels and LMZC Zone Controller:

    a. Hardware: Provide LMCP lighting control panels in the locations and capacities as indicated on the Drawing and schedules.

    b. User Interface: Each lighting control panel system shall be supplied with at least one handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer.

11. Segment Manager:

    a. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).

    b. Each segment manager shall have integral support for at least three

segment networks. Segment networks may alternately be connected to the segment manger via external BACnet-to-IP interface routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the Drawings.

12. Emergency Lighting Control Devices:

    a. Emergency Lighting Control Unit - device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored.

EXECUTION

1. Preparation:

    a. Do not begin installation until measurements have been verified and work areas have been properly prepared.

    b. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

    c. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

2. Installation:

    a. Install system in accordance with the approved system shop drawings and manufacturer's instructions.

    b. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.

        i. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.

        ii. Install all room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty.

        iii. Low voltage wiring topology must comply with manufacturer's specifications.

iv. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.

c. All line voltage connections shall be tagged to indicate circuit and switched legs.

d. Test all devices to ensure proper communication.

e. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

f. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

i. Sensor parameters, time delays, sensitivities, and daylighting setpoints.

ii. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)

iii. Load Parameters (e.g. blink warning, etc.)

g. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.

h. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

i. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

j. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

k. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

3. Field Quality Control:

a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

b. Tests and Inspections: Manufacturer's service

representative shall perform the following inspections and prepare reports.

c. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:

i. Date of test or inspection.

ii. Loads per space, or Fixture Address identification.

iii. Quantity and Type of each device installed

iv. Reports providing each device's settings.

26 09 43—NETWORK LIGHTING CONTROL

SUMMARY

1. Section Includes: microprocessor based, networked, digital, addressable lighting control system including control relay panels, addressable relays, addressable wall switches, addressable photocells, network astronomical time clock, contact closure interface devices, analog sensors, digital addressable sensors, integration interface module(s), dimmers, digital addressable dimmers, digital addressable multi-input dimming ballasts, control workstation with graphic user interface (GUI), software, handheld programmer(s) and required accessories to meet performance indicated in the contract documents.

2. All components of the system shall communicate via the digital intelligent lighting control network.

3. Pre-Installation Meetings:

a. Contractor, vendor (or vendor's representative), Owner and engineer shall meet after submittals are approved and prior to start of low voltage control system installation, to discuss and agree on:

i. Schedule of system installation.

ii. Programming documentation for lighting control schedules and control schemes.

iii. Programming documentation for lighting control graphics.

iv. Interface with building control system.

v. Telephone, wireless and network access.

vi. System startup and commissioning schedule.

vii. Record documentation requirements and schedule.

viii. Training schedule.

4. Coordination:

   a. Coordinate low voltage lighting control network system with:

      i. Building automation system for compatibility, graphics, status, control and interface requirements.

      ii. Architectural dimming controls for compatibility, graphics, status, control and interface requirements.

      iii. Lighting control devices for compatibility, graphics, status, control and interface requirements.

   b. Coordinate the location of all exposed low voltage lighting control switches and sensor devices with architectural finishes and mill work to ensure symmetrical appearance and to avoid interferences.

WARRANTY

1. Installation Warranty: The installing contractor shall provide a written warranty agreeing to provide labor and materials to replace any portion of the lighting control system equipment or wiring that fails due to materials or workmanship for a period of twelve months from warranty commencement.

2. Manufacturer's Warranty: The manufacturer shall provide a written warranty agreeing to provide parts to replace any portion of the lighting control system equipment that fails due to material or workmanship for a period of three years from warranty commencement.

3. Relay Warranty: In addition to the manufacturer's warranty above, the manufacturer shall provide a written warranty specifically for the relays. Warranty shall indicate warranty period and replacement process for each type of relay on the project. This minimum warranty period shall be three years and shall commence from the date of Substantial Completion.

4. Software Warranty: Provide all software upgrades and patches issued by the manufacturer, free of charge during the warranty period.

5. Warranty Commencement: Warranty shall begin at the point of substantial completion of the system installation, which is defined as the date when commissioning and Owner training has been completed and the Owner obtains beneficial use of the system.

6. Warranty Replacement Parts: The manufacturer shall be able to ship

replacement parts within 24 hours for any component that that fails due to material or workmanship during the warranty period.

PRODUCTS

1. Lighting Relay Control Panel:

    a. Enclosure:

        i. Surface mounted (unless otherwise indicated) steel enclosure with lockable, hinged door.

        ii. Minimum of 16 gauge steel construction, 18 gauge for remote relay enclosures (8 or less relays).

        iii. Completely painted with baked enamel paint or powder coated process finish. Galvanized steel enclosure can is acceptable.

        iv. Code gauge steel barrier shall separate the load voltage(s) and the Class 2 control voltage compartments of the panel.

        v. 16 AWG steel barrier shall separate the load voltages, 120 VAC and 277 VAC when both are present.

        vi. Panels must be available in various relay increments up to 48 relays per enclosure.

        vii. Panels must be able to be fully populated to maximum relay capacity without requiring the addition of any cards, additional electronics or additional power supply.

    b. Basic Lighting Control Panel Components:

        i. Microprocessor based controller, pre-assembled, plug-in electronic circuit boards including controller motherboard.

        ii. Relays:

            a) 20 Amp, zero crossing relay type rated for 200,000 operations and suitable for:

            b) 20 amperes 277/480 VAC Ballast

            c) 2400 watts tungsten, lamps

            d) 20 amperes HID lamp and ballast

            e) 1/2 HP, 120 VAC motor

            f) 1.5 HP, 240-277 VAC motor

        iii. Switch input module(s): Provide switch contact input module(s) with sufficient numbers of inputs to meet project requirements. Input types shall be completely user programmable to accept

any combination of momentary, or maintained and two or three-wire switches.

iv. Network module(s): Provide network communications modules of the types and in the quantities required to connect all LCP's in the network, work stations, laptops, LAN systems and specified interface systems.

v. Interconnect cables: Provide all necessary interconnect cables for the LCP, control work station, laptop (when utilized for maintenance or program entry).

vi. Power supply: Provide dual voltage (120 VAC and 277 VAC) transformer with primary and secondary fusing and LED power ON indicator.

vii. Required accessories: provide accessories required by this specification for the operation capabilities required and described.

viii. Nonvolatile memory or Lithium battery backup shall be provided so data is not lost during power outages or brown outs lasting up to 1 year.

ix. Filtering to reduce noise emissions on incoming power.

x. TVSS to mitigate impact from power line spikes.

c. Network Communications Bus

i. System shall communicate over one of the following bus mediums:

a) UL listed Category 5e, 4-pair UTP sequential daisy chain with end-of-line termination device

b) Two-wire, Class 2P, non-polarized bus in any connection topology such as star, loop or daisy chain or any combination of these

c) Fiber optic multimode or single mode cable as required by manufacturer's system

ii. RS-485 communications protocol

iii. Lighting Control LAN Link: Provide appropriate lighting control LAN module for each lighting control panel

iv. Telephone Override: Provide a voice prompted telephone override interface module. Interface module shall accept up to 3 phone lines and allow up to 3 simultaneous phone calls.

Provide voice prompted menu and a minimum of 999 unique pass codes (when required for the project).

d. Operational Features

i. Programmable astronomical date and time clock with a minimum of 1 year power loss protection, automatic leap year and daylight savings time adjustment.

ii. Relay Control

a) Individual control of each relay position in the network.

b) Status indication of the state of each relay

c) Manual override of each relay

d) Sequenced ON of all relays with programmable stagger times to reduce the in-rush effects on the power system

e) Programmable grouping of relays from one relay per group up to every relay in the entire system.

f) Ability to assign any relay to any group without rewiring

g) Positive relay status feedback and failure to respond warning

iii. Programmable OFF flash warning, programmable from 10 seconds to 60 minutes of warning time.

iv. Refresh commands to outputs to assure proper status; refresh command interval on a user programmable rate of once every 3-30 minutes.

v. Any switch shall be able to control any relay or group of relays anywhere on the network

vi. Programmable switch input module with sufficient capacity to meet the project requirements and capable of accepting inputs from dry contacts, 2 or 3-wire, maintained or momentary switches.

vii. Programmable switch input timers with intervals up to 18 hours

viii. Software capability to run a diagnostic check of the memory at any time. If the panel detects any problem with its memory after power up it shall provide warning indication a problem exists.

ix. Ability for each LCP to function independently of other panels if a network failure occurs. All the features listed here shall continue to operate.

x. Automatic program re-boot and system restoration after a power outage of up to 14 days or more.

e. Communications

i. RS-485 and RS-232 serial communications ports connection for lighting control network connection and laptop connection to any lighting control panel.

ii. Work station via RS-485 and RS-232 lighting control network and via separate local area computer network connected to the RS-485 network.

iii. Remote dial-up modem over telephone line

a) Provide full system remote programming, data logging, status, control function, diagnostic analysis over a telephone modem

b) Include software, hardware and 56 kBaud V.92 modem

iv. Internet Addressable Access

a) Provide software and connectivity to the local area network to allow individual users to have ON/OFF control of their lighting using Windows based Software, a PC and an internet browser. Include multi-level password protections

v. Wireless network

a) Provide full system remote programming, data logging, status, control function, diagnostic analysis over a telephone modem

b) Include software, hardware and IEEE 802.11 compatible interface module, transmitting antennae and receiving antennae.

f. Programming Means and Methods: System shall accept control at each LCP via one or all of the following:

i. Local Keypad and Display: built in keypad and alpha numeric display with all commands in plain English.

ii. Hand-held Programmer and Display: provide portable, handheld device with operations and capabilities similar to the built-in keypad. Handheld device shall communicate with

the LAN and any panelboard using a connection to any LCP via a serial cable or with wireless infrared technology.

iii. Laptop computer via software and a built-in modem with direct connection via on-board serial port and cable.

iv. Control Computer Workstation with Connectivity and Software Provide workstation configuration that includes the following components as a minimum:

a) Pentium 4 CPU, 1.8 GHZ minimum clock speed, with a 60 gigabyte (GB) hard disk, 512 MB synchronous dynamic random access memory (SDRAM) and expandable to 1 GB, two USB ports, two parallel ports and two asynchronous serial ports shall be provided for connection of peripherals, one 1.44M-3 1/2" floppy drive and one 24X CD RW drive.

b) Operating system for the computer operator workstation shall be Microsoft Windows NT, Windows XP or Windows 2000.

c) Microsoft wireless optical mouse

d) An enhanced keyboard with 101-key layout and dedicated numeric keypad for rapid data entry.

e) 17" color flat screen LCD monitor and video controller card shall provide a high resolution, SXGA monitor to display real time dynamic graphic data, execute operator commands, and report system activity. Video resolution shall be minimum 1280 by 1024 pixels. 250 candela per square meter brightness, 550:1 contrast ratio, 170 degree horizontal and vertical viewing angles, 50,000 hour life, anti-glare panel surface. View Sonic Model VE175b.

f) The system shall have modem compatibility with EIA-232C connection and automatic answer/originate capability. Minimum speed shall be 56 Kbps.

g) 10/100MBS Network card

g. Printer - Include a printer for activity log, software documentation, alarm

summary printing and report printing. 9-pin impact head dot matrix, bi-directional printer. High speed draft, 410 cps at 10 cpi, near letter quality at 77 cps at 10 cpi, 80 column, 240 x 144 dpi resolution; provide parallel port connectivity and optional Ethernet interface card, 32 kB input buffer. Epson Fx-880 series with required options.

2. External Components and Accessories:

   a. Switches

      i. General Switches

         a) All system switches shall be digitally addressable and connected to the lighting control network bus with a single category 5, 4-pair unshielded twisted pair cable

         b) Switch quantities of 1 to 6 switches on a single gang face plate

         c) Provide switches in the quantity and configurations indicated at each station

         d) Engraved labeling capability for each switch button (stick on labels are not acceptable.)

         e) LED Annunciation

            i) On Status for each button

            ii) Location LED - always on, for each switch group location

      ii. Key Switches: Provide digitally addressable key switch where indicated on the documents

      iii. Switch Wall Plates: Provide stainless steel wall plates. Submit sample of each type when requested.

      iv. Occupancy Sensor: Provide compatible occupancy sensors as required by contract drawings. Connect to switch input interface module and program the desired function.

      v. Photocell (exterior, ON/OFF applications): Provide digitally addressable photocell sensor and necessary interface module as required by the contract drawings. Photocell signal shall be transmitted to the LCP for processing and control. System shall display real time readout in foot-candles. Trigger point(s) shall be programmable (photocells requiring screw driver sensitivity adjustment are not acceptable.

vi. Photo sensors (interior daylighting applications): Provide digitally addressable photo sensor daylight sensor(s) and necessary interface module (s). Photo sensor signal shall be transmitted to the LCP or digital addressable ballast for processing and control. System shall display real time readout in foot-candles and trigger point(s) shall be programmable.

3. Interoperability:

When interfaces with other building systems are specified, the lighting control system shall have a tested, proven and completely seamless interface.

a. Building Automation System

i. Johnson Controls, Inc. Metasys™

ii. Lonworks™

iii. BacNet™

iv. Modbus plus™

v. Trane Tracer™

b. Dimming

i. DMX 512 (theatrical dimming protocol)

ii. Lutron Graphik Eye™ (architectural dimming)

iii. Lutron Ecosystem™ (architectural dimming)

iv. Crestron (architectural dimming)

v. Electronic Theatre Controls (ETC) (architectural dimming)

c. Demand Control: Electrical power demand shall be monitored through pulses from a remote meter and lighting control software programming shall control lighting to reduce demand based on preset priority control schemes activated at specified set points using:

i. Sliding window averaging

ii. Time-of-day demand schedule

4. Software:

a. Time of Day Scheduling (TOD)

i. Scheduling by building, area, zone, groups of zones, individually controlled lighting zones and groups of individually controlled lighting zones

ii. Each schedule shall provide beginning and ending dates and times (hours: minutes)

iii. Weekly repeating schedule capability, i.e. between 8:00 a.m. and 5:00 p.m., Monday through Friday

iv. Capability of entering date schedules in advance

v. Schedules shall be self-deleting when effective dates have passed

vi. Leap years shall be adjusted automatically

b. The Graphical User Interface (GUI)

i. GUI workstation software shall make extensive use of color to communicate information; displaying 1024 by 768 pixels 24 bit True Color as a minimum, with infinite pan and zoom features to maintain image quality.

ii. Comprehensive software package completely compatible with Owner's current Windows platform

iii. Enables operators to manage the facilities on a day-to-day basis

a) Monitor real time status

b) Define and adjust schedules via a visual representation of each device on the bus

c) Ability to change the status of any individual device, relay or zone

d) "Point and Click" mouse interface based upon floor plans and area graphics

e) Adjust and monitor set points

iv. Enables operators to make all schedule additions, modifications and deletions using the mouse and appropriate dialog boxes

v. Ability to schedule system wide with a single operator command by individual control device and user defined groups of control devices

vi. Operator Group Definition

a) Defined combination of lighting control devices that can be scheduled

b) Ability to designate any group to be a member of another group.

vii. Capability to edit all schedules off line and download any or all schedule changes to the network link modules

viii. Capability to upload any or all schedules from a network link module in any LCP, to the workstation

ix. Color-coded viewing of all normal, holiday and override schedules

x. Organize lighting control network in a logical hierarchy of systems, sites, areas and lighting circuits

a) Lighting Circuit - a group of lighting fixture and dimmers controlled by one relay or LCP dimmer output signal.

b) Area - the physical area within a building such as an individual floor, that contains multiple lighting circuit zones or other geographical boundaries.

c) Site - collection of lights controlled by a network of lighting control panels; generally, a building or group of buildings.

d) System - collection of sites, areas, and lighting contained within a single database maintained by a single group of operators.

xi. Capability to design and display graphics of system, site, area and lighting circuits indicating:

a) System block diagrams

b) Site plan views with building and equipment locations and identifying landmarks.

c) Area floor plan maps indicating lighting circuit zones throughout the buildings.

d) Real time status display of all lighting points at appropriate locations on the graphic representation.

e) Light level sensor status and analog readouts in appropriate engineering units at appropriate locations on the graphic representation.

f) Separate graphic screen for each building, each floor, each lighting zone.

xii. The following commands and information shall be selectable from a graphic Menu:

a) EXIT

b) HELP

c) RETURN

d) PRINT

e) GRAPHS

f) XFR SCHEDULES

g) LINK STATUS

h) SCHEDULE

i) UP/DOWN LOAD

j) TRENDS

k) GROUPS

l) SET POINT

m) PARAMETERS

n) CONFIGURE POINT

o) CALIBRATE POINT

p) MINIMIZE VIEW

xiii. Password level protection with at least five levels of access:

a) Administrator - complete access, including password controls

b) Maintenance - all access except password

c) Scheduler - modify and apply existing schedules to a zone and review status (no programming)

d) User - control (ON/OFF/ LEVEL ADUST)user's zone only (no programming and scheduling changes)

e) Monitor - check status only

xiv. Trending

a) The system shall be able to trend and display either numerically or graphically:

i) Analog light sensor

ii) Lighting zone

iii) Calculated point

iv) Any output

b) Provide simultaneous trend graphing of multiple parameters with automatic and manual scaling, distinct colors

c) Dynamically update at user-defined intervals

d) Zoom-in on a section for more detailed examination

e) Pick any point on a trend and display numerical value

f. Touch Screen: Provide lighting control workstation with "Touch Screen" control capability for the operator.

g. Billing: Provide a complete billing software module for Owner to track lighting energy usage and generate tenant invoices.

5. Workstation Furniture:

    a. Workstation: Mobile computer workstation, 36 inch wide x 24 inch deep, adjustable height (23 to 27 inches), all steel construction, gray powder coat finish, (4) 4 inch casters, two with locking capability, modesty panel, cord management bin, 6 square feet of work surface, CPU holder (left or right hand mounting), UL listed multi-outlet electrical surge suppression devise with 20 foot cord. Bretford Model No. BFD EC7000-GM (available from Boise Cascade Office Products).

    b. Printer Stand: Universal printer stand, nominal 22" wide x 16" deep printer stand with optional paper feed tray, paper-catching basket and guides, putty Beige color. Bretford Model No. BFD VALU1-PB with BFD UNPF chrome paper feed tray (available from Boise Cascade Office Products).

EXECUTION

1. Installation:

    a. Where shown on the drawings, the contractor shall furnish and install programmable lighting controllers of the quantities, sizes and types indicated and required by contract documents.

    b. All equipment shall be installed in accordance with manufacturer requirements and in compliance with all applicable local and national codes and standards.

    c. Wiring:

        i. Install manufacturer's recommended wiring types in quantities and types required and indicated on approved shop drawings.

        ii. Do not mix low voltage control (less than 120 VAC), 120 VAC or 277 VAC conductors in the control panelboards. Provide metal dividers.

        iii. Place manufacturer supplied end-of-line terminators at each end of line in the system bus per manufacturer instructions.

        iv. Neatly lace and rack wiring in cabinets.

        v. Terminate Category 5, 4 twisted pair cable on the RJ45 jack connectors provided with each lighting control device, per manufacturer instructions.

        vi. Do not exceed 80% of manufacturer's maximum circuit bus length to any system connection point.

vii. All items on the bus shall be connected per manufacturer's directions. "Tee tap bus connectivity is preferred, but series (daisy chain) is acceptable.

viii. All screw post control and power conductor terminations shall have Thomas & Betts StaKon™ ring or spade lug connectors.

ix. Torque all screws and terminations to manufacturer's recommended torque-tightening values

2. Daylighting Sensors:

   a. Provide sensors for each different interior daylight exposure including skylights.

   b. Comply with local energy code for number of daylight zones and sensors.

3. Field Quality Control:

   a. Manufacturer's Field Services: Provide a factory trained and authorized field service technician to inspect and approve all lighting control field installation work (equipment installation, terminations, programming), make all necessary adjustment and calibrations, test operation of the completed system, demonstrate system to Owner's representative and assist with the training.

   b. Testing:

      i. Complete all manufacturer's recommended commissioning and startup procedures.

      ii. Test continuity of all circuits

4. Adjusting:

   a. Occupancy Sensors: Provide a factory trained and authorized field service technician to aim and adjust sensitivity of each occupancy sensor to obtain desired operational reliability and sensing with final furniture and equipment layouts.

   b. Photocells: Provide a factory trained and authorized field service technician to aim and adjust sensitivity of each photocell to obtain desired ON/OFF operational thresholds of the photocell control.

   c. Clock: Provide a factory trained and authorized field service technician to demonstrate and make the final clock, calendar and latitude settings for accurate and reliable operation of the system. Perform activities at the first training session.

5. Cleaning:

    a. The contractor shall remove dirt and debris from the equipment.

    b. Clean equipment and devices internally and externally using methods and materials recommended by the manufacturer.

26 22 00—LOW VOLTAGE TRANSFORMERS

SUMMARY

1. Section includes general purpose transformers having a primary voltage of 600 volts or less for the supply of lower voltages. These transformers shall be self-cooled, ventilated dry-type. This section also includes specialty transformers having primary voltage of 600 volts or less for the supply of lower voltages to support sensitive electronic loads of noise emission, high harmonic load currents and overheating.

2. Do not locate ventilated dry-type transformers in environments containing contaminates including dust, excessive moisture, chemicals, corrosive gases, oils, or chemical vapors.

3. Transformers shall be designed for floor or wall mounting with suitable brackets and supports. Transformer mounting and supports shall withstand seismic forces. Floor mounted transformers shall be installed on a isolation pad.

4. Maximum ground resistance shall be 5 ohms at transformer location.

5. Measure primary and secondary voltages and provide documentation.

6. When transformer is located in areas where audible noise is a factor, specify sound levels at least 3 decibels below recommended values .

7. Mount transformer so that vibrations are not transmitted to the surrounding structure. Small transformers (30 KVA or lower rating) can usually be solidly mounted on a reinforced concrete floor or wall. Flexible mounting shall be required for transformers mounted to structure in normally low-ambient audible noise area.

8. Use flexible couplings and conduit to minimize vibration transmission through the connection points. Steel Flex shall be used for interior installations and seal tight for exterior installation.

9. Locate transformer in spaces where sound level is not increased by sound reflection (e.g. in terms of sound emission; the least desirable transformer location is in a corner near the ceiling because walls and ceilings function as a megaphone.)

PRODUCTS

1. General Requirements:
    a. Factory-assembled and tested, air-cooled units for 60-Hz service.
    b. Cores: Grain-oriented, non-aging silicon steel.
    c. Coils: Continuous windings without splices except for taps.
    d. Internal Coil Connections: Brazed or pressure type.
    e. Coil Material: Copper.
2. Distribution Transformers:
    a. Comply with NEMA ST 20 and list and label as complying with UL 1561.
    b. Cores: One leg per phase.
    c. Enclosure: Ventilated, NEMA 250, Type 2 for indoor, NEMA4X for outdoor enclosures.
    d. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
    e. Insulation Class:
        i. 220 degrees C, UL-component-recognized insulation system with a maximum of 80 degrees C rise above 40 degrees C ambient temperature.
        ii. Energy Efficiency for Transformers Rated 15 kVA and Larger: Complying with NEMA TP 1, Class 1 efficiency levels.
    i. K-Factor Rating: Transformers required to be K-Factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to degree defined by designated K-Factor.
        i. Indicate value of K-factor on transformer nameplate.
    k. Low-Sound-Level Requirements: Maximum sound levels.
        i. 9 kVA and Less: 40 dBA.
        ii. 30 to 50 kVA: 45 dBA.
        iii. 51 to 150 kVA: 50 dBA.
        iv. 151 to 300 kVA: 55 dBA.
        v. 301 to 500 kVA: 60 dBA.

EXECUTION

1. Examination:
    a. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

b. Verify that field measurements are as needed to maintain working clearances.

c. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

d. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

e. Construct concrete bases and support floor-mounted and wall-mounted transformers according to manufacturer's written instructions and seismic codes applicable to Project.

26 23 00—LOW VOLTAGE SWITCHGEAR

SUMMARY

1. Section includes metal-enclosed, floor mounted, free standing, low-voltage power circuit-breaker switchgear rated 1000 volts and less for use in AC systems.

2. Install space-only cubicles with appropriate bus provisions for future circuit breaker and protective device additions, as necessary to accommodate planned future growth.

3. Provide concrete housekeeping pad.

PRODUCTS

1. Fabrication:

   a. Indoor Enclosure Material: Galvanized Steel.

   b. Outdoor Enclosure Material: Stainless Steel NEMA 4X.

   c. Circuit-breaker compartments shall be equipped to house drawout-type circuit breakers and shall be fitted with hinged outer doors.

   d. Fabricate enclosure with removable, hinged, rear cover panels to allow access to rear interior of switchgear.

   e. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:

      i. Bus transition sections.

      ii. Incoming-line pull sections.

      iii. Hinged front panels for access to metering, accessory, and blank compartments.

   f. Bus bars connect between vertical sections and between

compartments. Cable connections are not permitted.

i. Vertical Section Bus Size: allowance for spare circuit breakers and spaces for future circuit breakers.

ii. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.

iii. Use silver-plated copper for connecting circuit-breaker line to copper bus.

iv. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.

v. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch-circuit ground conductors, minimum size 1/4-inch by 2 inches.

vi. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.

vii. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors.

viii. Neutral Disconnect Link: Bolted, uninsulated, 1/4-by-2-inch copper bus, arranged to connect neutral bus to ground bus.

ix. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.

x. Bus-Bar Insulation: Individual bus bars wrapped with factory-applied, flame-retardant tape or spray-applied, flame-retardant insulation.

a) Sprayed Insulation Thickness: 3 mils minimum.

b) Bolted Bus Joints: Insulate with secure joint covers that can easily be removed and reinstalled.

2. Circuit Breakers per Manufacturers recommendation.

i. Main Distribution Board and Feeder Breakers Metering:

a) Accuracy 1 percent of reading.

b) Values shall be rms average over a period of one second.

c) Voltage: Line-Line for each phase, three-phase average, Line-Neutral each phase.

d) Active Power: KW, three-phase total.

e) Apparent Power: KVA, three -phase total.

viii. Power Factor: Three-phase total.

ix. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic -bus diagram

3. Surge Suppression: Field-mounted surge suppressors including the following features and accessories:

i. Integral disconnect switch.

ii. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

iii. Indicator light display for protection status.

iv. Surge counter.

EXECUTION

1. Anchor switchgear assembly to 4-inch, channel-iron floor sill embedded in concrete base and attach by bolting. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no more than 3 inches in all directions beyond the maximum dimensions of switchgear unless otherwise indicated or unless required for seismic anchor support.

2. Examine roughing-in of conduits and grounding systems to verify the following:

i. Wiring entries comply with layout requirements.

ii. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will have to cross the section barriers to reach load or line lugs.

3. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

4. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.

5. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.

6. Set field-adjustable, protective-relay trip characteristics according to results in Section 260573 "Overcurrent Protective Device Coordination Study."

7. Determine long-time pickup and delay by primary current injection. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

8. Determine short-time pickup and delay by primary current injection. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

9. Determine instantaneous pickup value by primary current injection. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

10. Determine ground-fault pickup and delay by primary current injection. Ground-fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

26 24 13—SWITCHBOARDS
SUMMARY

1. Section includes:

    a. Service and distribution switchboards rated 600 V and less.

    b. Transient voltage suppression devices.

    c. Disconnecting and overcurrent protective devices.

2. Secure switchgear in accordance with manufacturer's instructions.

3. Support cable routed to switchgear to minimize forces applied to conductor terminals.

4. Do not use switchgear enclosure surfaces as physical support for any item unless specifically designed for that purpose.

5. Ground metal instrument cases.

6. Place safety sign on any cubicles containing more than one voltage source.

7. Locate switchboards that have any exposed live parts in permanently dry locations and accessible only to qualified persons.

8. Circuit breakers must clearly indicate whether they are in open (off) or closed (on) position.

9. Clearly and permanently mark all circuit breakers to show purpose of each breaker.

10. Place switchboards as close as possible to the center of loads to be served.

11. Series rated systems shall not be used.

PRODUCTS

1. Manufacturer Units:

    a. Front-Connected, Front-Accessible Switchboards:

        i. Main devices: Fixed, individually mounted.

        ii. Branch Devices: Panel mounted.

        iii. Sections front and rear aligned.

    b. Seismic Requirements: Fabricate and test switchboards. Switchboards shall withstand the effects of earthquake motions.

    c. Indoor Enclosures: Steel

    d. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

    e. Outdoor Enclosures NEMA 4X:

        i. Enclosure: Flat roof; for each section, with provisions for padlocking.

    f. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

    g. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

    h. Customer Metering Compartment: Separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

    i. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

j. Removable, Hinged Rear Doors and Compartment Covers: Secured by stainless steel security bolts, for access to rear interior of switchboard.

k. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

l. Buses and Connections: Three phase, four-wire unless otherwise indicated.

i. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with tin-plated copper feeder circuit-breaker line connections.

ii. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.

iii. Ground Bus: 1/4-by-2-inch-Minimum-size required, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

iv. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.

v. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

vi. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

m. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2. Transient Voltage Suppression Devices (to be installed on all IT panels):

a. Surge Protection Device Description:
IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules,
UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

i. Fuses, rated at 200-kA interrupting capacity.

ii. Fabrication using bolted compression lugs for internal wiring.

iii. Integral disconnect switch.

iv. Redundant suppression circuits.

v. Redundant replaceable modules.

vi. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

vii. LED indicator lights for power and protection status.

viii. Audible alarm, with silencing switch, to indicate when protection has failed.

ix. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

x. Six-digit, transient-event counter set to totalize transient surges.

b. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.

c. Withstand Capabilities: 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

3. Disconnecting and Overcurrent Protective Devices:

a. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. Molded Case Circuit Breakers shall be acceptable for frame ratings not exceeding 1200 A.

i. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads,

and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 100 A to 250 A.

ii. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

iii. Electronic trip circuit breakers with rms sensing for breakers rated over 250 A; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a) Instantaneous trip.

b) Long- and short-time pickup levels.

c) Long- and short-time time adjustments.

d) Ground-fault pickup level, time delay, and I2t response.

iv. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

v. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

vi. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a) Standard frame sizes, trip ratings, and number of poles.

b) Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.

c) Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

b. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current. All circuit breakers for frame ratings over 1200 A shall be Insulated Case type.

i. Fixed circuit-breaker mounting.

ii. Two-step, stored-energy closing.

iii. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the

following field-adjustable settings:

a) Instantaneous trip.

b) Long- and short-time pickup levels.

c) Long- and short-time time adjustments.

d) Ground-fault pickup level, time delay, and I2t response.

e) Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

4. Instrumentation: Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

   a. Include provisions for recordable attachments.

   b. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

      i. Phase Currents, Each Phase: Plus or minus 1 percent.

      ii. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.

      iii. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.

      iv. Megawatts: Plus or minus 2 percent.

      v. Megavars: Plus or minus 2 percent.

      vi. Power Factor: Plus or minus 2 percent.

      vii. Frequency: Plus or minus 0.5 percent.

      viii. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.

      ix. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.

      x. Contact devices to operate remote impulse-totalizing demand meter.

   b. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

5. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and

letter designations consistent with final mimic-bus diagram.

EXECUTION

1. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness.
2. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Bell Ends for PVC applications.
3. Set field-adjustable switches and circuit -breaker trip ranges according to the approved coordination study.
4. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Use Molded Case Circuit Breakers for frame ratings not exceeding 1200 A.
6. Use Insulated Case Circuit Breakers for frame ratings exceeding 1200 A.

26 24 16—PANELBOARDS

SUMMARY

1. Section includes panelboards used for the distribution of power and for the supply of branch circuits.
2. All tops and bottoms of panelboards shall not be pre-punched.
3. Panelboards shall be provided with 25 percent spare load capacity and 25 percent breaker space capacity.
4. Feeder conductors shall meet panelboard bussing requirements.
5. Panelboards main breaker shall be sized to match bussing.
6. Panelboards shall be provided with hinged front cover.
7. Series rated combination circuit breakers shall not be used.
8. Where flush mounted panelboards are used, stub five 1-inch empty conduits from panelboard into accessible ceiling space.

PRODUCTS

1. General Requirements:
    a. Fabricate and test panelboards to withstand seismic forces.
    b. Enclosures: Flush-and surface-mounted cabinets
        i. Rated for environmental conditions at installed location.
        ii. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
        iii. No skirts allowed.

iv. Gutters are acceptable above the panelboards but must be used exclusively.

v. Finishes:

a) Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b) Back Boxes: Galvanized steel.

c) Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

vi. Directory Card: Inside panelboard door, mounted in transparent card holder.

c. Incoming Mains Location: Top and bottom.

d. Phase, Neutral, and Ground Buses:

i. Material: Hard-drawn copper, 98 percent conductivity.

ii. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

iii. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads when required by project.

e. Conductor Connectors: Suitable for use with conduct material and sizes.

i. Material: Hard-drawn copper, 98 percent conductivity.

ii. Main and Neutral Lugs: Compression type.

iii. Ground Lugs and Bus-Configured Terminators: Compression type.

iv. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

v. Sub-feed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

vi. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at

same end of bus as incoming lugs or main device.

vii. Extra-Capacity Neutral Lugs: Rated 200 percent phase lugs mounted on extra-capacity neutral bus.

viii. Terminations shall allow the use of conductors at their 75 degree C temperature rating without ampacity derating.

f. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

g. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Series ratings shall not be allowed.

2. Panelboards:

a. Panelboards: power and feeder distribution type or branch circuit type.

b. Distribution panelboards shall be provided with factory-installed, integral, Surge Protection Device (SPD) rated at 160 KA per mode Peak Single-Impulse Surge Current.

c. Doors with hinged covers: Secured with vault-type latch with tumbler lock; keyed alike.

d. Main: Circuit breaker or main lugs as required by project.

e. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

f. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

3. Disconnecting and Overcurrent Protective Devices:

a. Molded-Case Circuit Breaker (MCCB): with interrupting capacity to meet available fault currents.

i. Thermal-Magnetic Circuit Breakers for panelboards rated 250 A or lower: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 125 A and larger.

b. Electronic trip circuit breakers with rms sensing for panelboards, feeders and branch circuits rated over 250 A; field-replaceable rating plug or field-replicable electronic

trip; and the following field-adjustable settings:

i. Instantaneous trip.

ii. Long- and short-time pickup levels.

iii. Long-and short-time adjustments.

iv. Ground-fault pickup level, time delay, and I2t response.

c. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

d. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

e. Molded-Case Circuit Breaker (MCCB) Features and Accessories:

i. Standard frame sizes, trip ratings, and number of poles.

ii. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

iii. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

f. Provide shunt-trip device as required by project.

EXECUTION

1. Mount panelboards so that the top of the operating handle of the highest mounted circuit breaker is 6 ft. or lower from finished floor.

2. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

3. Create a directory to indicate installed circuits; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Circuit designations shall uniquely identify each circuit.

4. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

5. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.

6. Correct malfunctioning units on-site, where possible, and retest to

demonstrate compliance; otherwise, replace with new units and retest.

7. Set field-adjustable circuit-breaker trip ranges as required by project.

8. Install filler plates in unused spaces.

9. If connected load calculated for the proposed panelboard exceeds 1200 A (including 25% spare capacity) replace it with a switchboard as per specification 262413 Switchboards.

26 24 19—MOTOR CONTROL CENTERS

SUMMARY

1. Section includes motor control centers (MCC) for use with ac circuits rated 600 V and lower with the following factory-installed components:

    a. Incoming main lugs and Over Current Protective Devices (OCPD.)

    b. Full-voltage magnetic controllers

    c. Feeder-tap units.

    d. Instrumentation.

    e. Auxiliary devices.

2. Install motor control centers on 4-inch nominal thickness concrete base.

3. Install motor controllers in accordance with manufacturer's instructions.

4. Select and install heater elements in motor starters to match installed motor characteristics.

5. Provide engraved nameplates.

6. Seismic Performance: MCCs shall withstand the effects of earthquake motions

PRODUCTS

1. Functional Features:

    a. Modular arrangement of main units, controller units, control devices, feeder-tap units, instruments, metering, auxiliary devices, and other items mounted in vertical sections of motor control centers.

    b. Controller Units: Combination controller units.

        i. Install units up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

        ii. Equip units in Type B and Type C motor control centers with pull-apart terminal strips for external control connections.

c. Feeder-Tap Units: Through 225-A rating shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

d. Future Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

2. Incoming Mains:

a. Location: Top or bottom as required by project.

b. Main Lugs Only: Conductor connectors suitable for use with conductor material and sizes.

i. Material: Hard-drawn copper, 98 percent conductivity.

ii. Main and Neutral Lugs: Compression type.

c. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents. Series rated breakers shall not be allowed.

i. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 100 A and higher.

ii. Electronic trip, for feeder circuit breakers rated 250 A and higher, with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a) Instantaneous trip.

b) Long- and short-time pickup levels.

c) Long- and short-time time adjustments.

d) Ground-fault pickup level, time delay, and I2t response.

d. MCCB Features and Accessories:

i. Standard frame sizes, trip ratings, and number of poles.

a) Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.

b) Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-

intensity discharge (HID) lighting circuits.

c) Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

d) Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

e) Auxiliary Contacts: One single pole double throw switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

3. Combination Controllers:

a. Full-Voltage Enclosed Controllers:

i. Magnetic Controllers: Full voltage, across the line, electrically held; no reversing configuration.

ii. Solid-State Overload Relays:

a) Switch or dial selectable for motor running overload protection.

b) Sensors in each phase.

c) Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

b. Disconnecting Means and OCPDs:

i. interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.

a) Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 100 A and higher.

b) Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

c) Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.

c. Control Power:

i. Control Circuits: 24-V ac; obtained from integral Control Power Transformer (CPT,) with primary and secondary fuses,

with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

ii. CPT Spare Capacity: 100 VA.

4. Feeder-Tap Units, MCCB:

a. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 100 A and higher.

b. Electronic trip circuit breakers, for feeders rated 250 A and higher, with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

i. Instantaneous trip.

ii. Long- and short-time pickup levels.

iii. Long- and short-time time adjustments.

iv. Ground-fault pickup level, time delay, and I2t response.

c. Features and Accessories:

i. Standard frame sizes, trip ratings, and number of poles.

ii. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.

iii. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

iv. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

v. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

vi. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

5. Motor Control Center Control Power: Control Circuits, 120-V ac, supplied through secondary disconnecting devices from CPT.

6. Instrumentation: Multifunction Digital-Metering.

a. Switch-selectable digital display of the following values with the indicated maximum accuracy tolerances:

b. Phase Currents, Each Phase: Plus or minus 1 percent.

c. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.

d. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.

e. Three-Phase Real Power (Kilowatts): Plus or minus 2 percent.

f. Three-Phase Reactive Power: Plus or minus 2 percent.

g. Power Factor: Plus or minus 2 percent.

h. Frequency: Plus or minus 0.5 percent.

7. Enclosures:

a. Freestanding steel cabinets that shall be installed on a house keeping pad unless otherwise indicated.

b. Outdoor Enclosures shall be Type 4X, with a downward, rearward sloping roof.

c. Finish: For interior applications only; Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

d. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.

e. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

f. Wiring Spaces:

i. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.

ii. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

g. Compartments marked "future" or "spare" shall be bused, wired and equipped with guide rails or equivalent, and ready for insertion of drawout units.

h. Auxiliary Devices:

   i. Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

   ii. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oil tight type.

      a) Push Buttons: Covered types; maintained contact unless otherwise indicated.

      b) Pilot Lights: LED types; push to test.

      c) Selector Switches: Rotary type.

   iii. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

   iv. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

i. Characteristics and Ratings:

   i. Control and Load Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

   ii. Short-Circuit Current Rating for Each Unit: Fully rated.

   iii. Short-Circuit Current Rating of MCC: Fully rated with its main overcurrent device.

   iv. Horizontal and Vertical Bus Bracing (Short-Circuit Current Rating): Match MCC short-circuit current rating.

   v. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions at one end.

   vi. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.

vii. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver plated.

viii. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables.

ix. Ground Bus: hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit equipment grounding conductors.

x. Front-Connected, Front-Accessible Motor Control Centers:

a) Main Devices: Drawout mounted.

b) Controller Units: Drawout mounted.

c) Feeder-Tap Units: Drawout mounted.

d) Sections front and rear aligned.

EXECUTION

1. Floor-Mounting Controllers: Install MCCs on 4-inch nominal thickness concrete base.

2. Seismic Bracing: Comply with requirements specified in Section 26 05 29 Electrical Support and Seismic Restraints.

3. Inspect controllers, wiring, components, connections, and equipment installation.

4. Test insulation resistance for each enclosed controller element, component, connecting motor supply, feeder, and control circuits.

5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection. Certify compliance with test parameters.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements in accordance with the overcurrent protection device coordination study and the arc flash analysis.

26 25 00—ENCLOSED BUS ASSEMBLIES

SUMMARY

1. Section includes feeder-bus assemblies, with Authority approval., for interior applications only.
2. Support bus assemblies independent from other equipment.
3. Install expansion fittings at locations where assemblies cross building expansion joints.
4. Use of exterior enclosed busing is not allowed.
5. Seismic Performance: Enclosed bus assemblies, plug-in devices, and components shall withstand the effects of earthquake motions

PRODUCTS

1. Low-impedance bus assemblies in nonventilated housing; single-bolt joints; ratings as indicated.
2. Seismic Fabrication Requirements: Fabricate mounting provisions and attachments for feeder-bus assemblies with reinforcement strong enough to withstand seismic forces.
3. Temperature Rise: 55 degrees C above 40 degrees C ambient maximum for continuous rated current.
4. Bus Materials: Current-carrying copper conductors, fully insulated with Class 130˚ C insulation except at joints; plated surface at joints.
5. Ground:
    a. 50 percent capacity internal bus bars of material matching phase bus material.
6. Enclosure: Steel with manufacturer's standard finish.
7. Fittings and Accessories: Manufacturer's standard.
8. Mounting: Arranged flat, edgewise, or vertically without derating.

EXECUTION

1. Develop coordination drawings using project floor plans and sections, drawn to scale, to indicate bus assembly layout and relationships between assembly and adjacent structural, mechanical, electrical and other building components.
2. Supports shall be design by a qualified registered engineer to comply with seismic requirements.
3. Coordinate size and location of floor and wall penetrations including concrete curbs around openings for vertical bus.

4. Installation of busway shall provide for permanent access to joints.

5. Construct rated firestop assemblies where bus assemblies penetrate fire-rated elements such as walls, floors, and ceilings.

26 27 13—ELECTRICAL METERING

SUMMARY

1. Section includes equipment for electricity metering by Airport.

2. Provide installation requirements that permit the Airport to meter electricity consumption and demand for individual tenants or loads, including restaurants, concessions and jet bridges.

3. Meter readings can be used for billing tenants and similar situations where sub -metered data are of value.

4. Meters shall be capable of being reset and monitored remotely; meters shall have the capability of monitoring electrical, both hot and cold water and natural gas.

5. Sending units shall be compatible with E-Mon, Class 5000.

MANUFACTURERS

1. E-Mon, Class 5000.

2. Or equal.

PRODUCTS

1. General Requirements:

    a. Meters used for billing shall have accuracy of 0.2 percent of reading,

    b. Enclosure: with hasp for padlocking or sealing.

    c. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.

    d. Sensors: Current-sensing type, supplied by meter manufacturer, with current or voltage output, selected for optimum range and accuracy for meters required for application; split core type.

    e. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with specified sensors.

2. Kilowatt-hour/Demand Meter: Electronic single or three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

    a. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.

b. Display: LCD with characters not less than 0.25-inch high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory until reset.

3. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway.

4. Software: PC based, a product of meter manufacturer, suitable for calculation of utility cost allocation and billing.

   a. Utility Cost Allocation: Automatically import energy-usage records to allocate energy costs for the following:

      i. At least 100 tenants.

      ii. At least 20 buildings.

   b. Tenant or Activity Billing Software: Automatically import energy-usage records to automatically compute and prepare tenant bills based on metering of energy use. Maintain separate directory for each tenant's historical billing information. Prepare summary reports in user-defined formats and time intervals.

EXECUTION

1. Installation shall strictly adhere to specific manufacturer's recommendation for the actual equipment being installed.

2. Provide KWHR / Demand meters (E-Mon Class 5000), including current sensors, at every Jet Bridge. Meters shall measure consumption of bridge operation and aircraft support equipment such as PC Air, 400 Hz ground power units, etc.

3. Provide KWHR / Demand meters), including current sensors, at every airport tenant, including concessions, restaurants, kiosks, etc.

4. Tests and inspections:

   a. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.

   b. Turn off circuits supplied by metered feeder and secure them in off condition.

   c. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.

   d. Check and record meter reading at end of test period and compare

with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record and issue test results.

e. Electricity metering will be considered defective if it does not pass tests and inspections.

26 27 26—WIRING DEVICES

SUMMARY

1. Section includes:

   a. Receptacles, receptacles with integral GFCI, and associated device plates.

   b. Twist-locking receptacles.

   c. Wall-box motion sensors.

   d. Isolated-ground receptacles.

   e. Snap switches and wall-box dimmers.

   f. Wall-switch occupancy / vacancy sensors.

   g. Communications outlets.

   h. Pendant cord-connector devices.

   i. Cord and plug sets.

   j. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies

2. Require ground pin of vertically mounted receptacles installed up and on horizontally mounted receptacles to the left.

3. Receptacles and Switches: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

PRODUCTS

1. Straight Blade Receptacles:

   b. Industrial Grade, premium, convenience receptacles, 125 V, 20 A: with nylon face and body, color white.

   c. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Orange in color.

2. GFCI Receptacles:

    a. Tamper-resistant, straight blade, feed-through type, color white. Include indicator light that is lighted when device is tripped.

    b. Duplex GFCI Convenience Receptacles, 125 V, 20 A.

3. Hazardous (Classified) Location Receptacles: Wiring Devices for Hazardous (Classified) Locations.

4. Twist-Locking Receptacles:

    a. Single Convenience Receptacles, 125 V, 20 A:

    b. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Orange in color.

5. Pendant Cord-Connector Devices: Matching, locking-type plug and receptacle body connector; heavy-duty grade.

    a. Body: Nylon with screw-open cable -gripping jaws and provision for attaching external cable grip.

    b. External Cable Grip: Woven wire-mesh type made of high-strength stainless steel, matched to cable diameter, and with attachment provision designed for corresponding connector.

6. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

    a. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW -A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

    b. Plug: Nylon body and integral cable -clamping jaws. Match cord and receptacle type for connection.

7. Snap Switches: Comply with NEMA WD 1 and UL 20.

    a. Switches, 120/277 V, 20 A.

    b. Pilot Light Switches, 20 A.

    c. Key-Operated Switches, 120/277 V, 20 A.

    d. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

8. Wall Box Dimmers:

    a. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

    b. Control: Continuously adjustable slider; with single-pole or three-way switching.

    c. LED Lamp Dimmer Switches: Modular; compatible with dimmer-LED; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

9. Occupancy / Vacancy Sensors:

    a. Passive-Infrared Wall-Switch Sensors: 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. Subject to compliance with requirements, provide one of the following:

        i. Occupancy or Vacancy function shall be selectable, via a switch on the device.

    b. Adaptive-Technology Wall-Switch Sensors: 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with minimum coverage area of 900 square feet.

10. Communications Outlets:

    a. Telephone Outlet: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP.

    b. Combination TV and Telephone Outlet: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP;

11. Wall Plates:

    a. Single and combination types to match corresponding wiring devices.

        i. Plate-Securing Screws: Metal with head color to match plate finish.

        ii. Material for Finished Spaces: Stainless Steel unless project requires the matching of wall finish color in which case the wall plate shall be smooth, high-impact nylon.

        iii. Material for Unfinished Spaces: Galvanized steel.

        iv. Material for Damp Locations: Cast aluminum with spring– in use loaded lift cover, and listed and labeled for use in "wet locations."

    b. Wet-Location, Weatherproof Cover Plates: die-cast aluminum with in use lockable cover.

12. Floor Service Fittings:

    a. Type: Modular, flap-type, dual-service units suitable for wiring method used.

    b. Compartments: Barrier separates power from voice and data communication cabling.

    c. Service Plate: Rectangular, solid brass with satin finish.

    d. Power Receptacle: gray finish, unless otherwise indicated.

    e. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 6 jacks for UTP cable.

13. Poke-Through Assemblies:

    a. Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

        i. Service Outlet Assembly: Flush type with two 20amp receptacles and space for two RJ-45 jacks.

        ii. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.

        iii. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

        iv. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.

        v. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, 4-pair, Category 6e voice and data communication cables.

14. Multioutlet Assemblies:

    a. Components: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

    b. Raceway Material: Metal, with manufacturer's standard finish.

    c. Wire: No. 12 AWG.

15. Service Poles:

    a. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.

    b. Poles: Nominal 2.5-inch- square cross section, with height adequate

to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.

c. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.

d. Finishes: Satin-anodized aluminum.

e. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 6 voice and data communication cables.

f. Power Receptacles: Two duplex, 20-A, heavy-duty,

g. Voice and Data Communication Outlets: Four RJ-45 Category 5e jacks.

16. Finishes:

a. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required

b. Wiring Devices Connected to Emergency Power System: Red.

c. Isolated-Ground Receptacles: Orange.

EXECUTION

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

5. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

6. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

7. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

8. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

9. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

10. Use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

11. Use a torque screwdriver when a torque value is recommended or required by manufacturer.

12. When conductors larger than No. 12 AWG are installed on 15-or 20-A circuits, splice No. 12 AWG pigtails for device connections.

13. Tighten unused terminal screws on the device.

14. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

15. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

16. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

17. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

18. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

19. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

20. Perform the following tests and inspections:

    a. Line Voltage: Acceptable range is 105 to 132 V.

    b. Percent Voltage Drop under 15-A Load: A value of 5 percent or higher is unacceptable.

    c. Ground Impedance: Values of up to 2 ohms are acceptable.

    d. GFCI Trip: Test for tripping

    e. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker,

poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

f. Wiring device will be considered defective if it does not pass tests and inspections.

g. Prepare and issue test and inspection reports.

26 28 13—FUSES

SUMMARY

1. Section includes cartridge fuses rated 600 volts AC and less for use in control circuits, enclosed switches, switchboards, enclosed controllers, and motor-control centers.

2. Applications:

   a. Service Entrance: Class L, time delay.

   b. Feeders: Class RK1, time delay.

   c. Motor Branch Circuits: Class RK5, time delay.

   d. Other Branch Circuits: Class RK1, time delay.

   e. Control Circuits: Class CC, fast acting.

   i. Provide fuses with current-limiting characteristics as required by short-circuit study.

PRODUCTS

1. Cartridge Fuses: nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2. Short-circuit interrupting rating shall be greater than available short-circuit capacity as determined by approved short-circuit study.

3. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

EXECUTION

1. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

2. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

3. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

4. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with

characteristics appropriate for each piece of equipment.

5. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

6. Verify that ratings of fuses to be installed comply with requirements of short-circuit and coordination studies.

7. Proceed with installation only after unsatisfactory conditions have been corrected.

26 28 16—ENCLOSED SWITCHES AND CIRCUIT BREAKERS

SUMMARY

1. Section includes:
    a. Fusible switches.
    b. Non-fusible switches.
    c. Receptacle switches.
    d. Shunt trip switches.
    e. Molded-case circuit breakers (MCCBs).
    f. Molded-case switches.
    g. Enclosures
2. Circuit breakers, disconnect switches, and other devices that are electrical energy-isolating must be lockable.
3. Ensure identification will be installed.
4. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions.

PRODUCTS

1. Fusible Switches:
    a. Type HD, Heavy Duty, Single Throw, 600 V ac,1200A and Smaller: horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
    b. Type HD, Heavy Duty, Double Throw, 600 V ac, 1200 A and Smaller: horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
    c. Accessories:
        i. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
        ii. Neutral Kit: Internally mounted; insulated, capable of being

grounded and bonded; labeled for copper neutral conductors.

iii. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.

iv. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

v. Auxiliary Contact Kit: Two NO/ NC (Form "C") auxiliary contact (s), arranged to activate before switch blades open.

vi. Hookstick Handle: Allows use of a hookstick to operate handle.

vii. Lugs: Mechanical type, suitable for number, size, and conductor material.

viii. Service-Rated Switches: Labeled for use as service equipment.

2. Nonfusible Switches:

a. Type HD, Heavy Duty, Single Throw, 600 V ac, 1200 A and Smaller: horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

b. Type HD, Heavy Duty, Double Throw, 600 V ac, 1200 A and Smaller: horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

c. Accessories:

i. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.

ii. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.

iii. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.

iv. Auxiliary Contact Kit: Two NO/ NC (Form "C") auxiliary contact (s), arranged to activate before switch blades open.

v. Hookstick Handle: Allows use of a hookstick to operate the handle.

vi. Lugs: Mechanical type, suitable for number, size, and conductor material.

3. Receptacle Switches:

    a. Type HD, Heavy-Duty, Single-Throw Fusible Switch: voltage and ampere ratings to match circuit application; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

    b. Type HD, Heavy-Duty, Single-Throw Non-fusible Switch: voltage and ampere ratings to match circuit application; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

    c. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

    d. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug) or as required for project conditions.

4. Shunt Trip Switches:

    a. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

    b. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

    c. Accessories:

        i. Oil tight key switch for key-to-test function.

        ii. Oil tight green ON pilot light.

        iii. Isolated neutral lug; 100 percent rating.

        iv. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.

        v. Form C alarm contacts that change state when switch is tripped.

        vi. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.

        vii. Three-pole, double-throw, fire-alarm voltage monitoring relay

    d. Molded-Case Circuit Breakers:

i. With interrupting capacity to comply with available fault currents. Circuit breakers shall be fully rated for the available short-circuit current. Series rated breakers shall not be allowed.

ii. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 100 A and larger.

iii. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

iv. Electronic Trip Circuit Breakers for circuit breaker frame sizes 250 A and higher: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

a) Instantaneous trip.

b) Long- and short-time pickup levels.

c) Long- and short-time time adjustments.

d) Ground-fault pickup level, time delay, and I2t response.

e. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

f. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

g. Features and Accessories:

i. Standard frame sizes, trip ratings, and number of poles.

ii. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

iii. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

iv. Ground-Fault Protection: integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time -delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

v. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

vi. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

vii. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

h. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

5. Molded-Case Switches:

a. MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating. Molded-case switches shall be fully rated for the available short-circuit current.

b. Features and Accessories:

i. Standard frame sizes and number of poles.

ii. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

iii. Ground-Fault Protection: remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

iv. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

v. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

vi. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.

vii. Alarm Switch: One NO contact that operates only when switch has tripped.

6. Enclosures for Enclosed Switches and Circuit Breakers: to comply with environmental conditions at installed location.

a. Kitchen Wash-Down Areas: stainless steel.

EXECUTION

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

3. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.

4. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

6. Prepare and issue test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

7. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

8. Set field-adjustable circuit-breaker trip ranges as indicated in the overcurrent protective device coordination study.

9. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data.

26 29 13—ENCLOSED CONTROLLERS

SUMMARY

1. Section includes full-voltage manual and combination magnetic controllers.

2. Where reversing or multi-speed contactors are required, provide a mechanical interlock of the lever type (with electrical contacts included) mechanism to prevent closing of one contactor when the other is closed.

3. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions.

4. Floor mounted controllers shall be installed on 4-inch nominal-thickness concrete pad.

PRODUCTS

1. Full-Voltage Controllers:

    a. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on. Non reversing configuration.

    b. Fractional Horsepower Manual Controllers: "Quick-make, quick-

break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

i. Non reversing configuration.

ii. Overload Relays: Inverse-time-current characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.

iii. Red pilot light.

c. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

i. Non reversing configuration.

ii. Overload Relays: Inverse-time-current characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.

iii. Red pilot light.

iv. Normally open auxiliary contact.

d. Magnetic Controllers: Full voltage, across the line, electrically held.

i. Non reversing configuration.

ii. Contactor Coils:

a) Pressure-encapsulated type with coil transient suppressors.

iii. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

iv. Control Circuits:

a) 24-V ac; obtained from integral control power transformer (CPT), with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

b) CPT Spare Capacity: 100 VA.

v. Solid-State Overload Relay:

a) Switch or dial selectable for motor running overload protection.

b) Sensors in each phase.

c) Class 10/20 selectable tripping characteristic

selected to protect motor against voltage and current unbalance and single phasing.

d) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

e) Analog communication module.

vi. Normally closed isolated overload alarm contact.

vii. External overload reset push button.

e. Combination Magnetic Controller:

i. Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

ii. Contactor Coils:

a) Pressure-encapsulated type with coil transient suppressors.

b) Solid-State Overload Relay:

1) Switch or dial selectable for motor running overload protection.

2) Sensors in each phase.

3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting. Analog communication module.

iii. Fusible Disconnecting Means:

a) Heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.

b) Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

c) Auxiliary Contacts: Normally open/normally closed, arranged to activate before switch blades open.

2. Enclosures:

a. Enclosed Controllers: comply with environmental conditions at installed location.

i. NEMA 4X Stainless Steel for exterior installations.

b. Accessories:

i. Control Circuit and Pilot Devices: factory installed in controller enclosure cover unless otherwise indicated.

a) Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oil tight type.

b) Push Buttons: Covered Recessed types.

c) Pilot Lights: LED types; colors as indicated; push to test.

d) Selector Switches: Rotary type.

ii. Elapsed Time Meters: Heavy duty with digital readout in hours resettable.

iii. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

iv. Reversible normally closed/ normally open auxiliary contact (s).

v. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

vi. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

vii. Breather and drain assemblies, to maintain interior pressure and release condensation

viii. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

ix. Terminals for connecting power factor correction capacitors to the line side of overload relays.

EXECUTION

1. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 Electrical Support and Seismic Restraints.

2. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base.

3. Install fuses in each fusible-switch enclosed controller.

4. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

5. Setting of Overload Relays: Select and set overloads based on the full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required

6. Identify enclosed controllers, components, and control wiring.

7. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

8. Install wiring between enclosed controllers and remote devices.

9. Connect selector switches and other automatic-control selection devices where applicable.

10. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.

11. Test continuity of each circuit.

12. Test each motor for proper phase rotation.

13. Perform each electrical test and visual and mechanical inspection. Certify compliance with test parameters.

14. Prepare and issue test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

15. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

16. Set field-adjustable circuit-breaker trip ranges as determined by overcurrent protective device coordination study.

26 29 23—VARIABLE FREQUENCY MOTOR CONTROLLERS

SUMMARY

1. Separately enclosed, pre-assembled, combination variable frequency controllers (VFCs), rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

2. Seismic Performance: VFCs shall withstand the effects of earthquake motions

PRODUCTS

1. Manufactured Units:

    a. Application: Variable torque.

    b. Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

    c. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

    d. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

    e. Unit Operating Requirements:

        i. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.

        ii. Input AC Voltage Unbalance: Not exceeding 3 percent.

        iii. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.

        iv. Minimum Efficiency: 97 percent at 60 Hz, full load.

        v. Minimum Displacement Primary -Side Power Factor: 98 percent under any load or speed condition.

        vi. Minimum Short-Circuit Current (Withstand) Rating: Verify prior to selection.

        vii. Ambient Temperature Rating: Not less than 14 degrees F and not exceeding 104 degrees F.

        viii. Ambient Storage Temperature Rating: Not less than minus 4 degrees F and not exceeding 104 degrees F.

        ix. Humidity Rating: Less than 95 percent (noncondensing).

        x. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times base load current for three seconds.

xi. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.

xii. Speed Regulation: Plus or minus 10 percent.

xiii. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.

xiv. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

f. Inverter Logic: Microprocessor based, 32-bit, isolated from all power circuits.

g. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

i. Signal: Electrical.

h. Internal Adjustability Capabilities:

i. Minimum Speed: 5 to 25 percent of maximum rpm.

ii. Maximum Speed: 80 to 100 percent of maximum rpm.

iii. Acceleration: 0.1 to 999.9 seconds.

iv. Deceleration: 0.1 to 999.9 seconds.

v. Current Limit: 30 to minimum of 150 percent of maximum rating.

i. Self-Protection and Reliability Features:

i. Input transient protection by means of surge suppressors (SPD) to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

ii. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.

iii. Under- and overvoltage trips.

iv. Inverter overcurrent trips.

v. VFC and Motor Overload/ Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.

vi. Critical frequency rejection, with three selectable, adjustable deadbands.

vii. Instantaneous line-to-line and line-to-ground overcurrent trips.

viii. Loss-of-phase protection.

ix. Reverse-phase protection.

x. Short-circuit protection.

xi. Motor overtemperature fault.

j. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

k. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

l. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

m. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

n. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

o. Integral Input Disconnecting Means and OCPD: NEMA AB 1, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.

i. Disconnect Rating: Not less than 115 percent

ii. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.

iii. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

iv. NC alarm contact that operates only when circuit breaker has tripped.

2. Controls and Indication:

a. Status Lights: Door-mounted LED indicators displaying the following conditions:

i. Power on.

ii. Run.

iii. Overvoltage.

iv. Line fault.

v. Overcurrent.

vi. External fault.

b. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain -English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

i. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

ii. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a) Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

c. Historical Logging Information and Displays:

i. Real-time clock with current time and date.

ii. Running log of total power versus time.

iii. Total run time.

iv. Fault log, maintaining last four faults with time and date stamp for each.

d. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

i. Output frequency (Hz).

ii. Motor speed (rpm).

iii. Motor status (running, stop, fault).

iv. Motor current (amperes).

v. Motor torque (percent).

vi. Fault or alarming status (code).

vii. PID feedback signal (percent).

viii. DC-link voltage (V dc).

ix. Set point frequency (Hz).

x. Motor output voltage (V ac).

e. Control Signal Interfaces:

i. Electric Input Signal Interface:

a) A minimum of two programmable analog inputs: Operator-selectable "x"- to "y"-mA dc.

b) A minimum of six multifunction programmable digital inputs.

ii. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:

a) 0- to 10-V dc.

b) 4- to 20-mA dc.

c) Potentiometer using up/down digital inputs.

d) Fixed frequencies using digital inputs.

iii. Output Signal Interface: A minimum of one programmable analog output signal (operator-selectable "x"- to "y"-mA dc), which can be configured for any of the following:

a) Output frequency (Hz).

b) Output current (load).

c) DC-link voltage (V dc).

d) Motor torque (percent).

e) Motor speed (rpm).

f) Set point frequency (Hz).

iv. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a) Motor running.

b) Set point speed reached.

c) Fault and warning indication (overtemperature or overcurrent).

d) PID high- or low-speed limits reached.

f. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.

i. Network Communications Ports: Ethernet and RS-422/485.

ii. Embedded BAS Protocols for Network Communications: Siemens system 600 APOGEE Protocols accessible via the communications ports.

3. Line Conditioning and Filtering:

    a. Input Line Conditioning: Based on the harmonic analysis study and report, provide input filtering, as required, to limit TDD and THD(V) at the defined PCC

4. Bypass Systems:

    a. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

    b. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.

    c. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

        i. Bypass Contactor: Load-break.

        ii. Output Isolating Contactor: Non-load-break.

        iii. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

    d. Bypass Contactor Configuration: Full-voltage (across-the-line) type.

        i. NORMAL/BYPASS selector switch.

        ii. HAND/OFF/AUTO selector switch.

        iii. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while motor is running in bypass mode.

        iv. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

a) Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

v. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

a) CPT Spare Capacity: 100 VA.

vi. Overload Relays:

a) Solid-State Overload Relays:

b) Switch or dial selectable for motor-running overload protection.

c) Sensors in each phase.

d) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

e) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

f) Analog communication module.

g) NC isolated overload alarm contact.

h) External overload reset push button.

5. VFC Enclosures: comply with environmental conditions at installed location.

6. Accessories:

a. Control-Circuit and Pilot Devices: factory installed in VFC enclosure cover unless otherwise indicated.

b. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oil tight type.

i. Push Buttons: Covered Recessed types.

ii. Pilot Lights: LED types; push to test.

iii. Selector Switches: Rotary type.

iv. Stop and Lockout Push-Button Station: Momentary-break, push -button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed

position with control circuit open.

c. Reversible NC/NO bypass contactor auxiliary contact(s).

d. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

e. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays:

i. Solid-state sensing circuit with isolated output contacts for hard -wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

ii. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry.

f. Supplemental Digital Meters:

i. Elapsed-time meter.

ii. Kilowatt meter.

iii. Kilowatt-hour meter.

g. Breather and drain assemblies, to maintain interior pressure and release condensation

h. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

EXECUTION

1. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances.

2. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

3. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

4. Proceed with installation only after unsatisfactory conditions have been corrected.

5. Perform a harmonic analysis study to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at the defined PCC to specified levels.

6. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and

adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

7. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 Electrical Support and Seismic Restraints.

8. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base.

9. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

10. Identify VFCs, components, and control wiring.

11. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

12. Install wiring between VFCs and remote devices.

13. Connect selector switches and other automatic control devices where applicable.

14. Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

15. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

16. Test continuity of each circuit.

17. Inspect VFC, wiring, components, connections, and equipment installation.

18. Test each motor for proper phase rotation.

19. Perform each electrical test and visual and mechanical inspection. Certify compliance with test parameters.

20. Correct malfunctioning units on-site, where possible, and retest to

demonstrate compliance; otherwise, replace with new units and retest.

21. VFCs will be considered defective if they do not pass tests and inspections.

22. Prepare and issue test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

23. Complete installation and startup checks according to manufacturer's written instructions.

24. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

25. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

26. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes.

27. Set field-adjustable circuit-breaker trip ranges as determined by the overcurrent protective device coordination Study.

28. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

26 32 13—ENGINE GENERATORS

SUMMARY

1. This Section includes engine-generator sets for emergency power supply with the following features:

    a. Generators shall have auxiliary (secondary) connection point for temporary generator hook-up;

    b. Diesel engine.

    c. Generator.

    d. Generator output protective devices.

    e. Control panel.

    f. Batteries and charger.

    g. Remote graphic annunciator panel.

    h. Exhaust silencer and flexible piping.

    i. Unit mounted Radiator.

j. Particulate filter.

k. Vibration isolators.

l. Flexible connections.

m. Radiator-mounted load bank.

n. Spare parts.

o. Fuel supply and storage tank, cooling and exhaust system

p. Day tank with secondary containment and leak detection and transfer pumps.

q. Gas power drain.

2. Quality Assurance:

a. Source Limitations: Obtain generator sets and auxiliary components through one source from a single manufacturer.

3. Project Conditions:

a. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

i. Notify Owner no fewer than fourteen (14) days in advance of proposed interruption of electrical service.

ii. Do not proceed with interruption of electrical service without Owner's written permission.

b. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

i. Ambient Temperature: Zero to 40 deg C.

ii. Relative Humidity: 0 to 95 percent.

iii. Altitude: Sea level to 1000 feet (300 m).

4. Coordination:

a. Coordinate size and location of concrete bases for engine generators.

5. Warranty:

a. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

i. Warranty Period: 5 years from date of Substantial Completion.

PRODUCTS

1. Engine-Generator Set:

   a. Factory-assembled and -tested, engine-generator set.

   b. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

      i. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

   c. Capacities and Characteristics:

      i. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.

      ii. Output Connections: Three-phase, four wire.

      iii. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

   d. Generator-Set Performance:

      i. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

      ii. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

      iii. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

      iv. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

      v. Transient Frequency Performance: Less than 5 percent variation for 50 percent step- load increase or decrease. Frequency shall recover and remain within the steady-state

operating band within five seconds.

vi. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, shall not exceed 50 percent.

vii. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

e. Generator-Set Performance for Sensitive Loads:

i. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

a) Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

ii. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.

iii. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.

iv. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.

v. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

vi. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

vii. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, shall not exceed 50 percent.

viii. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

ix. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

a) Provide permanent magnet excitation for power source to voltage regulator.

2. Engine:

a. Reciprocating engine, 4-cycle, vertical in-line or vertical Vee type design. Construct engine to eliminate undue heating, vibration and wear. Provide engine capable of burning diesel fuel oil grade DF-2.

b. Coolant Jacket Heater: Provide a jacket water heater of sufficient capacity (two at 3 kilowatt each, minimum) to maintain jacket water at the 100˚F temperature in a 42 ˚F ambient for automatic 10 second starting and acceleration to full rated speed. The jacket water heater shall be tank-type to insure proper circulation. Immersion heaters are not acceptable. The heater shall be thermostatically controlled. Voltage shall be 208 volts, single phase.

c. Governor: Adjustable isochronous, with speed sensing.

d. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator- set mounting frame and integral engine -driven coolant pump.

e. Engine Exhaust System:

i. Shall meet APCD minimum requirements.

ii. A complete engine exhaust system shall be supplied, and all necessary rigid piping, flexible exhaust tubing, wall thimble, rain cap, bird screen, and unless otherwise specified, flanged fittings.

f. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with

replaceable dry-filter element and "blocked filter" indicator.

3. Fuel Oil Storage:

    a. Day Tank: skid-mounted, factory-fabricated fuel tank assembly, with integral, float-controlled transfer pump and the following features:

        i. Containment: Double wall tank with secondary containment.

        ii. Tank Capacity: 894 gallon.

        iii. Low-Level Alarm Sensor: Liquid -level device operates alarm contacts at 25 percent of normal fuel level.

        iv. High-Level Alarm Sensor: Liquid -level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.

4. Finishes:

    a. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

5. Source Quality Control:

    a. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

        i. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

    b. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

        i. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.

        ii. Full load run.

        iii. Maximum power.

        iv. Voltage regulation.

        v. Transient and steady-state governing.

        vi. Single-step load pickup.

        vii. Safety shutdown.

        viii. Provide 14 days' advance notice of tests and opportunity for

observation of tests by Owner's representative.

ix. Report factory test results within 10 days of completion of test.

EXECUTION

1. Examination:

    a. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

    b. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

    c. Proceed with installation only after unsatisfactory conditions have been corrected.

2. Installation:

    a. Comply with engine-generator manufacturers' written installation and alignment instructions.

    b. Install engine generator to provide access, without removing connections or accessories, for periodic maintenance.

    c. Install engine generator with restrained spring isolators having a minimum deflection of on 4-inch-(100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.

    d. Install Schedule 40, black steel piping with welded joints for cooling water piping between engine-generator set and heat exchanger.

    e. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

        i. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

    f. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3. Connections:

    a. Connect fuel, cooling-system, and exhaust-system piping adjacent to engine generator to allow service and maintenance.

    b. Connect cooling-system water piping to engine-generator set and

heat exchanger with flexible connectors.

c. Connect engine exhaust pipe to engine with flexible connector.

d. Connect fuel piping to engines with a gate valve and union and flexible connector.

4. Field Quality Control:

a. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

b. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

c. Perform tests and inspections and prepare test reports.

i. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

d. Tests and Inspections:

i. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection

26 33 53—UNINTERRUPTIBLE POWER SUPPLY

SUMMARY

1. This Section includes:

a. UPS system, rated at 200 kW capacity.

b. One VRLA cabinetized battery system per UPS module, rated at 30 minutes at full- specified kW load.

c. Maintenance bypass panel, which is separate from (detached) the UPS module, and allows for complete isolation at the UPS, and its inputs and outputs during maintenance or replacement. Key interlocked.

2. The UPS shall consist of rectifier/ chargers, battery, inverters, a static transfer switch, a maintenance bypass switch, synchronizing equipment, protective devices, controls, metering, batteries, battery disconnect, and accessories as specified herein. The UPS is to automatically effect continuity of electric power within specified tolerances to the critical load, without interruption, even with a failure or deterioration of the normal power supply. Continuity of electric power to

the load shall be maintained for an emergency period with the UPS supplied by battery back up to the specified time or until restoration of the power supply.

3. The UPS technology shall be double conversion, delta conversion, or rotary. Normally, electric energy from the utility company power source shall be used to supply power to each rectifier/ charger unit. The rectifier/chargers shall be solid state and shall convert incoming AC power to DC power. The rectifier/charger outputs shall be fed into solid state inverters. The inverters shall convert the DC power into AC power, which shall supply the load. Upon failure of AC power, input power for the inverters shall automatically be supplied from the battery with no interruption to or disturbances of the UPS output in excess of the limits of these specifications. At the same time, the UPS shall energize an alarm circuit and associated trouble indicators. When the ac power is restored, input power for the inverters and for recharging the battery shall automatically be supplied from the rectifier/charger outputs without interruption or disturbances in excess of limits of these specifications. If the battery is exhausted before ac power returns, the UPS shall shutdown automatically.

4. UPS is to consist of single or multiple modules configured per the single line diagram. All modules shall operate and share the load.

5. The UPS shall have one more module than what is required to supply the full rated load in redundant applications. Any module shall be capable of being taken off the critical load manually for maintenance without disturbing the critical load bus.

MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Quality System: The manufacturer shall be certified to conform to ISO 9001.

PRODUCTS

1. Rating:

    a. The load voltage and bypass line voltage shall be 480 VAC, three phase, 3 wire. The utility input voltage will be 480 VAC, three phase, 3 wire.

    b. The UPS battery is to have a capacity to support the loads for a minimum period of 30 minutes at a temperature of 25°C. Battery

capacity will be load bank tested. The battery is to provide 100 percent of the specified capacity at initial startup. The battery cabinets shall be two tier and have seismic zone 4 construction.

c. The UPS, including the static transfer switch, shall have an efficiency of not less than 92 percent.

2. Batteries:

a. Storage batteries shall be furnished for the UPS with sufficient capacity to maintain UPS output at the specified load for a duration as specified herein. The battery is to provide 100 percent of the specified capacity at initial startup. The battery shall be of heavy-duty industrial type designed for stationary power service.

b. The batteries shall have a design life of 5 years for VRLA or 20 years for flooded cells as indicated and be guaranteed directly by the manufacturer.

3. Equipment Details:

a. All materials and parts comprising the UPS shall be new, of current manufacturer, of a high grade and free from all defects and imperfections and shall not have been in prior service, except as required during factory testing.

b. The maximum working voltage, current and di/dt of all solid-state power components and electronic devices shall not exceed 75 percent of the ratings established by their manufacturer. The operating temperature of solid state component cases shall not be greater than 75 percent of their ratings. Electrolytic capacitors s

4. Construction and Mounting:

a. The UPS shall be constructed in NEMA Type I metal enclosure, designed for floor mounting. The UPS shall be structurally adequate and have provisions for hoisting, jacking and forklift handling.

b. The individual cabinets shall be capable of being arranged either butted side-by-side or butted back-to-back. Wire runs shall be protected in a manner which separate power and control wiring. Provisions shall be made in the cabinets to permit installation of input, output and inter- cabinet cabling, using raceway or conduit.

c. The UPS cabinets shall be cleaned, primed and painted with the manufacturer's standard color.

5. Ventilation:

    a. Adequate ventilation shall be provided to insure that all components are operated within their environmental ratings. The cooling fans shall be redundant. All fans are to be equipped with wind vane sensors connected to an alarm on the module control panel.

    b. Temperature sensors shall be provided to monitor temperature of critical components. Upon detection of temperatures in excess of component manufacturer's recommended ambient working temperature, the sensors shall cause audible and visual alarms to be sounded on the module control panel.

    c. A separate UPS ambient temperature sensor shall be provided to give an alarm if the temperature of the inlet air to the UPS modules is above specified limits.

EXECUTION

1. Installation:

    a. Installation of the UPS shall be in full accordance and under the technical supervision of qualified engineers provided by the UPS manufacturer as part of this contract. In addition, the UPS manufacturer shall provide a qualified engineer to attend, at UPS manufacturer's expense, not less than one meeting of one day duration as scheduled by the Owner or their Engineers for the purpose of planning the installation of the UPS system.

    b. Transparent plastic covers of suitable gauge shall be provided by the UPS manufacturer for use during installation of the UPS system to protect the entire UPS system from dust and dirt at all times, except while working on a given module, after which the plastic covers will be reinstalled by the Electrical Contractor.

    c. Provide housekeeping concrete pad for each module, control cabinet and DC switchboard.

    d. Provide 24 inch wide air insulating mat in front of modules, control cabinet, DC switchboard.

    e. Upon completion of the installation, the Contractor shall provide certification to the Owner that the complete UPS system has been assembled and installed in full accordance with the requirements, recommendations, and complete satisfaction of the manufacturer. This certification shall be submitted prior to final field testing and shall not relieve the Contractor from any

of his obligations or responsibilities or guarantees for the successful and proper performance of the UPS system.

2. Guarantee:

    a. The complete UPS, including all accessories specified herein, shall be guaranteed against faulty and improper material and workmanship for a period of one (1) year from the date of final acceptance, or 18 months from date of shipment, except that the batteries shall be guaranteed on a pro-rata basis for ten years, provided that the Battery Room ambient temperature does not exceed 77°F, and shall deliver a minimum of 80 percent of its rated capacity for the full guarantee period.

    b. The manufacturer shall promptly correct any deficiencies or failures/ malfunctions in his equipment which occur during the guarantee period, all to the satisfaction of the Owner at no additional cost.

    c. The manufacturer shall respond to requests for warranty service within 24 hours after notification of a need for such service.

26 36 00—TRANSFER SWITCHES

SUMMARY

1. This Section includes transfer switches rated 600 V and less, including the following:

    a. Automatic transfer switches.

    b. Bypass/isolation switches.

    c. Remote annunciation systems.

    d. Remote annunciation and control systems.

2. Project Conditions:

    a. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

        i. Notify Owner no fewer than fourteen (14) days in advance of proposed interruption of electrical service.

        ii. Do not proceed with interruption of electrical service without Owner's written permission.

3. Coordination:

    a. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

MANUFACTURERS

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Contactor Transfer Switches.

PRODUCTS

1. General Transfer-Switch Product Requirements:

    a. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg

    b. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements.

    c. Electrical Operation: Accomplish by a non fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

    d. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

    e. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

    f. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

    g. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

    h. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

    i. Battery Charger: For generator starting batteries.

        i. Float type rated 10 A.

        ii. Ammeter to display charging current.

        iii. Fused ac inputs and dc outputs.

j. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

2. Automatic Transfer Switches:

a. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

b. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

c. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

d. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

e. Automatic Open-Transition Transfer Switches: Include the following functions and characteristics:

i. Fully automatic break-before-make operation.

ii. Failure of power source serving load initiates automatic break-before-make transfer.

f. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

g. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are

rated for actual currents to be encountered.

h. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.

i. Automatic Transfer-Switch Features:

   i. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

   ii. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

   iii. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

   iv. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

   v. Test Switch: Simulate normal-source failure.

   vi. Switch-Position Pilot Lights: Indicate source to which load is connected.

   vii. Provide two sets of Form 'C' contacts with time delay for customer functions, elevator signal contacts to operate prior to transfer from either normal to emergency or from emergency to normal.

viii. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

a) Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

b) Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

ix. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240 -V ac.

x. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

xi. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

xii. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.

xiii. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

xiv. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5- minute cool-down period. Exerciser features include the following:

a) Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

b) Push-button programming control with digital display of settings.

c) Integral battery operation of time switch when normal control power is not available.

3. Bypass/Isolation Switches:

a. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

i. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.

ii. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.

iii. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.

iv. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.

v. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.

vi. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.

vii. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

b. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

4. Remote Annunciator System:

    a. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

        i. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

        ii. Switch position.

        iii. Switch in test mode.

        iv. Failure of communication link.

    b. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

        i. Indicating Lights: Grouped for each transfer switch monitored.

        ii. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

        iii. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

        iv. Lamp Test: Push-to-test or lamp -test switch on front panel.

5. Remote Annunciator and Control System:

    a. Functional Description: Include the following functions for indicated transfer switches:

        i. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

        ii. Indication of switch position.

        iii. Indication of switch in test mode.

        iv. Indication of failure of digital communication link.

        v. Key-switch or user-code access to control functions of panel.

        vi. Control of switch-test initiation.

        vii. Control of switch operation in either direction.

        viii. Control of time-delay bypass for transfer to normal source.

    b. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating

function shall not depend on remote panel for proper operation.

c. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

i. Controls and indicating lights grouped together for each transfer switch.

ii. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.

iii. Digital Communication Capability: Matched to that of transfer switches supervised.

iv. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

EXECUTION

1. Floor-Mounting Switch: Anchor to floor by bolting.

a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support.

b. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

c. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

2. Connections:

a. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

b. Furnish and install all power and interconnect control, annunciator and alarm wiring between transfer switches, the generator system or switchgear, and other remote monitoring device.

3. Field Quality Control:

a. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.

b. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies,

and equipment installations, including connections. Report results in writing.

c. Perform tests and inspections and prepare test reports.

d. Testing Agency's Tests and Inspections:

   i. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

   ii. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.

   iii. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   iv. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

   v. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

e. Coordinate tests with tests of generator and run them concurrently.

f. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

g. Remove and replace malfunctioning units and retest as specified above.

h. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

26 43 13—SURGE PROTECTIVE DEVICE

SUMMARY

1. Coordination:

   a. Coordinate location of field-mounted surge protective devices

to allow adequate clearances for maintenance.

2. Warranty:

    a. Manufacturer shall provide a product warranty for a period of not less than five (5) years from date of installation. Warranty shall cover unlimited replacement of surge protective device modules during the warranty period. Those firms responding to this specification shall provide proof that they have been regularly engaged in the design, manufacturing and testing of surge protective devices for not less than twenty (20) years.

PRODUCTS

1. General:

    a. Except as otherwise indicated, provide high-energy transient voltage surge suppression electronic filter devices, suitable for application in Category A, B and C environments as indicated. Provide types, sizes, ratings and electrical characteristics indicated which comply with manufacturer's standard materials, design and construction in accordance with published information and as required for a complete installation.

    b. SPD stands for "surge protective device" where used herein.

2. Surge Protective Device System Description:

    a. Provide surge protective devices, which comply with the following:

        i. Have operating temperature of -40 to + 122 degrees F and operate reliably in environments with 0 to 95% humidity (non-condensing).

        ii. Emit no audible noise and capable of operation of up to 12,000 feet above sea level and emit no appreciable magnetic field.

        iii. Have a maximum continuous operating voltage not less than 125% of the nominal system operating voltage for 120/208 volt systems, 115% for 277/480 volt systems, and a frequency operating range of 47 to 63 Hertz.

        iv. Provide protection modes for line-to-neutral, line-to-line, line to ground, and neutral-to-ground for three phase, 4-wire wye systems.

    b. The system protection modules shall contain a linear array of balanced metal oxide varistors (MOV). Silicon avalanche diodes and gas tubes are not to be used or other components, which may short

or "crowbar" the AC line and lead to possible disruption of the normal AC power flow.

c. All primary transient path wiring shall be of #6 minimum for service entrance units and #8 AWG copper minimum. No plug-in modules, components or printed circuit boards shall be used in surge carrying paths.

d. Each protection module shall have a visual indicator that signifies the protection circuitry is on line. A redundant status indicator shall be mounted on the front of the panel.

e. Each protection module shall have a capacitive filtering system connected in each Line to Neutral (LN)(Wye) mode or Line to Line (LL) (Delta) mode to provide sine wave tracking and better performance of the protection modules.

f. The fusing elements must be capable of allowing the suppressor's minimum rated transient current to pass through suppressor, at a minimum 1,000 times, without fuse operation. No external current limiting devices shall be used.

g. Protection modes: surge protective device shall provide Line to Neutral (LN)(Wye), Line to Ground (LG) (Wye or Delta), Line to Line (LL)(Delta) and Neutral to Ground (NG)(Wye) protection, except that (NG) is not required in units at service entrance switchboards.

h. Each unit shall have a listed filter that reduces low level fast rise tie electrical line noise

i. Provide each unit with status indicators. Only where specifically indicated on drawings, provide each unit with audible alarm, disturbance counters, and form C contacts as indicated on the drawings.

j. The SPD shall be rated for the available fault current, and shall be labeled with its rating.

3. Units Installed at Service Entrance as defined by the NEC:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

b. Basis-of-Design Product: Subject to compliance with requirements, provide Insert manufacturer's name; product name or designation:

c. Equipment shall be a multi-stage parallel protector rated for VAC, 3 PHASE, 4 WIRE, plus ground. The equipment's minimum surge

current capacity shall be 300,000 per phase (L-N plus L-G).

d. The system protection modules shall contain a linear array of balanced metal oxide varistors (MOV). Each MOV will be individually fused. Each protection module shall have a minimum surge current rating of 150,000 per mode. Each protection module shall be capable of withstanding over 1,000 sequential 10,000 Amp impulses without degradation or failure.

e. The L-G mode is not required in service entrance units.

f. Surge protective device units shall be externally mounted to the switchboard. Verify that overcurrent protection is provided within the switchboard for surge protective device units in sizes and types as recommended by the manufacturer

4. Units Installed for Distribution Panels Downstream of the Service Entrance:

a. Equipment shall be a multi-stage parallel protector rated for VAC, 3 PHASE, 4 WIRE, plus ground. The equipment's minimum surge current capacity shall be 200,000 per phase (L-N plus L-G).

b. The system protection modules shall contain a linear array of balanced metal oxide varistors (MOV). Each protection module shall have a minimum surge current rating of 100,000 per mode. Each protection module shall be capable of withstanding over 1,000 sequential 10,000 Amp impulses without degradation or failure.

5. Units Installed for Panelboards:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

b. Basis-of-Design Product: Subject to compliance with requirements, provide manufacturer's name; product name or designation:

c. Equipment shall be a multi-stage parallel protector rated for VAC, 3 PHASE 4 WIRE, plus ground. The equipment's minimum surge current capacity shall be 160,000 per phase (L-N plus L-G).

d. The system protection modules shall contain a linear array of balanced metal oxide varistors (MOV). Each protection module shall have a minimum surge current rating of 80,000 per mode. Each protection module shall be capable of withstanding over 1,000 sequential 10,000 Amp impulses without degradation or failure.

e. Surge protective device units shall be mounted external to the panelboard. Provide over current protection for surge protective device units in sizes and types as recommended by the manufacturer

EXECUTION

1. General Installation:

   a. The specified surge protective device system shall be installed no further than eighteen (18) electrical inches from the power conductor(s) it is protecting, and must have a grounding of 25 ohms or less and shall avoid any unnecessary or sharp bends.

   b. Install devices in accordance with manufacturer's written installation and operation manuals.

   c. The installing contractor shall install service entrance SPD with short and straight conductors as practically possible. The contractor shall twist the SPD input conductors together to reduce input conductor inductance. The contractor shall follow the SPD manufacturer's recommended installation practices and comply with all applicable codes.

   d. The contractor shall follow the SPD manufacturer's recommended installation practices and comply with all applicable codes.

   e. Factory trained ISO 9001 certified service division employees shall be required to perform a site inspection prior to the project being turned over to the owner. Site inspection shall include verification of proper SPD installation, correct SPD voltage application, and startup procedures. Documentation shall be submitted to the Engineer verifying site visit and findings of the above.

   f. Contractor to provide CB or molded case switch sized per manufacturer's recommendations for units not provided with internal disconnects.

   g. Contractor to provide conduit and wiring from panel to surge protective device manufacturers recommendations.

26 51 00—INTERIOR LIGHTING

SUMMARY

1. Interior lighting lighting fixtures, lamps, and LED drivers.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

5. Exit signs shall be LED type.

6. Exit signs and emergency lighting fixtures shall be connected to engine generators whenever possible.

7. Seismic Performance: Luminaires shall withstand the effects of earthquake motions

8. All lighting fixtures shall be listed and labelled for the inended location and application.

9. Lighting fixtures using fluorescent lamps shall not be allowed.

PRODUCTS

1. Recessed Fixtures: for ceiling compatibility for recessed fixtures.

2. All interior lighting fixtures shall have LED light sources except where HID light sources are justified by the specific application and previously approved by the Owner.

3. Metal Parts: Free of burrs and sharp corners and edges.

4. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

5. Operating Temperature Range: 40 degrees F to 104 degrees F.

6. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

7. Diffusers and Globes:

    a. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

        i. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

        ii. UV stabilized.

    b. Glass: Annealed crystal glass unless otherwise indicated.

8. Factory-Applied Labels: Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place. Label shall include following lamp and ballast characteristics:

    a. "USE ONLY" and include specific lamp type.

    b. Lamp type, wattage, bulb type (ED17, BD56, etc.).

c. CCT 4000˚ K and CRI 80 (minimum) for all luminaires and lighting sources.

9. Exit Signs:

a. Comply with Code; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

b. Internally Lighted Signs:

i. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

ii. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a) Battery: Sealed, maintenance-free, nickel-cadmium type.

b) Charger: Fully automatic, solid-state type with sealed transfer relay.

c) Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

d) Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e) LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

f) Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

10. Emergency Lighting Units:

a. LED, self-contained units complying with UL 924.

b. Battery: Sealed, maintenance-free, lead-acid type.

c. Charger: Fully automatic, solid-state type with sealed transfer relay.

d. Operation: Relay automatically turns lamp on when power-supply

circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects LED driver from battery, and battery is automatically recharged and floated on charger.

e. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

f. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

g. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.

h. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

i. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

11. Lighting Fixture Support Components:

    a. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

    b. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

    c. Wires: Soft temper, zinc-coated steel, 12 gage.

    d. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

    e. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

EXECUTION

1. Lighting fixtures: Set level, plumb, and square with ceilings and walls unless otherwise indicated. Install lamps in each luminaire.

2. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the

temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

3. Remote Mounting of Ballasts or Drivers: Distance between the ballast, or driver, and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

4. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.

5. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently.

6. Suspended Lighting Fixture Support: Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

7. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

8. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

9. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

10. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

26 56 00—EXTERIOR LIGHTING

SUMMARY

1. LED Lights only for all exterior applications.

2. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.

3. All new exterior luminaires shall be LED.

4. Luminaire-mounted photoelectric relays.

5. Poles and accessories.

6. Pole installation using web fabric slings (not chain or cable).

7. Seismic Performance: Luminaires shall withstand the effects of earthquake motions.

PRODUCTS

1. Luminaires shall be listed and labeled for installation in wet locations.

2. Lateral Light Distribution Patterns: Comply with parameters of lateral light distribution patterns indicated for luminaires.

3. Metal Parts: Free of burrs and sharp corners and edges.

4. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

5. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

6. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

7. Exposed Hardware Material: Stainless steel.

8. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

9. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

10. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

    a. White Surfaces: 85 percent.

    b. Specular Surfaces: 83 percent.

    c. Diffusing Specular Surfaces: 75 percent.

11. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

12. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Match finish process and color of pole or support materials.

13. Factory-Applied Finish for Steel Luminaires:

    a. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel.

    b. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build

polyurethane enamel. Color as selected by Airport from manufacturer's full range.

14. Factory-Applied Finish for Aluminum Luminaires:

    a. Natural Satin Finish: Provide fine, directional, medium satin polish; buff and seal aluminum surfaces with clear, hard-coat wax.

    b. Class I, Clear Anodic Finish: (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker)

    c. Class I, Color Anodic Finish: (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker). Color as selected by Airport from manufacturer's full range.

15. Factory-Applied Labels:

    a. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

    b. Label shall include the following lamp and ballast characteristics:

        i. "USES ONLY" and include specific lamp type.

        ii. Lamp type, wattage, bulb type (ED17, BD56, etc.(.

        iii. CCT and CRI for all luminaires.

16. Luminaire-Mounted Photoelectric Relays:

    a. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

        i. Adjustable window slide for adjusting on-off set points.

17. LED Light Sources:

    a. CRI 80 (minimum), CCT 3000K.

    b. LED drivers shall be provided with a 5-year warranty.

    c. LED Fixtures shall be provided with internal driver(s) and in-line fusing.

    d. Pole mounted Apron Lights shall have separate external driver that is easily accessible.

18. Poles and Support Components:

    a. The following structural requirement information has been included to ensure the base foundations properly conform to the same requirements as the pole.

    b. All structural design shall conform to the requirements of AASHTO 2009.

    c. Structural Design Requirements:

        i. Wind-Load Strength of Poles: Pressure of wind on standard and luminaire, calculated and applied per AASHTO.

        ii. Wind speed for calculating wind load for poles 50 feet in height or less in 130 mph or as required for the elevation of the pole will be mounted.

        iii. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

        iv. Design Dead Load: Weight of luminaire, horizontal and vertical supports, and supporting structure.

        v. Live Load: Single load of 500 lbf.

    d. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

    e. Provide separate, internal raceway for lo-voltage wiring on poles with such other equipment such as CCTV cameras, etc.

    f. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

        i. Materials shall not cause galvanic action at contact points.

        ii. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

        iii. Anchor-Bolt Template: Plywood or steel.

    g. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

h. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange.

19. Aluminum Poles:

a. Seamless, extruded structural tube with access handhole in pole wall.

b. Poles: marine sheet alloy with access handhole in pole wall.

c. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

d. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug.

e. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

i. Tapered oval cross section, with straight tubular end section to accommodate luminaire.

ii. Finish: Same as pole.

f. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

g. Aluminum Finish

5.8. FIRE ALARM AND FIRE SUPPRESSION SYSTEMS

28 31 11—DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

SUMMARY

1. Section Includes:

a. Fire-alarm control unit;

b. Manual fire-alarm boxes;

c. System smoke detectors;

d. Heat detectors;

e. Notification appliances;

f. Magnetic door holders; and

g. Addressable interface device .

2. Non-coded system, dedicated to fire-alarm service only.

3. Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

4. Coordinate and interconnect to existing center system.

5. Identify conductors, raceways, and equipment.

6. Comply with NFPA 72 for installation of fire alarm equipment.

7. Install framed instructions in a location visible from fire alarm control unit.
8. Prepare test and inspection reports.
9. Ground fire alarm control unit and associated circuits; comply with IEEE 1100.
10. Train Airport Facility Management Department or other designated personnel to operate and maintain fire alarm system.

MANUFACTURERS

1. GE Infrastructure; a unit of General Electric Company.
2. NOTIFIER; a Honeywell company.
3. Siemens Building Technologies, Inc.; Fire Safety Division.
4. Or equal.

PRODUCTS

1. System Operation:
    a. Fire-alarm signal initiation shall be by one or more of the following devices:
        i. Smoke detectors;
        ii. Manual stations;
        iii. Heat detector; and
        iv. Water flow.
        v. Or equal.
    b. Fire-alarm signal shall initiate the following actions:
        i. Continuously operate alarm notification appliances;
        ii. Identify alarm at fire-alarm control unit and remote annunciators;
        iii. Transmit an alarm signal to the existing alarm receiving station;
        iv. Unlock electric door locks in designated egress paths;
        v. Release fire and smoke doors held open by magnetic door holders;
        vi. Activate voice/alarm communication system;
        vii. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode;
        viii. Activate stairwell and elevator-shaft pressurization systems;
        ix. Close smoke dampers in air ducts of designated air-conditioning duct systems;
        x. Recall elevators to primary or alternate recall floors; and

xi. Record events in the system memory.

c. Supervisory signal initiation shall be by one or more of the following devices and actions:

i. Valve supervisory switch;

ii. Low-air-pressure switch of a dry -pipe sprinkler system;

iii. Elevator shunt-trip supervision;

iv. Crossed zone smoke detector;

v. System trouble signal initiation shall be by one or more of the following devices and actions:

a) Open circuits, shorts, and grounds in designated circuits.

b) Opening, tampering with, or removing alarm initiating and supervisory signal-initiating devices.

c) Loss of primary power at fire -alarm control unit.

d) Ground or a single break in fire-alarm control unit internal circuits.

e) Abnormal ac voltage at fire-alarm control unit.

f) Break in standby battery circuitry.

g) Failure of battery charging.

h) Abnormal position of any switch at fire-alarm control unit or annunciator.

d. System Trouble and Supervisory Signal Actions:

i. Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

ii. Record the event on system.

2. Fire-Alarm Control Unit:

a. General Requirements for Fire-Alarm Control Unit:

i. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

a) System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary

and secondary power supplies.

b) Include a real-time clock for time annotation of events on the event recorder and printer.

ii. Addressable initiation devices that communicate device Identity and status.

a) Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire–alarm control unit. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

iii. Addressable control circuits for operation of mechanical equipment.

b. Alphanumeric Display and System Controls:

i. Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

ii. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.

iii. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

c. Circuits:

i. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.

a) Initiating Device Circuits: Style D.

b) Notification Appliance Circuits: Style Z.

c) Install no more than 50 addressable devices on each signaling line circuit.

ii. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

a) Initiating Device Circuits: Style B.

b) Notification Appliance Circuits: Style W.

c) Signaling Line Circuits: Style 4.5.

d) Install no more than 50 addressable devices on each signaling line circuit.

iii. Serial Interfaces: Two RS-232 ports for printers.

d. Smoke-Alarm Verification:

i. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.

ii. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.

iii. Record events by the system printer.

iv. Sound general alarm If the alarm Is verified.

v. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

e. Elevator Recall:

i. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm Initiating devices, except those listed, shall not start elevator recall.

a) Elevator lobby detectors except the lobby detector on the designated floor.
Smoke detector in elevator machine room.
Smoke detectors in elevator hoistway.

ii. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.

iii. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

f. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

g. Primary Power:

i. 24-V dc obtained from 120-Vac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals,

supervisory signals shall be powered by 24-V dc source.

ii. Alarm current draw of entire fire -alarm system shall not exceed 80 percent of the power supply module rating.

h. Secondary Power:

i. 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

ii. Batteries: Sealed lead calcium.

i. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

3. Manual Fire-Alarm Boxes:

a. Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible Indication of operation; and shall be mounted on recessed outlet box. If Indicated as surface mounted, provide manufacturer's surface back box.

b. Single-action mechanism, pull-lever type; with Integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

c. Station Reset: Key- or wrench-operated switch.

d. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to Initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn Intended to discourage false-alarm operation.

4. System Smoke Detectors:

a. General Requirements for System Smoke Detectors:

i. Comply with UL 268; operating at 24-V dc, nominal.

ii. Detectors shall be four-wire type.

iii. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

iv. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

v. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

vi. Integral Visual-Indicating Light: LED type indicating detector has operated.

vii. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, Individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

a) Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 degrees F or 20 degrees F per minute.

b) Fixed-temperature sensing shall be independent of rate -of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 degrees F or 155 degrees F.

c) Provide multiple levels of detection sensitivity for each sensor.

b. Photoelectric Smoke Detectors:

i. Detector address shall be accessible from fire alarm control unit and shall be able to identify the detector's location within the system and Its sensitivity setting.

ii. An operator at fire-alarm control unit. having the designated access level, shall be able to manually access the following for each detector:

a) Primary status. Device type. Present average value. Present sensitivity selected.

b) Sensor range (normal, dirty, etc.).

c. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

i. Detector address shall be accessible from fire alarm control unit and shall be able to identify the detector's location

within the system and its sensitivity setting.

ii. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a) Primary status.

b) Device type.

c) Present average value.

d) Present sensitivity selected.

e) Sensor range (normal, dirty, etc.).

iii. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.

iv. Each sensor shall have multiple levels of detection sensitivity.

v. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

vi. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

5. Heat Detectors:

a. Comply with UL 521.

b. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 degrees F or a rate of rise that exceeds 15 degrees F per minute unless otherwise indicated.

i. Mounting: Twist-lock base interchangeable with smoke-detector bases.

ii. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

6. Notification Appliances:

a. Individually addressed, connected to a signaling line circuit, equipped for mounting as Indicated and with screw terminals for system connections.

b. Combination Devices: Factory-Integrated audible and visible devices in a single-mounting assembly, equipped for mounting as Indicated and with screw terminals for system connections.

c. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

d. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 1 O feet from the horn, using the coded signal prescribed in UL 464 test protocol.

e. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

i. Rated Light Output: 15/30/75/11 O cd, selectable in the field.

ii. Mounting: Wall mounted unless otherwise indicated.

iii. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

iv. Flashing shall be in a temporal pattern, synchronized with other units.

v. Strobe Leads: Factory connected to screw terminals.

vi. Mounting Faceplate: Factory finished, white.

7. Magnetic DoorHolders:

a. Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

i. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.

ii. Wall-Mounted Units: Flush mounted unless otherwise directed by Airport.

iii. Rating: 24-Vac or dc.

iv. Rating: 120-Vac.

b. Material and Finish: Match door hardware.

8. Addressable Interface Device:

a. Microelectronic monitor module, NRTL listed for use in providing a system address for alarm initiating devices for wired applications with normally open contacts.

b. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown.

9. Digital Alarm Communicator Transmitter:

a. Digital alarm communicator transmitter shall be acceptable to

the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

b. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal Indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

c. Local functions and display at the digital alarm communicator transmitter shall include the following:

    i. Verification that both telephone lines are available.

    ii. Programming device.

    iii. LED display.

    iv. Manual test report function and manual transmission clear indication.

    v. Communications failure with the central station or fire-alarm control unit.

d. Digital data transmission shall include the following:

    i. Address of the alarm-initiating device.

    ii. Address of the supervisory signal.

    iii. Address of the trouble-initiating device.

    iv. Loss of ac supply or loss of power.

    v. Low battery.

    vi. Abnormal test signal.

    vii. Communication bus failure.

e. Secondary Power: Integral rechargeable battery and automatic charger.

f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

10. Device Guards:
    a. Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
    b. Factory fabricated and furnished by manufacturer of device.
    c. Finish: Paint of color to match protected device.

28 31 12—ZONED (DC) FIRE ALARM SYSTEM

SUMMARY

1. Section includes:
    a. Fire-alarm control unit.
    b. Manual fire-alarm boxes.
    c. System smoke detectors.
    d. Heat detectors.
    e. Notification appliances.
    f. Magnetic door holders.
    g. Digital alarm communicator transmitter.
2. Non-coded system, dedicated to fire-alarm service only.
3. Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
4. Coordinate and interconnect to existing center system.
5. Identify conductors, raceways, and equipment.
6. Comply with NFPA 72 for installation of fire alarm equipment.
7. Install framed instructions in a location visible from fire alarm control unit.
8. Prepare test and inspection reports.
9. Ground fire alarm control unit and associated circuits; comply with IEEE 1100.
10. Train Authority Facility Management Department or designated maintenance personnel to operate and maintain fire alarm system.

MANUFACTURERS

1. GE Infrastructure; a unit of General Electric Company.
2. NOTIFIER; a Honeywell company.
3. Siemens Building Technologies, Inc.; Fire Safety Division.
4. Or equal.

PRODUCTS

1. System Operation:

a. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

   i. Manual stations.

   ii. Heat detectors.

   iii. Smoke detectors.

   iv. Duct smoke detectors.

   v. Automatic sprinkler system water flow.

   vi. Fire-extinguishing system operation.

   vii. Fire standpipe system.

b. Fire-alarm signal shall initiate the following actions:

   i. Continuously operate alarm notification appliances.

   ii. Identify alarm zone at fire-alarm control unit and remote annunciators.

   iii. Transmit an alarm signal to the remote alarm receiving station.

c. Supervisory signal initiation shall be by valve supervisory switch.

d. System trouble signal Initiation shall be by one or more of the following devices and actions:

   i. Open circuits, shorts, and grounds In designated circuits.

   ii. Opening, tampering with, or removing alarm initiating and supervisory signal-Initiating devices.

   iii. Loss of primary power at fire-alarm control unit.

   iv. Ground or a single break In fire-alarm control unit internal circuits.

   v. Abnormal ac voltage at fire-alarm control unit.

   vi. Break in standby battery circuitry.

   vii. Failure of battery charging.

   viii. Abnormal position of any switch at fire-alarm control unit or annunciator.

e. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2. Fire-Alarm Control Unit:

   a. Modular, power-limited design with electronic modules, UL 864 listed and compatible with existing systems. Include a real-time clock for time annotation of events.

b. Alphanumeric Display and System Controls:

   i. Display alarm, supervisory, and component status messages and the programming and control menu.

   ii. Annunciator and Display: Liquid -crystal type, one line of 40 characters, minimum.

c. Circuits:

   i. No Fewer Than Five Initiating Device Circuits:

      a) Four circuits, NFPA 72, Class B.

      b) One circuit(s), NFPA 72, Class A, Style 6

   ii. No Fewer Than Two Notification Appliance Circuits: NFPA 72, Class B, Style Y.

d. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

e. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

f. Primary Power:

   i. 24-V dc obtained from 120-Vac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by the 24-V dc source.

   ii. Alarm current draw of the entire fire-alarm system shall not exceed 80 percent of the power -supply module rating.

g. Secondary Power:

   i. 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

   ii. Batteries: Sealed lead calcium.

h. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

3. Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating

instructions in contrasting color; sl1all show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

a. Single-action mechanism, pull-lever type.

b. Station Reset: Key- or wrench-operated switch.

c. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

d. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

4. System Smoke Detectors:

a. Operating at 24-V dc, nominal.

b. Four-wire type.

c. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

d. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

e. Integral Visual-Indicating Light: LED type indicating detector has operated.

f. Provide multiple levels of detection sensitivity for each sensor.

g. Photoelectric Smoke Detectors: Comply with UL 268.

h. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

i. Remote indication and test station.

ii. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.

iii. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

a) Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

5. Heat Detectors:

   a. Comply with UL 521.

   b. Combination type, actuated by fixed temperature of 135 degrees F or a rate of rise that exceeds 15 degrees F per minute unless otherwise indicated.

   c. Mounting: Twist-lock base interchangeable with smoke-detector bases.

6. Notification Appliances:

   a. Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

   b. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

   c. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

   d. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 1 O feet from the horn, using the coded signal prescribed in UL 464 test protocol.

   e. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

      i. Rated Light Output: 15/30/75/110 cd, selectable in the field.

      ii. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

      iii. Flashing shall be in a temporal pattern, synchronized with other units.

      iv. Strobe Leads: Factory connected to screw terminals.

      v. Mounting Faceplate: Factory finished, white.

7. Magnetic Door Holders:

    a. Provide units equipped for wall or floor mounting as indicated and are complete with matching doorplate.

        i. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.

        ii. Rating: 24-Vac or dc.

    b. Material and Finish: Match door hardware.

8. Digital Alarm Communicator Transmitter:

    a. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

    b. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

    c. Local functions and display at the digital alarm communicator transmitter shall include the following:

        i. Programming device.

        ii. LED display.

        iii. Manual test report function and manual transmission clear indication.

        iv. Communications failure with the central station or fire-alarm control unit.

    d. Digital data transmission shall include the following:

        i. Zone of the alarm initiating device.

        ii. Zone of the supervisory signal.

        iii. Zone of the trouble initiating device.

        iv. Loss of ac supply or loss of power.

        v. Low battery.

vi. Abnormal test signal.

vii. Communication bus failure.

e. Secondary Power: Integral rechargeable battery and automatic charger.

f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

9. Device Guards:

a. Welded wire mesh of size and shape for manual station, smoke detector, gong, or other device requiring protection.

b. Factory fabricated and furnished by manufacturer of device.

c. Finish: Paint of color to match protected device.

5.9. TELECOMMUNICATIONS

(RESERVED)

5.10. IT AND SECURITY

(RESERVED)

5.11. AIRSIDE FACILITIES

(RESERVED)

5.12. LANDSIDE FACILITIES

(RESERVED)

5.13. SITE UTILITIES

(RESERVED)

5.14. APPENDIX

APPENDIX A—MEASUREMENT AND PAYMENT

The following standard paragraph shall be used in each specification. The parenthesis should be used only when special or unusual work is to be included in the contract bid item, such as sawcutting, grouting, traffic control, or coordination not usually included in the common scope of meaning of the contract bid item.

(Note: Parenthesis can also be used to exclude work.)

*_____
will be measured by the number of (select one from each category, below):

Method of Measurement	Type of Construction	Method of Determination
☐ Linear feet of	☐ Actually constructed	☐ As determined by Engineer from field measurement
☐ Square feet of	☐ Actually placed	☐ As verified from certified weight tickets
☐ Cubic feet of	☐ Actually installed	☐ As measured below subgrade by the Engineer.
☐ Pounds of	☐ Actually planted	☐ _____
☐ Tons of	☐ Actually demolished	
☐ _____	☐ _____	

The Contract unit price for *_____shall include full compensation for furnishing all labor, materials, equipment, tools and incidentals and for doing all the work of _____complete in place, (including **_____) as shown on the drawings and as specified in these Special Provisions.

APPENDIX B—OVER RUN OR UNDER RUN QUANTITIES

Use the following paragraph if quantities are over or under run. This paragraph will not print unless selected. The normal range of variation is from 75 percent to 125 percent. Other limits may be acceptable depending on situation and case involved. Deviations from the normal range shall be reconciled during the 100 percent review of final documents.

The actual quantity of *_____will be determined by the Engineer based on conditions found at the time of construction. The estimated bid quantity is for the purpose of establishing a Contract unit price for this item and Authority reserves the right to vary the actual quantity of *_____from_____% to_____% of the bid quantity at no change in the Contract unit price.

Notes To Specification Writer For Measurement and Payment:

1. Insert the title of the bid item at first asterisk only. Insert the title of the bid item at each following asterisk.
2. Check one unit of measure and one method of application. Write in unit and method if not indicated.

APPENDIX C—LUMP SUM PAY CLAUSE

*_____will be paid for at the Contract lump sum amount for *_____, which amount shall include full compensation for furnishing all labor, materials, equipment, tools, and incidentals and for doing all the work of *_____ (including_____), complete in place, as specified in these Special Provisions and shown in the drawings.

Notes to Specification Writer for Lump Sum Pay Clause:

1. Insert the title of the bid item in each of the blanks with one asterisk. You need to write it only once.
2. Use the inclusion phrase in parenthesis only when including any operations such as sawcutting, grouting, traffic control or coordination that are not usually included in the commonly understood scope of a bid item. Please note that in final form commas remain; but the parentheses are removed.

APPENDIX D—UNIT PRICE / LUMP SUM (COMBO) PAY CLAUSE

The contract (1)_____

price paid per (2) _____for (3)_____

shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in (4) _____

complete in place, including.(5) _____

_____,

as shown on the drawings, and as specified in these Special Provisions.

Notes to Specification Writer:

1. "Lump sum" if the item is lump sum "Unit" only if item is each- NO ENTRY FOR OTHER MEASUREMENTS

☐ Cubic Yard	☐ Linear Foot	☐ Cubic Foot	☐ Square Foot	☐ Pound
☐ Ton	☐ Tablet	☐ Gallon ____ square yard	☐ Application _____ square acre	

2. (No entry if lump sum or each)-delete the word "per" above when using lump sum/unit
3. Exact wording of the contract item listed in the bid schedule.
4. Description of work (use of the contract item is usually sufficient). Example: "…work involved in constructing chain link fences and gates"
5. Special or unusual work to be included in the contract item. (Note: Can also be used to exclude work).

This measurement and payment clause may be used at discretion of specification writer. Writer should use clause on Page 1 when specific measurement clause is necessary. An example of a measurement clause with specifics is Section 65-1.09, Measurement of the Caltrans Standard Specifications, July 1995.

APPENDIX E —FULL COMPENSATION PAY CLAUSE (FCPC)

Full compensation for (1) _____ shall be considered as included in the contract (2) _____ price paid per (3) _____for (4) _____. (5) _____ and no additional compensation will be allowed therefore.

The above measurement and payment clause shall be used as the contract wording for the Full Compensation Pay Clause (FCPC)

1. This pay clause is for work that is not to be paid for separately.
2. "Lump sum" if item is lump sum; "unit" only if item is each; nothing is entered for other units of measure.
3. Cubic yard, linear foot, etc. Nothing is entered for lump sum or each.
4. Use exact wording of the contract item and include compensation for work listed in (1).
5. Use Phrase (5) if the work listed in (1) is usually a separate contract item.

Notes to Specification Writer:

The FCPC is used to include compensation for work in another contract item instead of adding a separate contract item.

1. Payment is made and compensation is allowed. "Allowing payment" or "making compensation" is not acceptable terminology. The full compensation pay clause shall include compensation for the work in one contract item if practical. If this is not possible, compensation shall be included in the contract items which are involved. FCPC's are useful in eliminating nuisance items of small value but should be used with judgment and restraint for the following reasons:

APPENDIX F —FULL COMPENSATION PAY CLAUSE (CONTINUED)

a. FCPC's make it difficult to adjust the price of the contract item or items that include payment of nuisance items. Where the Authority reserves the right to vary the actual quantity, discretion is particularly important because increases or decreases could exceed the amount of the contract item(s).

b. FCPCs result in false data being accumulated in the Facilities Development Department database records.

APPENDIX G— TRASNFERABLE PAY CLAUSE (TPC)

(1) _____ will be measured and paid for as (2_ _____.

Notes to Specification Writer:

This type of pay clause is used to pay for the quantity of one item of work as included in another bid schedule item.

The correct wording for a TPC is:

1. Item of work which is paid for as the bid schedule item listed in (2).
2. Exact wording of bid schedule item.

APPENDIX H — SHORT PAY CLAUSE

(1) _____ will be measured and paid for (2) _____ in the same manner specified for (3) _____ as provided in Section (4) _____ of the Special Provisions.

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APPENDIX I —MAINTENANCE LOG

Date	XX/XX/XXXX	Maintenance Log—Project Name					
Item No.	Spec Section	Submittal No	Scope Description	Sub-Contractor	Responsible Party for Maintenance	Maintenance Info	Specification Subsection
1							
2							
2							
4							

CHART MATCH LINE

Specifications Requirement	Maintenance Term (Typical = Maintain until Beneficial Occupancy	Maintenance Start Date	Extended Maintenance	Maintenance Instruction	Training	Attic Stock	Warranty

CHART MATCH LINE

APPENDIX J—SOLE SOURCE / BOD MANUFACTURERS AND PRODUCTS

PLUMBING FIXTURES			
Manufacturer & Products	**Application**	**Sole Source Manufacturer / Product (required in order to match other products in use at the Airport)**	**Basis of Design Product**
Application	**Water Closets**		
Manufacturer:	Sloan		X
Product:	ST-2469 - Elongated Wall-Mounted Water Closet		
Application	**Water Closets**		
Manufacturer:	Sloan		X
Product:	ST- 2029 (ADA) Floor Mounted - Water Closet		
Application	**Water Closets**		
Manufacturer:	Sloan		X
Product:	ST- 2009 Floor Mounted - Water Closet		
Application	**Exposed Flush Valve - Water Closet**		
Manufacturer:	Sloan	X	
Product:	Royal 111 SFSM-1.28-HW		
Application	**Concealed Flush Valve - Water Closet**		
Manufacturer:	Sloan	X	
Product:	Royal 152 ESS Hardwired - Royal Sensor Flushometer		
Application	**Faucets**		
Manufacturer:	Sloan	X	
Product	Optima Sensor Faucet ETF-880-4-PLG-TEE-CP-0.5GPM-MLM-IR-BT-FCT / Code Number: 3365013BT		
Application	**Counter Mounted Soap dispenser**		
Manufacturer:	GoJo		X
Product	GOJO 8540-01 / 8501-AC-KIT-02 power adapter kit for 2 dispensers.		

APPENDIX J—SOLE SOURCE / BOD MANUFACTURERS AND PRODUCTS (CONTINUED)

PLUMBING FIXTURES			
Manufacturer & Products	**Application**	**Sole Source Manufacturer / Product (required in order to match other products in use at the Airport)**	**Basis of Design Product**
Application	**Urinals - with Concealed-Flush Valve**		
Manufacturer:	Sloan		X
Product	SU-1019; Retrofit Washdown Urinal		
Application	**Urinal -with Exposed-Flush Valve**		
Manufacturer:	Sloan		X
Product	SU-1009 Washdown Urinal		
Application	**Exposed - Flush Valve**		
Manufacturer:	Sloan	X	
Product	Royal 186 SFSM-0.125-HW		
Application	**Concealed - Flush Valve**		
Manufacturer:	Sloan	X	
Product	Royal Sensor Flushometer, Royal 195 ESS Hardwired		
Application	**Lavatories**		
Manufacturer:	American Standard or Kohler		X
Product	No Specific Product		
Application	**Drinking Fountains**		
Manufacturer:	Elkay	X	
Product	LZSTL8WSLK Water Refilling Station, Bi-Level Reversible, W/Filter, Light Gray.		
Application	**Angle Supply Stops**		
Manufacturer:	Dahl		X
Product	#611-33-31		

APPENDIX J—SOLE SOURCE / BOD MANUFACTURERS AND PRODUCTS (CONTINUED)

HVAC INSTRUMENTATION			
Manufacturer & Products	**Application**	**Sole Source Manufacturer / Product (required in order to match other products in use at the Airport)**	**Basis of Design Product**
Application	**HVAC Instrumentation**		
Manufacturer:	Siemens Building Technologies	X	
Product:	None Listed.		

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CHAPTER 06:
DELIVERABLES AND PERMITTING PROCESS

6.1. INTRODUCTION
6.2. GENERAL CONSIDERATIONS FOR DELIVERABLES
- 6.2.1. QUALITY ASSURANCE
- 6.2.2. DETAILED CHECKING
- 6.2.3. REGULATORY REQUIREMENTS AND APPROVAL OVERVIEW
- 6.2.4. AUTHORITY REVIEW, COMMENT AND APPROVAL OF DELIVERABLES
- 6.2.5. AUTHORITY SPONSOR AND STAKEHOLDER INTERFACE
- 6.2.6. DESIGN-BUILD & DESIGN-BID-BUILD PROJECT DELIVERY AT THE AIRPORT

6.3. DESIGN—BUILD DELIVERABLES
- 6.3.1. PROGRAM DEFINITION DOCUMENT
- 6.3.2. MILESTONE DELIVERABLES
- 6.3.3. DESIGN REVIEWS
- 6.3.4. PERMITTING PROCESS
- 6.3.5. RECORD DRAWING DELIVERABLES

6.4. DESIGN—BID—BUILD DELIVERABLES
- 6.4.1. SCHEMATIC DESIGN PHASE
- 6.4.2. DESIGN DEVELOPMENT PHASE
- 6.4.3. CONSTRUCTION DOCUMENTS PHASE
- 6.4.4. PERMITTING PROCESS
- 6.4.5. RECORD DRAWING DELIVERABLES

6.5. APPENDIX

6.1. INTRODUCTION

The purpose of this Chapter is to provide the design Architect / Engineer (Consultant) with a guideline of the tasks and deliverables associated with design services for construction projects at San Diego International Airport This chapter does not attempt to comprehensively define every possible airport project. Instead, what is offered here are general criteria and guidelines applicable across projects.

The Consultant shall use this Chapter in concert with project documents; the Contract and Programmatic documents (Program Definition Documents / Project Definition Packages), as well as the information presented elsewhere in this Standards Manual.

6.2 GENERAL CONSIDERATIONS FOR DELIVERABLES

6.2.1. QUALITY ASSURANCE

The Consultant shall provide professional, technically accurate calculations, drawings, specifications, and cost estimates. Ambiguity, omissions, and conflicts in construction contract drawings and specifications generally result in higher bids and field change orders, thereby causing an unnecessary expenditure of public funds.

6.2.2. DETAILED CHECKING

As a component of Quality Assurance, an uninvolved, knowledgeable senior member of the Consultant's staff shall thoroughly review deliverables prior to their submittal to accomplish an "independent" check. The purpose is to identify and eliminate errors, conflicts, and inconsistencies between all design disciplines and design subconsultants, and between drawings and specifications. The review shall verify that the drawings and specifications have been prepared in accordance with Authority requirements and appropriate design criteria and that the design is constructible. The Consultant must submit documentation of this in-house review for the Authority's record keeping as part of the deliverable.

6.2.3. REGULATORY REQUIREMENTS AND APPROVAL OVERVIEW

The Consultant shall work with the Authority Project Manager (APM) in establishing and obtaining all regulatory approvals and permitting required for the project prior to the start date of construction.

The California Environmental Quality Act (CEQA), compliance process commences at or before the 30% design phase.

To assist in compliance with CEQA and other governmental and environmental regulatory requirements, the Consultant shall prepare all necessary environmental documents based on the relevant regulatory codes and environmental guidelines.

All projects implemented at the Airport require a California Coastal Commission (CCC) permit. The Coastal Commission Permitting process commences at or before 30% design phase of the project. Consultant will prepare site plans, building floor plans, building sections, building elevations, view simulations, 3D renderings, storm water management plan, and other documents as required by the project team. The project team including the Consultant will collaborate with the Airport's Planning and Environmental Affairs department, who will liaise with the CCC Staff on behalf of the project team.

FAA 7460 approval is required for each project that will occupy air space. The Consultant will prepare all required documents, reviewed with APM, and submit a 7460 permit application to the FAA at least 45 business days before the start date of the proposed construction.

6.2.4. AUTHORITY REVIEW, COMMENT AND APPROVAL OF DELIVERABLES

At each milestone, the Consultant shall present deliverables to the Authority for review and comment, with at least one review period per milestone. The typical review duration is 21 calendar days. Based

on the Authority's comments, the Consultant will revise and resubmit the deliverable addressing and incorporating comments to the Authority's satisfaction as part of next milestone deliverable.

6.2.5. AUTHORITY SPONSOR AND STAKEHOLDER INTERFACE

To ensure the project scope satisfies sponsor and stakeholder requirements, the Consultant shall ensure sufficient stakeholder interface opportunities. While the stakeholder interface is most intensive during the Validation Phase, it is necessary throughout the duration of the project. In later phases, stakeholders and sponsors will review the milestone deliverable with the consultant's assistance during "page-turn" sessions organized by the consultants. The Authority will identify the sponsors and stakeholders relevant to the project to be invited to the "page-turn" sessions.

6.2.6. DESIGN-BUILD AND DESIGN-BID-BUILD PROJECT DELIVERY AT THE AIRPORT

The Authority utilizes both Design-Build (DB) and Design-Bid-Build (DBB) delivery methods at the Airport and determines which to use based on the scale and complexity of the project scope. Larger and/or more complex projects are typically delivered via DB and simpler and/or smaller projects are delivered by DBB. The initial section of this chapter deals with DB projects.

'Consultant' refers to the project's design consultant (Architect / Engineer) and Design-Builder refers to the Contractor.

6.3. DESIGN—BUILD DELIVERABLES

DB design milestones and deliverables are tailored to the project and are described in the Contract and may not occur in a linear sequence.

6.3.1. PROGRAM DEFINITION DOCUMENT

Improvements to airport facilities are proposed by project sponsors and studied by the Authority's Planning Department in collaboration with relevant stakeholders. The scope of the project is developed by Airport Design and Construction (ADC) Department into a defined set of objectives, criteria and concepts that describe the anticipated physical, fiscal and schedule envelopes.

The scope and general outline of the project are presented to the Consultant in the form of programmatic documents prepared by the Authority that may vary with each project. DB projects will typically consist of a more comprehensive Program Definition Document (PDD).

The PDD communicates the Authority's expectations for the project to the Consultant. The PDD defines the scope, location, intent, standards, and criteria

throughout the design, construction, activation, and commissioning process of the facilities. It serves to ensure that the execution of the finished facility does not lose sight of the original identified needs.

6.3.2. MILESTONE DELIVERABLES

The Consultant shall submit project milestones deliverables as set forth in the approved Design Review Plan required in the Contract.

6.3.3. DESIGN REVIEWS

Authority Design Reviews will occur at each milestone deliverable as set forth in Design Review Plan or at the completion of a 'composite' 30%, 60%, 90% and 100% level of design documents (unless otherwise agreed to in the approved Design Review Plan).

The Consultant shall bring to the Authority's attention any aspects in the drawings and specifications that vary from information presented in the Validated PDD and the effects of any changes with regard to the Guaranteed Maximum Price (GMP) schedule and GMP amount.

6.3.4. PERMITTING PROCESS

The Authority is committed to working collaboratively with City of San Diego Development Services Department (DSD) staff for permitting of airport projects and will facilitate the initial introduction of the project team to the DSD project manager and other staff members. Depending on a project's scale and schedule, the Authority may request that the City of San Diego DSD staff expedite plan check reviews.

The Consultant shall coordinate with assigned DSD staff to schedule plan check reviews. The DSD plan check process includes an airport clearance requirement which is obtained by receiving the Authority's stamp & signature on a given drawing package prior to submittal for plan check. After plan check comments have been addressed, the Consultant/Design-builder will resubmit the drawing package to the Authority for signature, then submit the signed set to the SD DSD for issuance of building permits to the Design Builder.

Once the plan check approval is issued by the City of San Diego, Contractor to submit the scanned PDFs of perforated plans and calculations to the Authority for record keeping.

6.3.5. RECORD DRAWINGS

Record drawing requirements are included in the Contract and Chapter 7 Sections 7.3.5 Project Deliverable Process and 7.4.4.4 Record Drawing Procedure of this Standards Manual.

6.4. DESIGN—BID—BUILD DELIVERABLES

For Design-Bid-Build projects, the Consultant's activities are organized in the following project phases:

SCHEMATIC DESIGN PHASE:

Validation of Project Definition Package (PDP)

Preparation of Basis of Design (BOD) report including Preliminary Engineering / Schematic Design

DESIGN DEVELOPMENT PHASE:

Design Development (30%)

CONSTRUCTION DOCUMENTS PHASE:

Construction Documents (60%, 90% and 100% deliverables)

Permitting

BIDDING PHASE:

Bid support, including preparing draft answers to bidders' questions and draft addenda, if applicable.

CONSTRUCTION PHASE:

Contract Administration during construction

Commissioning of building systems

PROJECT CLOSEOUT PHASE:

Record Drawing Deliverables

6.4.1. SCHEMATIC DESIGN PHASE

The Authority will furnish the Consultant with the Project Definition Package (PDP) and other relevant documents. Upon receiving the Task Authorization / Notice to Proceed (NTP), the Consultant's initial task is to validate the project scope as represented in the PDP.

6.4.1.1. VALIDATION OF PROJECT DEFINITION PACKAGE (PDP)

The PDP communicates the Authority's expectations of the scope, location, intent, standards, and criteria for the project. The PDP serves as a guidance document throughout the design, construction, activation, and commissioning process.

The scope of proposed improvements may be described in a written description, sketches, drawings, photographs and/or cut sheets for illustration purposes. Site plans, floor plans and building sections may be provided that define components, configuration, scale and relationships, functions, and site utilities, including interface with existing facilities. It will also include the Authority's ROM budget and schedule milestones including start and completion dates. In the case of smaller

projects, the Project Definition could be in the form of Scope of Work (SOW) report.

While every effort is made to comprehensively define a given project's scope and context, the Consultant shall undertake to verify that the PDP and other existing information supplied by the Authority are accurate and complete.

The Consultant's efforts to validate the PDP is presented in the Basis of Design (BOD) and serves three overall objectives;

1. Identify relevant physical, regulatory and implementation parameters;
2. Confirm that the PDP's project scope substantially addresses the identified need or improvement; and,
3. The Consultant and the Authority concur on the project scope before proceeding with schematic design.

6.4.1.2. PREPARATION OF BASIS OF DESIGN REPORT

The BOD's form and extent may be modified subject to approval by the Authority but generally it will include the sections described below:

EXECUTIVE SUMMARY:

The core of the Consultant's findings and conclusions with respect to validating the project scope shall be presented in summary form to provide a high-level overview.

SCOPE NARRATIVES:

The Consultant shall provide scope narratives that validate project scope through supporting stakeholder input, design criteria and data derived through field investigations, life-cycle cost analysis, and other relevant environmental or factual considerations. Scope narratives shall be organized for major disciplines:

1. Civil / Landscape
2. Architectural;
3. Structural;
4. Mechanical, Electrical, Plumbing, Fire Protection;
5. Information Technology / Telecommunication Systems;
6. Special Airport Systems (i.e., BHS, PBB, Aircraft Systems);
7. Signage & Wayfinding;
8. Simulation Analysis of PAX & BHS; and
9. Preliminary LEED Analysis.

6.4.1.3. PRELIMINARY ENGINEERING / SCHEMATIC DESIGN EXHIBITS:

The Consultant shall prepare exhibits to support the written narratives and proposed design to;

1. Orient the project elements on the site and define the relationship to existing facilities;
2. Generally define the size, scale and relationship of each major component;
3. Select the major building systems – Structural, MEP, IT, other;
4. Identify building materials and finishes for the interior and exterior; and,
5. Perform adequate site investigation and analysis to substantiate and justify the proposed design.

The Consultant shall prepare and deliver exhibits organized by major disciplines as follows:

1. Civil / Landscape;
2. Architectural;
3. Structural;
4. Mechanical, Electrical, Plumbing, Fire alarm and Fire protection;
5. Information Technology / Telecommunication systems;
6. Special Airport Systems (i.e., BHS, PBB, Aircraft Systems); and,
7. Signage & Wayfinding.
8. Simulation Analysis of PAX & BHS; and
9. Preliminary LEED Analysis.

The Consultant shall provide 3D renderings if applicable.

Consultant shall address any other specific components relating to the project that are not addressed by this section.

6.5. Appendix - Provides the minimum Level of Completion the Authority will accept.

6.4.1.4. INITIAL PROJECT COST ESTIMATE

The Consultant shall provide an itemized project cost estimate if requested by the Authority Project Manager (APM).

6.4.1.5. PROJECT SCHEDULE & MILESTONES

The Consultant shall confirm the viability of the Authority provided project start and end dates by providing an initial breakdown of significant milestones for design and construction. These should include anticipated milestones for environmental clearances and other regulatory agency (AHJ) approvals.

6.4.1.6. CONSTRUCTION PHASING

The Consultant shall submit an initial construction phasing plan. The Authority will use this to assess project impacts to ongoing operations, airport facilities and interdependent and adjacent projects.

6.4.1.7. PRELIMINARY LEED CERTIFICATION SUPPORT

The Consultant shall be responsible for providing necessary information and documentation in support of the LEED Certification process. For more information, refer to Chapter 3 of this Standards Manual.

6.4.1.8. PRELIMINARY ENERGY REPORT

The Consultant shall submit the minimum requirements to meet California Code of Regulations, Title 24, Part 6 and Part 11 (Energy Code & CALGreen code). For further information, refer to Chapter 3 of this Standards Manual.

6.4.1.9. PRELIMINARY CALCULATIONS

The calculations shall be sufficiently detailed to quantify individual elements of the systems defined in the BOD to establish levels of completion for civil, architectural, structural, mechanical, electrical, plumbing, fire protection, information technology / telecommunication systems.

6.4.1.10. AUTHORITY REVIEW

The Authority will review the BOD and Schematic Design Deliverables to verify that the design concepts proposed by the Consultant align with the PDP.

The Authority's approval of the Preliminary Engineering / Schematic Design package signifies the end of the phase and the start of the Design Development phase

6.4.2. DESIGN DEVLOPMENT PHASE (30%)

The Consultant is responsible for ensuring that Design Development remains aligned with the Programmatic documents and Schematic Design Phase deliverables. The design shall also address and incorporate all design review comments from the previous phase to the satisfaction of the Authority.

The Consultant is responsible for sufficiently developing the project design to achieve the following for the disciplines relevant to the project:

1. Define all major building design and equipment decisions;
2. Integrate building systems into the overall design, resolving all interdisciplinary relationships;
3. Provide key building details; and

4. Define colors, materials and finishes and provide specification and performance requirements.

Design Development deliverables point towards the final work product by developing all data required for the preparation of Construction Documents.

The design development drawings shall be in the final format of the Construction Documents and shall be presented in corresponding scale across all disciplines. Dimensioning shall be sufficient to define sizes of details, material thickness, equipment and fixture sizes, etc.

6.5. Appendix - Provides the minimum Level of Completion the Authority will accept.

6.4.2.1. SPECIFICATIONS

The Design Development deliverables shall include a Specification of all applicable sections developed using the Authority guideline and the CSI industry standards. The specifications shall indicate unique requirements including coordination with other specifications sections, listing of products and general description of specialized execution sequences and quality control procedures. Provide a list of potential Sole-Source items and Sole-Source Justifications. See Chapter 5 of this Standards Manual.

6.4.2.2. COST ESTIMATE / CONSTRUCTION SCHEDULE

At the Design Development submittal, the Consultant shall provide the Cost Estimate in UniFormat and Construction Schedule in the latest version of Primavera.

6.4.2.3. LEED CERTIFICATION SUPPORT

The Consultant shall be responsible for providing necessary information and documentation at the design development phase in support of the LEED Certification process. The Consultant, with Authority assistance, shall register the project with USGBC. For more information, refer to Chapter 3 of this Standards Manual.

6.4.2.4. ENERGY REPORT

The Consultant shall submit the minimum requirements to meet California Code of Regulations, Title 24, Part 6 and Part 11 (Energy Code & CALGreen code). For further information, refer to Chapter 3 of this Standards Manual.

6.4.2.5. CALCULATIONS

Calculations shall be sufficiently detailed to quantify individual elements of the systems defined during prior design submittals. Calculations shall be given for:

1. Determination of sizes, grade/quality of materials, sizing and location of details

and equipment. (e.g., wall/floor thickness, column/beam/connection sizes, equipment sizes, and spatial requirements) and

2. Establishing levels of completion for civil, architecture, structural, mechanical, plumbing, electrical and fire protection, and information technology / telecommunication systems.

6.4.2.6. BOD UPDATE

The Consultant shall submit a BOD update at the completion of the Design Development Phase.

6.4.3. CONSTRUCTION DOCUMENTS PHASE (60% 90%, 100%)

Construction Documents deliverables provide all information necessary for bidding and construction. The 90% deliverables are prepared for review by the City of San Diego Development Services Department for obtaining a Building Permit, if applicable.

The Consultant shall complete pre-final contract documents suitable for public procurement and construction.

The Consultant is responsible for ensuring that the Construction Documents remains aligned with the programmatic documents and deliverables. The deliverable shall also address and incorporate all design review comments from the previous phase of the project to the satisfaction of the Authority.

Construction Documents present the final form of the project and include:

1. Complete specifications coordinated with the drawings;

2. Complete design details;

3. Complete and finalized bid requirements incorporated into the design; and

4. Inclusion of all information, research and findings from previous phases.

5. 100% Construction Documents sets are signed and sealed documents ready for advertising for public bidding.

6. 6.5. Appendix - Provides the minimum Level of Completion the Authority will accept.

6.4.3.1. CONSTRUCTION SPECIFICATIONS

Final specifications shall address all applicable subdivisions, and shall contain final technical information to supplement the drawings to quantify sizes, capacities and quantities, finishes, and other characteristics applicable to materials and equipment. Provide a final list of Sole-Source items and Sole-Source

Justifications. See Chapter 5 of this Standards Manual.

6.4.3.2. COST ESTIMATE / CONSTRUCTION SCHEDULE

The Consultant shall provide a final Cost Estimate in UniFormat and Construction Schedule in the latest version of Primavera.

6.4.3.3. LEED CERTIFICATION SUPPORT

The Consultant is responsible for submitting the design credits to USGBC for review and comment. Construction credits will be finalized and submitted prior to substantial completion of the project. For more information, refer to Chapter 3 of this Standards Manual.

6.4.3.4. ENERGY REPORT

The Consultant shall submit the minimum requirements to meet California Code of Regulations, Title 24, Part 6 and Part 11 (Energy Code & CALGreen code). For more information, refer to Chapter 3 of this Standards Manual.

6.4.3.5. CALCULATIONS

The Consultant shall furnish final calculations for all disciplines, components and systems for all parts of the projects leading to satisfactory execution and completion of construction work.

6.4.3.6. BOD UPDATE

The Consultant shall submit a final BOD with all issues reviewed and coordinated, cross-referenced, and incorporated into the Construction Documents.

6.4.3.7. ISSUE FOR CONSTRUCTION – PERMITTTED DOCUMENTS

Issue for Construction deliverables provide complete design documents that have been permitted by the San Diego Planning and Development Department Service.

The Consultant is responsible for ensuring that the Issue for Construction deliverables remains aligned with the Programmatic documents and prior deliverables. The design shall also address and incorporate all comments by the City of San Diego Development Services Department.

The Consultant shall update the contract design drawings and specifications into the contract construction documents that incorporate all the addenda issued during the bid and award phase.

6.4.4. PERMITTING PROCESS

The Authority is committed to working collaboratively with City of San Diego Development Services Department (DSD) staff for permitting of airport projects and will facilitate initial introduction of the project including the Consultant to the DSD project manager and other staff members.

Depending on a project's scale and schedule, the Authority may request that the City of San Diego DSD staff expedite plan check reviews.

The Consultant shall coordinate with assigned DSD staff to schedule plan check reviews. The DSD plan check process includes an airport clearance requirement which is obtained by receiving the Authority's stamp & signature on a given drawing package prior to submittal for plan check. After plan check comments have been addressed, the Consultant will resubmit the drawing package to the Authority for signature, then submit the signed set to the SD DSD for issuance of building permits to the Contractor.

Once the plan check approval is issued by the City of San Diego, Contractor to submit the scanned PDFs of perforated plans and calculations to the Authority for record keeping.

6.4.5. RECORD DRAWING DELIVERABLES

Upon completion of construction, the Consultant shall correct the original drawings by incorporating the changes, corrections, additions, or deletions which were made during construction. The digital version of the record drawings will conform to the Authority's standards contained within this document.

Consultant shall transmit the record drawings, the construction Field Record Drawing set, and updated electronic files back to the Authority.

*See Chapter 7 Drawing Requirements & Procedures, 7.4.4.4 Record Drawings Procedure

6.5. APPENDIX

The charts on the following pages specify the Level of Completion (LOC) required at each deliverable by discipline.

APPENDIX A—LEVEL OF COMPLETION—ARCHITECTURAL

Level of Completion - Architectural		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
A.000	**Architecture**				
	Site Plan; Project Location; Vicinity Plan; Roads; General Notes; Keynotes;	X	X	X	X
	Vicinity Plan; Scope of Work Description; SWPPP Note; Assessor's Parcel Number, Occupancy Type, Construction Type, Building Height, Hazardous Material Notes, Coastal Commission Permit Number, Code Analysis, CALGREEN Notes, Least Tern Nesting Season	X	X	X	X
	Project Team Contact Information, Architect Of Record Statement, Owners Contact Information	X	X	X	X
	Drawing Index Sheet,	X	X	X	X
	ADA Standards & Requirements	X	X	X	X
	Deferred Submittals		X	X	X
LS.100	**Life Safety Area Floor Plans**				
	Overall Floor Plan - per level	X	X	X	X
	Life Safety Plans -per level	X	X	X	X
	Emergency Egress Exit Plan Symbol; General Notes	X	X	X	X
	Occupancy Calculation, Travel Distance and Exit Paths	X	X	X	X
AD.000	**Demolition**				
	Overall Demolition Plans, General Notes & Keynotes	X	X	X	X
	Floor Demolition Plan -	X	X	X	X
	Roof Demolition Plan - General Notes & Keynotes	X	X	X	X
	Overall Floor Plan				
	General Notes; Keynotes; Legend, Symbol; Area Summary	X	X	X	X

APPENDIX A—LEVEL OF COMPLETION—ARCHITECTURAL (CONTINUED)

Level of Completion - Architectural		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
A.100	**Area Floor Plans**				
	General Notes; Keynotes; Legend, Symbol; Area Summary	X	X	X	X
	Keyed References: North Arrow, Match Line, Keyed Callout and Notes, Enlarged Drawings Callout;	X	X	X	X
	Structural Grid - Overall Dimension	X	X	X	X
	Dimension Structural Grid, Key Dimensions,	X	X	X	X
	Identify Finish Floor Elevation	X	X	X	X
	Identify Expansion Joints	X	X	X	X
	Identify Exterior Walls	X	X	X	X
	Identify Exterior Door and Window	X	X	X	X
	Identify Interior Partitions	X	X	X	X
	Identify Interior Doors and Windows	X	X	X	X
	Identify Fire Rated Partitions and STC Rated Partitions	X	X	X	X
	Identify Room Names/Labels	X	X	X	X
	Identify Room Numbers	X	X	X	X
	Identify Building Core & Vertical Circulation- Stairs, Escalators, Elevators	X	X	X	X
	Identify all Restrooms with all Plumbing Fixtures	X	X	X	X
	Identify Equipment Room - Mechanical & Electrical & IT Rack	X	X	X	X
	References Building Elevation Symbols	X	X	X	X
	Reference Building Section Cuts Symbol	X	X	X	X
	Reference Interior Elevation Symbols	X	X	X	X
	Reference Exterior Wall Type Details and Columns		X	X	X
	Identify Partition Type, Wall Types		X	X	X
	Identify Floor Mounted Equipment		X	X	X
	Identify Doors and Windows and Louvers	X	X	X	X
	Fireproofing Plans - per level and Schedule		X	X	X
	Special Airport Systems				
	Departure Ticket Counters & Self Checking-in Kiosks & Baggage Drop-off	X	X	X	X
	TSA Security Screening Check Points	X	X	X	X
	Outbound BHS Inspection Station	X	X	X	X
	Checked Baggage Resolution Area	X	X	X	X
	Outbound & Inbound Baggage Makeup	X	X	X	X
	Baggage Claim Area	X	X	X	X
	Passenger Boarding Bridges	X	X	X	X
	Gate Hold rooms	X	X	X	X
	IT Rack Rooms	X	X	X	X

APPENDIX A—LEVEL OF COMPLETION—ARCHITECTURAL (CONTINUED)

Level of Completion - Architectural		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
A110	**Overall Roof Plan**				
	Keyed References: North Arrow, Match Line, Keyed Callout and Notes, Enlarged Drawings Callout, Detail References	X	X	X	X
	Dimension Overall Roof Plan with Structural Grid	X	X	X	X
	Roof Framing Fireproofing Schedule & Plans & General Notes & Keynotes		X	X	X
	Area Roof Plan -				
	Keyed References: North Arrow, Match Line, Keyed Callout and Notes, Enlarged Drawings Callout, Detail References	X	X	X	X
	Indicate all New Roof Mounted Equipment and Skylights	X	X	X	X
	Indicate Roof Curb, Roof Penetrations and Vents		X	X	X
	Identify Roof Material and Parapet Height	X	X	X	X
	Identify all Roof Drains and Slope and Overflow Drain and Roof Scuppers	X	X	X	X
	Identify all Walking Pad on the Roof		X	X	X
	Identify all Mechanical Screening Devices		X	X	X
	Identify all Roof Overhang and Canopy	X	X	X	X
	Identify Roof Access	X	X	X	X
	Solar Orientation Diagram (FAA Requirements)	X	X	X	X
A200	**Overall Reflected Ceiling Plans**				
	Keyed References: North Arrow, Match Line, Keyed Callout and Notes, Enlarged Drawings Callout, Detail References	X	X	X	X
	Overall ceiling layout and lighting plan	X	X	X	X
A210	**Reflected Ceiling Plans - Per Level**				
	Keyed References: North Arrow, Match Line, Keyed Callout and Notes, Enlarged Drawings Callout, Detail References	X	X	X	X
	Dimension Reflected Ceiling Grid and Lighting Plan		X	X	X
	Reference all Ceiling Heights	X	X	X	X
	Identify Ceiling Mounted Light Fixtures,	X	X	X	X
	Identify Life Safety Devices, Speakers, Security Cameras, Signage, Ventilation Grills, Access Panels, Fire Sprinklers Fire Alarm Devices; Paging Systems;, Soffit, Emergency Lighting Devices		X	X	X
	Reference Ceiling Details		X	X	X
	Identify Expose Structure	X	X	X	X
A300	**Building Elevations**				
	Keyed References: Match Line, Keyed Callout and Notes, Enlarged Drawings Callout, Detail References	X	X	X	X
	Dimension Structural Gridlines	X	X	X	X
	Dimension Vertical Structural Elements- Floors Height and Roof Heights		X	X	X
	Identify Expansion Joints	X	X	X	X
	Identify all Exterior Windows and Doors	X	X	X	X
	Identify all Louvers and Grills required by Mechanical	X	X	X	X
	Reference Vertical Dimensions, Floor to Floor Heights and Overall Building Heights	X	X	X	X
	Identify all Exterior Materials and noted Demarcation of Materials	X	X	X	X

APPENDIX A—LEVEL OF COMPLETION—ARCHITECTURAL (CONTINUED)

Level of Completion - Architectural		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
A400	**Building Sections**				
	Keyed References: Match Line, Keyed Callout and Notes, Enlarged Drawings Callout, Detail References	X	X	X	X
	Dimension Structural Gridlines	X	X	X	X
	Dimension Floor to Floor Height and Floor to Ceiling Height	X	X	X	X
	Note the Clearances for Ductwork and other systems above the Ceiling Line.		X	X	X
	Reference Match lines, Buildings Sections	X	X	X	X
	Reference Exterior Wall Sections	X	X	X	X
	Reference Exterior Section Details		X	X	X
	Dimension clearances of Mechanical Ductwork and other systems above the ceiling line.		X	X	X
A450	**Wall Sections**				
	Keyed References: Match Line, Keyed Callout and Notes, Enlarged Drawings Callout	X	X	X	X
	Reference Details		X	X	X
A500	**Vertical Circulation Elements Enlarge Plans and Sections**				
	Enlarged Plans and Sections for all Vertical Elements	X	X	X	X
	Keyed References: Match Line, Keyed Callout and Notes, Drawings Callout, Detail References	X	X	X	X
	Dimension Overall Stairs	X	X	X	X
	Dimension of Stairs Width and Length and Tread Size and Riser Heights		X	X	X
	Reference all Detail of Guardrail and Handrail		X	X	X
	Identify Finishes of the Stairs and Guardrail and Handrail	X	X	X	X
	Dimension Elevator Hoistways, including Override	X	X	X	X
	Dimension Elevator Sump Pit, Elevator Penthouse, Elevator Shafts, Elevator Machine rooms		X	X	X
	Reference all Elevator Details		X	X	X
	Identify Elevator Finishes		X	X	X
	Dimension Overall Escalators	X	X	X	X
	Dimension of Escalator Width and Length and Pit and Inclination from Floor to Floor	X	X	X	X
	Reference Escalator Details		X	X	X
A600	**Exterior Detail Section**				
	Keyed References: Match Line, Keyed Callout and Notes, Enlarged Drawings Callout, Detail References		X	X	X
	Detail Basement, Tunnel & Perimeter Treatment		X	X	X
	Typical Edge of Slab		X	X	X
	Typical Exterior Wall Detail	X	X	X	X
	Typical Exterior Doors and Window Details	X	X	X	X
	Typical Expansion Joint Details	X	X	X	X
	Typical Exterior Roof and Parapet Details	X	X	X	X
	All Non - Typical Details Exterior Walls, Doors, Windows, Roof & Parapet and Expansion Joints		X	X	X

APPENDIX A—LEVEL OF COMPLETION—ARCHITECTURAL (CONTINUED)

Level of Completion - Architectural		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
A650	**Enlarge Plans & Details**				
	Keyed References: Match Line, Keyed Callout and Notes, Detail References		X	X	X
	Restrooms Plans & Elevations	X	X	X	X
	Restrooms Accessories & Fixtures		X	X	X
	Enlarge Ticket Lobby	X	X	X	X
	Enlarge Security Checkpoint Plan	X	X	X	X
	Enlarge Hold room Plans	X	X	X	X
	Enlarge Baggage Claim Plans	X	X	X	X
	Enlarge Baggage Area Plans	X	X	X	X
	Enlarge Amenities Plans	X	X	X	X
	Technology Rack Rooms	X	X	X	X
	Mechanical & Electrical & Plumbing Equipment Rooms	X	X	X	X
A700	**Interior Elevation**				
	Typical - Public Spaces- Ticket Lounges, Hold room, Concourse	X	X	X	X
	Typical - Restrooms,	X	X	X	X
	All required Interior Elevations		X	X	X
	Keyed References: Match Line, Keyed Callout and Notes, Detail References	X	X	X	X
	Dimension Interior Elevation, Note Room Materials and Room Heights.	X	X	X	X
	Built-ins, Equipment, Fire Alarm, AED, Extinguishers, Architectural Material		X	X	X
A710	**Interior Details**				
	Keyed References: Match Line, Keyed Callout and Notes, Detail References	X	X	X	X
	Typical Interior Wall and Base Details	X	X	X	X
	Typical Ceiling Details	X	X	X	X
	Typical Floor Finish Details	X	X	X	X
	Floor Drain Details		X	X	X
	Depressed Floor Details		X	X	X
	Expansion and Control Joint Details		X	X	X
	Material Transition Floor Finishes		X	X	X
	Material Transition Details – Floor and Wall		X	X	X
A710	**Interior Details (continued)**				
	Material Transition Details – Wall and Ceiling		X	X	X
	Typical Detail Doors and Window Head Jamb and Sill Conditions	X	X	X	X
	Detail Doors and Window Head Jamb and Sill Conditions		X	X	X
	Ceiling Details		X	X	X
	Details Interior Column		X	X	X
	Details Interior Walls		X	X	X
	Typical Partition Details	X	X	X	X
	Details for all wall recessed equipment such as fire hose cabinets		X	X	X
	Interior Glazing Details		X	X	X
	Fire Stop Details Vertical & Horizontal		X	X	X
	Details Vertical Circulation- Stairs, Elevators, Escalator		X	X	X
	Typical Storefront Details	X	X	X	X
	Typical Fire Stop Details- Vertical and Horizontal	X	X	X	X
	Typical Millwork Details	X	X	X	X
	Millwork Details		X	X	X
	Equipment Details		X	X	X

APPENDIX A—LEVEL OF COMPLETION—ARCHITECTURAL (CONTINUED)

Level of Completion - Architectural		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
A800	**Schedules**				
	Door Schedule	X	X	X	X
	Window Schedule		X	X	X
	Room Finish Schedule	X	X	X	X
	FFE Schedule		X	X	X
GS000	**Wayfinding - Signage**				
	Signage Legend & Sheet Index	X	X	X	X
	Signage Location Plans	X	X	X	X
	Signage Type Schedule	X	X	X	X
	Message Schedule		X	X	X
	Typical Signage Details	X	X	X	X
	Signage Details		X	X	X

APPENDIX B—LEVEL OF COMPLETION—STRUCTURAL

Level of Completion - Structural		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
S.000	**General Sheets**				
	Establish design specific design criteria	X	X	X	X
	Applicable codes and standards, Authority Having Jurisdiction	X	X	X	X
	Establish load criteria	X	X	X	X
	Structural notes	X	X	X	X
	Structural abbreviations	X	X	X	X
	Special Inspection Requirements	X	X	X	X
	Geotechnical Criteria	X	X	X	X
S.100	**Typical Structural details**				
	Legends	X	X	X	X
	Typical concrete reinforcing details	X	X	X	X
	Typical grade beam details	X	X	X	X
	Typical steel beam details	X	X	X	X
	Non-bearing wall details	X	X	X	X
	Lintel details	X	X	X	X
	Equipment anchorage	X	X	X	X
	Typical openings	X	X	X	X
S.200	**Plans**				
	Demolition Plan		X	X	X
	Roof Framing Plans		X	X	X
	Framing elements with sizes		X	X	X
	Rooftop Equipment Opening Sizes			X	X
	Basement Plans: Grids, walls, columns layout	X	X	X	X
	Foundation Plan	X	X	X	X
	Grade beam sizes	X	X	X	X
	Deep Foundation Sizes	X	X	X	X
	All Pits sizes including Elevator/Escalator		X	X	X
	Slab Thickness	X	X	X	X
	Slab Thickness	X	X	X	X
	Floor Framing Plans: Grids, walls, columns layout	X	X	X	X
	Framing elements with sizes	X	X	X	X
	Moment connections		X	X	X
	Opening Sizes		X	X	X
	Slab thickness	X	X	X	X
	Detail references		X	X	X
	Enlarged partial framing plans		X	X	X
S.400	**Building Sections**	X	X	X	X
	Elevation of floors	X	X	X	X
	Depth of structural members	X	X	X	X
	References to details		X	X	X
	Curtain Wall framing plans		X	X	X
S.500	**Structural Details**				
	General Details aligned with building material types		X	X	X
	Typical Details: Foundation, Slab Edge, Grade Beam	X	X	X	X
	Lateral Load system details		X	X	X
S.600	**Specialty Details**			X	X
	Architectural Appurtenances			X	X
	Curtain Wall framing Details	X	X	X	X
	Handrails		X	X	X
	Stairs		X	X	X
	Signage			X	X
	Site Protection Elements		X	X	X

APPENDIX B—LEVEL OF COMPLETION—STRUCTURAL (CONTINUED)

Level of Completion - Structural		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
SC	**Structural Calculations**				
	Site specific load criteria	X	X	X	X
	Gravity load criteria	X	X	X	X
	Lateral load criteria	X	X	X	X
	Blast Mitigation Criteria	X	X	X	X
	Gravity framing system	X	X	X	X
	Lateral Load Resisting System design		X	X	X
	Foundation design		X	X	X
	Final Calculations			X	X

APPENDIX C—LEVEL OF COMPLETION—MECHANICAL

Level of Completion - Mechanical		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
M.000	**Cover Sheet**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: , Enlarged Drawings Callout, Detail References		X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
	Title 24 - Compliance Forms	X	X	X	X
MD.000	**Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition plan per level	X	X	X	X
M.100	**Mechanical Equipment Schedules**				
	Large HVAC equipment (chillers, cooling towers, boilers, air handlers)	X	X	X	X
	Smaller HVAC equipment (air handlers, VAV, fan coils, condensers)		X	X	X
	Supply Diffusers, Return Registers		X	X	X
	Pumps, VFDs, tanks		X	X	X
M.200	**Site Plan**				
	Over All Site Plan	X	X	X	X
	Point of connections to central chilled water system, if applicable	X	X	X	X
	Point of connections to central heating hot water system, if applicable	X	X	X	X
M.300	**Floor Plans**				
	Overall Floor Plan	X	X	X	X
	Mechanical Room Plan	X	X	X	X
	Locations of larger HVAC equipment (chillers, cooling towers, boilers, air handlers)	X	X	X	X
	Locations of smaller HVAC equipment (air handlers, fan coils, condensers)		X	X	X
	Supply and Return duct routing, Major Hydronic Pipe routing	X	X	X	X
	Thermostat locations		X	X	X
	Location of louvers, dampers		X	X	X
	Mechanical piping		X	X	X
	Location of mechanical chase or shafts and openings	X	X	X	X
M.400	**Roof Plan**				
	Roof penetrations and openings	X	X	X	X
	Locations of larger HVAC equipment (chillers, cooling towers, boilers, air handlers)	X	X	X	X
	Locations of smaller HVAC equipment (air handlers, fan coils, condensers)		X	X	X
	10 foot clearances from fresh air intakes and exhaust outlets		X	X	X
M.500	**Enlarged Mechanical Plans**				
	Mechanical equipment will fit in space allocated	X	X	X	X
	Mechanical equipment maintenance clearances shown	X	X	X	X
M.600	**Elevations and Sections**				
	Mechanical equipment will fit in space allocated	X	X	X	X
	Mechanical equipment maintenance clearances shown		X	X	X
M.700	**Mechanical Details**				
	Duct details		X	X	X
	CHW, HHW Coil details		X	X	X
	Chilled water flow diagrams		X	X	X
	Heating hot water flow diagrams		X	X	X
	Seismic/vibration isolation details		X	X	X
	Miscellaneous details coordinated with each discipline		X	X	X
	mechanical Equipment Curb Detail		X	X	X

APPENDIX C—LEVEL OF COMPLETION—MECHANICAL (CONTINUED)

Level of Completion - Mechanical		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
M.800	**Controls**				
	Chilled water flow diagrams	X	X	X	X
	Heating hot water flow diagrams	X	X	X	X
	BMS point matrix		X	X	X
	Air handling units and fans control diagrams		X	X	X
	Fan coils and VAV unit control diagrams		X	X	X
	Valve schedule		X	X	X
	Sequence of Operations		X	X	X
M.900	**Title 24 Forms**	X	X	X	X

APPENDIX D—LEVEL OF COMPLETION—ELECTRICAL

Level of Completion - Electrical		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
E.000	**Cover Sheet**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: N, Enlarged Drawings Callout, Detail References	X	X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
	Title 24 - Compliance Forms	X	X	X	X
ED.000	**Electrical Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition plan per level	X	X	X	X
E.100	**Site Plan & Below Grade Electrical Plan**				
	Over All Site Utility Plan including	X	X	X	X
	Enlarged Electrical Site Plan		X	X	X
	Below Grade Site Plan	X	X	X	X
	Site System Grounding Plan	X	X	X	X
	Site Lighting Plan	X	X	X	X
	Site Lighting Photometric Plan		X	X	X
	Location of Electrical Distribution Eqpt. and Generator System Eqpt.	X	X	X	X
	Site Landscape Control Locations and Power Connection.		X	X	X
E.200	**Power Plan**				
	Overall Power Plan	X	X	X	X
	Power Floor Plan per Level	X	X	X	X
	Electrical Room Locations	X	X	X	X
	Generator Room/Pad/Yard and Generator Fuel System (Tank/Piping).	X	X	X	X
	MDF/IDF Room/Communication Closet Locations	X	X	X	X
	Security/Paging System Room Locations	X	X	X	X
	Mechanical Room and Mechanical/Plumbing Equipment Locations	X	X	X	X
	System Furniture and Power Feed Locations		X	X	X
	Drinking Fountain, Motorized Valves, Flush Sensors Location and Power Connection.		X	X	X
	Bldg. electrified special features such as illuminated art works, fountains		X	X	X
	UPS Room, IT/Server Room Locations	X	X	X	X
	Fire Protection System Room/Locations	X	X	X	X
	Smoke Containment System Location and Power Point of Connection		X	X	X
	Flight Information Display System (FIDS/BIDS/RIDS) Location and Power Point of Connection		X	X	X
	TSA Security Checkpoint Equipment Location	X	X	X	X
	Outbound BHS Inspection Station General Power/Receptacle Layout		X	X	X
	Baggage Claim Area General Power/Receptacle Layout	X	X	X	X
	Garbage/Trash Compactor System Location and Power Connection		X	X	X
	Departure Ticket Counters & Self Checking-in Kiosks & Baggage Drop-off Location and Power/Receptacle Layout	X	X	X	X
	Gate Counters, Gate Hold rooms, Passenger Seating, Phone Charging Stations, Information Booth General Power/Receptacle Layout		X	X	X
	Concourse General Power/Receptacle Layout		X	X	X
	Tenant Shop Locations		X	X	X
	Electrified Airport Signage Power Connections		X	X	X
	Elevators, Escalators and Moving Walkways Passenger Transportation System Power Connections	X	X	X	X
	Electrical Vehicle (EV) Charging Stations		X	X	X
	Cable Tray Layout and Seismic Bracing Plan		X	X	X

APPENDIX D—LEVEL OF COMPLETION—ELECTRICAL (CONTINUED)

Level of Completion - Electrical		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
	Roof Plan				
	Reference all New Roof Mounted Equipment and show power switching/points of connection.		X	X	X
	Show roof conduit penetrations, photocell/sensor location and skylights/roof access.		X	X	X
	Roof conduit run and support system.		X	X	X
	If PV system is in scope, show location of solar panels, inverters.		X	X	X
E.300	**Lighting Plan**				
	Overall lighting plan	X	X	X	X
	Lighting and Control/Switching Plan (Per Level)	X	X	X	X
	Emergency/Egress Lighting and Control/Switching Plan (Per Level)		X	X	X
	Exit Sign Locations		X	X	X
	Daylight zone and switch location (Per Level)		X	X	X
	Normal Power Photometric Plans (Per Level)	X	X	X	X
	Egress Photometric Plans (Per Level)		X	X	X
	Enlarged Tenant Shop Lighting Plan		X	X	X
E.400	**Enlarged Electrical Plans**				
	Enlarged Electrical Rooms	X	X	X	X
	Enlarged Generator Room and Fuel Tank/System Room/Pad	X	X	X	X
	Enlarged MDF/IDF Rooms and Communication Closets	X	X	X	X
	Enlarged Security/Paging/Fire Command Center Rooms	X	X	X	X
	Enlarged Mechanical Rooms	X	X	X	X
	Enlarged UPS/Server/Computer Room	X	X	X	X
	Enlarged Baggage Handling System Area		X	X	X
	Enlarged Tenant Shop Power Plan		X	X	X
E.500	**Electrical Details**				
	Electrical Distribution Equipment Elevations		X	X	X
	Grounding Details			X	X
	Power and Distribution Equipment Circuiting/Wiring Details		X	X	X
	Electrical Equipment Framing and Support Details		X	X	X
	Lighting Installation and Support Details			X	X
	Conduit/Cable Tray Structure Penetration and Fire Rated Penetration Details		X	X	X
	Lighting Installation and Support Details		X	X	X
	Equipment Seismic/Vibration Isolation Details			X	X
	Electrical Duct Bank Details		X	X	X
	Electrical handhold/manhole detail		X	X	X
E.600	**Single Line Diagram**				
	Normal Power System Single Line Diagram	X	X	X	X
	Emergency Power Standby System Single Line Diagram	X	X	X	X
	Building System Ground Riser Diagram		X	X	X
	Lighting Control Diagram		X	X	X
	Tenant Metering Riser Diagram		X	X	X
	PV system Single Line Diagram (if PV System is in project scope)		X	X	X

APPENDIX D—LEVEL OF COMPLETION—ELECTRICAL (CONTINUED)

Level of Completion - Electrical		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
E.700	**Schedules and Calculations**				
	Luminaire Schedule (Interior/Exterior)	X	X	X	X
	Lighting Control Schedule		X	X	X
	Photometric Calculation Schedules		X	X	X
	Feeder Schedule		X	X	X
	Short Circuit and Coordination Study Schedule/Summary			X	X
	Arc Flash Study and PPE Schedule at each distribution/switching equipment			X	X
	Voltage Drop Calculation		X	X	X
	Equipment Connection Schedule		X	X	X
	Normal Power Electrical Load Calculation/Summary	X	X	X	X
	Emergency Power Electrical Load Calculation/Summary	X	X	X	X
	Panel Schedules (Preliminary at 30%)	X	X	X	X
	Sequence of Operations (Automatic Switching and Load Shedding)			X	X

APPENDIX E—LEVEL OF COMPLETION—PLUMBING

Level of Completion - Plumbing		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
P.000	**Cover Sheet**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: , Enlarged Drawings Callout, Detail References,		X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
PD.000	**Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition plan per level	X	X	X	X
P.100	**Fixture Schedules**				
	Lavatory, water closet, urinal, water cooler,	X	X	X	X
	Water heater, hot water storage tanks	X	X	X	X
	Circulating pumps, sump pumps		X	X	X
	Fuel Oil tank for emergency generator	X	X	X	X
P.200	**Site Plan**				
	Over All Site Plan	X	X	X	X
	Point of connections to underground water, sewer, waste, natural gas	X	X	X	X
	Location of backflow preventor, PRV, station, water meter, gas meter	X	X	X	X
	Location of grease interceptor, Fuel oil tank	X	X	X	X
	Foundation Plan				
	Overall Foundation Plan	X	X	X	X
	Locate water, sewer, waste lines	X	X	X	X
	Locate all cleanouts and vent lines		X	X	X
P.300	**Floor Plans**				
	Overall Floor Plan	X	X	X	X
	Floor Plans-per level	X	X	X	X
	Mechanical Room, Boiler Room, Water Heater	X	X	X	X
	Locate plumbing Chase with floor drains	X	X	X	X
	Indicate routing for Cold and Hot Water		X	X	X
	Indicate routing of waste and vent. Locate cleanouts and floor drains		X	X	X
	Indicate routing of natural gas lines		X	X	X
P.400	**Roof Plan -**				
	Roof penetrations		X	X	X
	Locations of water and natural gas lines	X	X	X	X
	Locations of roof drains	X	X	X	X
	10 foot clearances from fresh air intakes and plumbing vents		X	X	X
P.500	**Enlarged Mechanical Plans**				
	Plumbing Equipment Space Allocation	X	X	X	X
	Plumbing equipment maintenance clearances	X	X	X	X
	Pump Rooms	X	X	X	X
P.600	**Sections**				
	Plumbing Equipment Height Requirement		X	X	X
	Plumbing equipment maintenance clearances		X	X	X
	Isometric diagrams of waste and vent lines		X	X	X
	Isometric diagrams of cold and hot water lines		X	X	X
	Isometric diagrams of natural gas line		X	X	X

APPENDIX E—LEVEL OF COMPLETION—PLUMBING (CONTINUED)

Level of Completion - Plumbing		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
P.700	**Plumbing Details**				
	Typical Details, Roof Drains, Piping Penetration and Piping Support	X	X	X	X
	Hot water heater details		X	X	X
	Details- At Seismic Joint		X	X	X
	Condensate drain		X	X	X
	Pressure reducing valve assembly		X	X	X
	Roof drains, cleanouts, grease interceptor		X	X	X
	Point of use water heaters		X	X	X
	Sump pumps		X	X	X
	Piping supports, piping penetrations		X	X	X
P.800	**Calculations**				
	Cold and Hot Water Demand	X	X	X	X
	Waste, grease interceptor	X	X	X	X
	Stormwater from roof drain	X	X	X	X

APPENDIX F—LEVEL OF COMPLETION—FIRE PROTECTION

Level of Completion - Fire Protection		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
FS.000	**Cover Sheet**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: , Enlarged Drawings Callout, Detail References	X	X	X	X
	Code analysis outlining system requirements	X	X	X	X
	Overall system description	X	X	X	X
	Description of existing systems	X	X	X	X
	Water supply information	X	X	X	X
	System design requirements based on area/hazard classification	X	X	X	X
	Seismic bracing requirements	X	X	X	X
	Deferred approval submittal notes			X	X
	Keyed References: , Enlarged Drawings Callout, Detail References,	X	X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
FSD.000	**Fire Suppression Demolition Plans**				
	Overall demolition floor plans showing sprinkler zones	X	X	X	X
	Floor Plans per level	X	X	X	X
	Demolition Notes	X	X	X	X
FS.100	**Fire Suppression Floor Plans**				
	Overall floor plans per level showing zones	X	X	X	X
	Floor plans per level - location of zone control valves and water supply	X	X	X	X
	Fire Suppression Main Piping and zone control valves		X	X	X
	Fire Suppression standpipes and hose connections		X	X	X
	Sprinkler hazard classifications for each area		X	X	X
	Tie-in points to existing systems		X	X	X
	Indication of ceiling height, type of ceiling, beam pockets, skylights, and other ceiling features		X	X	X
	Fire Pump Plans		X	X	X
	Backflow preventer, PIV, underground piping coordinated with Civil		X	X	X
	Fire department connection coordinated with Civil and Architecture	X	X	X	X
	Fire Sprinkler requirements for shafts, ducts, or concealed spaces		X	X	X
	Fire Alarm components requiring monitoring		X	X	X
FS.400	**Enlarged Fire Suppression Plans**				
	Enlarged plans showing water service entry room		X	X	X
	Enlarged plans showing fire pump room		X	X	X
FS.500	**Fire Suppression Details**				
	Typical Details: Seismic Joints, Penetrations; Fire Hose Cabinet		X	X	X
	All Other Details			X	X
FS.600	**Single Line Diagram**				
	Fire suppression riser diagram	X	X	X	X
	Calculations				
	Preliminary calculations to verify adequacy of water supply	X	X	X	X
	Detailed hydraulic calculations		X	X	X

APPENDIX G—LEVEL OF COMPLETION—FIRE ALARM

Level of Completion - Fire Alarm		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
FA.000	**Cover Sheet**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: , Enlarged Drawings Callout, Detail References	X	X	X	X
	Code analysis outlining system requirements	X	X	X	X
	Overall system description	X	X	X	X
	Description of existing systems	X	X	X	X
	Keyed References: , Enlarged Drawings Callout, Detail References,	X	X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
	Deferred approval submittal notes			X	X
FAD.000	**Fire Alarm Demolition Plans**				
	Overall demolition floor plans showing Fire Alarm zones	X	X	X	X
	Floor Plans per level	X	X	X	X
	Demolition Notes	X	X	X	X
FA.100	**Fire Alarm Plans**				
	Overall floor plans showing zones	X	X	X	X
	Floor Plans - Per level	X	X	X	X
	Phased evacuation strategy, private mode signaling, or other unique notification strategy		X	X	X
	Life safety components (e.g. area of refuge communications systems, firefighter communications systems)		X	X	X
	Voice alarm or mass notification systems		X	X	X
	Fire Alarm control panels, annunciators, amplifier panels, and strobe power supply panels		X	X	X
	Fire Alarm notification appliances		X	X	X
	Fire Alarm initiating devices		X	X	X
	Fire Alarm of all monitoring points coordinated with fire suppression systems		X	X	X
	Fire Alarm of all duct smoke detectors and fire smoke dampers coordinated with the mechanical and electrical design		X	X	X
	Interfaces with elevators and vertical transportation systems		X	X	X
	Indication of ceiling height, type of ceiling, beam pockets in locations where detection is required			X	X
	Interfaces coordinated with door hardware and security		X	X	X
	Device and appliance locations coordinated with reflected ceiling plans			X	X
	Power for fire alarm and emergency communications equipment coordinated with the electrical design		X	X	X
	Emergency responder radio system distributed antenna network layout, or other means to satisfy CFC Section 510		X	X	X
	Add notes not to install fire alarm equipment above electrical equipment			X	X
	Fire Alarm panels coordinated with Electrical		X	X	X
FA.400	**Enlarged Fire Alarm Plans**				
	Floor plan showing each room with a fire alarm control panel		X	X	X
	Floor plan showing equipment in fire or security control room as applicable.		X	X	X
FA.500	**Fire Alarm Details and Schedules**				
	Fire alarm sequence of operations with all expected inputs and outputs, including those necessary for interface with other systems. Provide an individual matrix for each building where the project involves multiple buildings.		X	X	X
	Typical device mounting height detail		X	X	X
	All other details			X	X
FA.600	**Single Line Diagram**				
	Fire alarm riser diagram	X	X	X	X
	Calculations				
	Preliminary calculations to determine quantity of power supply and amplifier panels		X	X	X
	Updated circuit calculations based on final number of appliances			X	X

APPENDIX H—LEVEL OF COMPLETION—TECHNOLOGY

Level of Completion - Technology		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
T.000	**Cover Sheet**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: N, Enlarged Drawings Callout, Detail References	X	X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
TD.000	**Technology Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition plan per level	X	X	X	X
T.100	**Site Plan & Below Grade Technology Plan**				
	Over All Site Technology Plan	X	X	X	X
	Enlarged Site Plans (If required)		X	X	X
	Below Grade Site Plan	X	X	X	X
	Site Technology Grounding Plan	X	X	X	X
T.200	**Technology Plan**				
	Overall Technology Plan	X	X	X	X
	Technology Floor Plan per Level	X	X	X	X
	Technology Room Location and Coverage	X	X	X	X
	MDF/IDF Room/Radio Room /Communication Room Locations	X	X	X	X
	BMS Connectivity: Electrical, Mechanical/Plumbing Equipment Locations		X	X	X
	EVIDS Monitors, Back Wall Monitors,	X	X	X	X
	Ticket Counters, Gate Counters, Gate Hold rooms	X	X	X	X
	TSA Security Checkpoint Equipment Location	X	X	X	X
	TSA CBRA and CBIS	X	X	X	X
	Dynamic Signage & Directories	X	X	X	X
	Voice and Data Ports	X	X	X	X
	Visual Guidance Docking System		X	X	X
	Baggage Claim Area	X	X	X	X
	Departure Ticket Counters & Self Checking-in Kiosks & Baggage Drop-off Location	X	X	X	X
	Tenant Shop Locations		X	X	X
	Elevator Machine Room Connectivity	X	X	X	X
	Electrical Vehicle (EV) Charging Stations Connectivity		X	X	X
	Cable Tray Layout and Seismic Bracing Plan		X	X	X
	Passenger Boarding Bridges Connectivity (Voice, Data, Wi-Fi)	X	X	X	X
	Wi-Fi___33 System	X	X	X	X
	Distributed Antenna System (Cellular and Emergency Response DAS Systems)		X	X	X
T. 300	**Roof Plan**				
	Roof Mounted Antenna & Equipment		X	X	X
	Show roof conduit penetrations		X	X	X
	Roof mounted Antenna System Infrastructure/Conduit/Cable tray		X	X	X
T.400	**Enlarged Technology Plans**				
	Enlarged MDF/MPOE/Technology/Communications/Radio Rooms	X	X	X	X

APPENDIX H—LEVEL OF COMPLETION—TECHNOLOGY (CONTINUED)

Level of Completion - Technology		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
T.500	**Technology Details**				
	Telecommunications Equipment Cabinet/Rack Elevations		X	X	X
	Cabinet/Rack Power Outlet mounting detail		X	X	X
	Grounding and Bonding Detail		X	X	X
	Conduit/Cable Tray Structure Penetration and Fire Rated Penetration and Fire Stopping Detail		X	X	X
	Communication Duct Bank Detail		X	X	X
	Communications outlet/wall plate detail		X	X	X
	Communications floor poke through detail		X	X	X
	Wireless antenna mounting detail		X	X	X
	Gate counter Back Wall detail		X	X	X
	Gate Counter detail		X	X	X
	Ticket Counter back wall detail		X	X	X
	Ticket Counter detail		X	X	X
	Kiosk Detail		X	X	X
	Dynamic signage detail		X	X	X
	Radio Antenna mounting detail		X	X	X
	Communications handhold/manhole detail (butterfly drawings)		X	X	X
T.600	**Single Line Diagram**				
	Backbone fiber single line diagram	X	X	X	X
	Backbone copper single line diagram	X	X	X	X
	Building System Ground Riser Diagram		X	X	X
	Network diagram		X	X	X
T.700	**Schedules and Calculations**				
	Predictive wireless study (cellular/WIFI/RCS)		X	X	X
	Outlet to Communications room schedule		X	X	X
	Network equipment port count schedule		X	X	X
	Short Circuit and Coordination Study Schedule/Summary			X	X
	Arc Flash Study and PPE Schedule at each distribution/switching equipment			X	X
	Voltage Drop Calculation		X	X	X
	Equipment Connection Schedule		X	X	X
	Normal Power Electrical Load Calculation/Summary	X	X	X	X
	Emergency Power Electrical Load Calculation/Summary	X	X	X	X
	Panel Schedules (Preliminary at 30%)	X	X	X	X
	Sequence of Operations (Automatic Switching and Load Shedding)			X	X

APPENDIX I—LEVEL OF COMPLETION—SECURITY

Level of Completion - Security		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
TY.000	**Cover Sheet**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: N, Enlarged Drawings Callout, Detail References	X	X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
TYD.000	**Security Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition plan per level	X	X	X	X
TY.100	**Site Plan & Below Grade Security Plan**				
	Over All Site Security Plan	X	X	X	X
	Enlarged Site Plans (If required)		X	X	X
	Below Grade Site Plan (if required)	X	X	X	X
TY.200	**Security Plan**				
	Overall Security Plan	X	X	X	X
	Security Floor Plan per Level	X	X	X	X
	Security Rack Room Location and Coverage plan	X	X	X	X
	ACS Card reader locations	X	X	X	X
	CCTV camera locations	X	X	X	X
	Breach management beacon locations	X	X	X	X
	Perimeter Intrusion Detection plan	X	X	X	X
	TSA Security Checkpoint Equipment Location	X	X	X	X
	TSA CBRA and CBIS	X	X	X	X
	CCTV viewing angles (SSI)				
	Shot detection plan	X	X	X	X
TY. 300	**Roof Plan**				
	Overall CCTV roof plan	X	X	X	X
	CCTV roof plan per area	X	X	X	X
TY.400	**Enlarged Security Plans**				
	Enlarged MDF/MPOE/Technology/Communications/Radio Rooms	X	X	X	X
	Exit Lane plan				
TY.500	**Security Details**				
	Security Equipment Cabinet/Rack/Wall Elevations		X	X	X
	ACS card reader mounting details		X	X	X
	CCTV mounting details		X	X	X
	PIDS mounting details		X	X	X
	ACS Door details		X	X	X
	ACS Perimeter Gate detail		X	X	X
	Exit lane detail		X	X	X
	TSA check point duress button and foot pedal details		X	X	X
	Exit lane bypass detail		X	X	X
	Breach beacon detail		X	X	X
	Roof hatch detail		X	X	X
	Door controller detail		X	X	X
	Power supply detail		X	X	X
	Shot detection mounting detail		X	X	X
TY.600	**Single Line Diagram**				
	Security Network diagram		X	X	X
TY.700	**Schedules and Calculations**				
	Cable/Wire schedule		X	X	X
	ACS schedule by rack room		X	X	X
	CCTV schedule by rack room		X	X	X
TY.800	**Sensitive Security Information (SSI) sheets**		X	X	X

APPENDIX J—LEVEL OF COMPLETION—PASSENGER BOARDING BRIDGES

Level of Completion - Passenger Boarding Bridges		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
PBB.000	**Passenger Boarding Bridges (PBB)**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Drawing Index Sheet,	X	X	X	X
PBB.100	**Passenger Boarding Bridges (PBB) Parking Plans**				
	Overall Aircraft Parking Layout Plans	X	X	X	X
	Aircraft Parking - per Gate	X	X	X	X
	Aircraft Marking Plans - Safety Line, Lead Line, Stop Bar Designation - per Gate		X	X	X
	Overall Passenger Boarding Bridges (PBB) Marking Plans	X	X	X	X
	Passenger Boarding Bridges Marking - per Gate		X	X	X
	Overall Tug Striping Plans -	X	X	X	X
	Tug Striping Inbound and Outbound		X	X	X
	ADA Slope Compliance Matrix	X	X	X	X
	Marking Typical Details	X	X	X	X
	Reference Details on Plans		X	X	X
PBB.200	**Passenger Boarding Bridges (PBB)**				
	Overall Passenger Boarding Bridge Pedestal Location -	X	X	X	X
	Passenger Boarding Bridges Pedestal Location - per Gate		X	X	X
	Overall Passenger Boarding Bridges Layout Plan	X	X	X	X
	Passenger Boarding Bridges Plan - per Gate		X	X	X
PBB.300	**Passenger Boarding Bridges (PBB) Profile**				
	Passenger Boarding Bridges Elevation per Gate	X	X	X	X
	Passenger Boarding Bridge Plan per Gate	X	X	X	X
PBB.400	**Passenger Boarding Bridges Details**				
	Typical Passenger Boarding Bridges Details	X	X	X	X
	Reference Details		X	X	X
PBB.500	**Passenger Boarding Bridges Equipment**				
	Passenger Boarding Bridges Schedule	X	X	X	X
	Equipment Schedule PCA, GPU, Potable Water Cabinet	X	X	X	X
	Aircraft Mating -Schedule	X	X	X	X

APPENDIX K—LEVEL OF COMPLETION—BAGGAGE HANDLING SYSTEM

Level of Completion - Baggage Handling System		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
BHS.000	**Baggage Handling Systems**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance; Legends and Symbols; North Arrow; Match Line; Keyed Callout and Notes	X	X	X	X
	Drawing Index Sheet;	X	X	X	X
DBHS.100	**Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition Plan per level	X	X	X	X
BHS.100	**Conveyor System - Plans**				
	Overall Conveyor System	X	X	X	X
	Conveyor System - Per Level	X	X	X	X
	Conveyor System - Tunnel Outbound	X	X	X	X
	Conveyor System - Tunnel Inbound	X	X	X	X
	Conveyor System - Curbside	X	X	X	X
	Conveyor System - Ticket Counter	X	X	X	X
	Conveyor System Make-up Area - Outbound	X	X	X	X
	Conveyor System - Inbound	X	X	X	X
	Conveyor System - Claim Area	X	X	X	X
	Conveyor System - Overall Catwalk	X	X	X	X
	Conveyor System - Catwalk per Area		X	X	X
	Conveyor System Overall Isometric	X	X	X	X
	Conveyor System Isometric per Area		X	X	X
BHS.200	**Conveyor System - Elevation**				
	Overall Conveyor System Elevation	X	X	X	X
	Elevation View - Conveyor System per Area (Typical)	X	X	X	X
	Elevation View - Conveyor System per Area		X	X	X
BHS.300	**Conveyor System per Area - Sections**				
	Overall Conveyor System Sections	X	X	X	X
	Sections - Conveyor System per Area (Typical)	X	X	X	X
	Sections - Conveyor System per Area		X	X	X
BHS.400	**Conveyor System - Electrical**				
	Overall Conveyor System Electrical	X	X	X	X
	Electrical Single Line Diagram & Panel Schedule	X	X	X	X
	Electrical Conveyor System Power Plan		X	X	X
	Electrical Conveyor System Details			X	X
BHS.500	**Conveyor System - Fire Alarm System**				
	Overall Conveyor System Fire Alarm System	X	X	X	X
	Conveyor System Fire Alarm per Area		X	X	X
	Conveyor System Fire Alarm Power Supply		X	X	X
	Conveyor System Fire Protection		X	X	X
	Conveyor System Fire Protection Per Area		X	X	X
BHS.600	**Conveyor System - Security System**				
	Overall Conveyor Security System	X	X	X	X
	Conveyor Security System per Area		X	X	X
	Conveyor Security System Power Supply		X	X	X

APPENDIX K—LEVEL OF COMPLETION—BAGGAGE HANDLING SYSTEM (CONT.)

BHS.700	**Details**				
	Typical System Details	X	X	X	X
	Non-Typical System Details		X	X	X
	Reference Details - per Area	X	X	X	X
	Equipment & Motor Schedule		X	X	X
BHS.800	**Conveyor System- Support Details**				
	Typical Load - Load Schedule	X	X	X	X
	Typical Structural Support Details	X	X	X	X
	Header steel Details		X	X	X
	Sill Hangar Details		X	X	X
	Steel Connection Details		X	X	X
	Concrete Connection Details		X	X	X
	Bracing Details		X	X	X
BHS.900	**Conveyor System Equipment Schedule**				
	Conveyor System Equipment Schedule		X	X	X

APPENDIX L—LEVEL OF COMPLETION—PARKING SYSTEM

Level of Completion - Parking System		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
PRS.000	**Parking Revenue System**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: N, Enlarged Drawings Callout, Detail References	X	X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
DPRS.100	**Parking Revenue System Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition plan per area	X	X	X	X
PRS.100	**Parking Revenue System Plans**				
	PARCS site plan	X	X	X	X
	PARCS Plans and equipment locations	X	X	X	X
	PARCS Equipment Schedule		X	X	X
	PMO surveillance camera locations		X	X	X
	PMO access control reader locations		X	X	X
PRS.200	**Enlarged Plans**				
	Entry/Exit plaza plan		X	X	X
	Equipment cabinet/rack elevations		X	X	X
PRS.300	**Parking Revenue System Details**				
	PARCS mounting and wiring Details		X	X	X
	Gate Arm detail		X	X	X
	Ground loop detail		X	X	X
	Wiring details		X	X	X
	Access Control detail		X	X	X
	CCTV details		X	X	X
PRS.400	**Single line diagrams**				
	Network diagram		X	X	X
	Wiring diagram		X	X	X
	Communication backbone diagram		X	X	X
PGS.00	**Parking Guidance System**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: N, Enlarged Drawings Callout, Detail References	X	X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
DPGS.100	**Parking Guidance System Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition plan per area	X	X	X	X
PGS.200	**Parking Guidance System Plans**				
	PGS site plan	X	X	X	X
	PGS plans and equipment locations	X	X	X	X
	PGS sign locations		X	X	X
	PGS mounting detail		X	X	X

APPENDIX L—LEVEL OF COMPLETION—PARKING SYSTEM (CONTINUED)

Level of Completion - Parking System		30% DD	60% CD	90% CD	100% CD
Drawing No. Series	**Description**				
PGS.300	**Enlarged Plans**				
	Equipment cabinet/rack elevations		X	X	X
PGS.400	**Parking Guidance System Details**				
	PGS sensor mounting and wiring Details		X	X	X
	PGS sign mounting detail		X	X	X
	PGS Monument Sign mounting details		X	X	X
PGS.500	**Single line diagrams**				
	Network diagram		X	X	X
	Wiring diagram		X	X	X
AVI.100	**Automated Vehicle Identification**				
	General Notes; Keynotes; Abbreviations; Relevant Code Compliance, Legends and Symbols, North Arrow, Match Line, Keyed Callout and Notes	X	X	X	X
	Keyed References: N, Enlarged Drawings Callout, Detail References	X	X	X	X
	Drawing Sheet Index	X	X	X	X
	Site Key Plan	X	X	X	X
AVI.200	**Automated Vehicle Identification System Demolition**				
	Overall Demolition Plan	X	X	X	X
	Demolition General Notes	X	X	X	X
	Demolition plan per area	X	X	X	X
AVI.300	**Automated Vehicle Identification System Plans**				
	AVI site plan	X	X	X	X
	AVI antenna locations	X	X	X	X
	AVI cabinet locations		X	X	X
AVI.400	**Enlarged Plans**				
	(As Needed)		X	X	X
AVI.500	**Automated Vehicle Identification Details**				
	AVI pole detail		X	X	X
	AVI antenna mounting detail		X	X	X
AVI.600	**Single Line Diagrams**				
	AVI single line		X	X	X
	AVI wiring diagram		X	X	X
	AVI fiber/copper connectivity		X	X	X
	AVI Network Diagram		X	X	X

CHAPTER 07:
DRAWING REQUIREMENTS AND PROCEDURES

7.1. INTRODUCTION
7.2. GENERAL REQUIREMENTS
7.3. BIM STANDARDS—REVIT AND CIVIL 3D
7.4. DRAWING STANDARDS

7.1. INTRODUCTION

This chapter provides drawing documentation guidelines and defines the standards the Consultants are to follow in the preparation of project submittal drawing requirements. It is essential that all Consultant's personnel and associates responsible for the preparation of drawings follow the procedures and instructions outlined herein. Although general instructions cannot cover every situation, specific requirements for an individual project shall be addressed during the development of the Project Scope of Work, and issues relating to the project shall be resolved jointly in conference with the Authority's Project Manager (APM).

7.2. GENERAL REQUIREMENTS

7.2.1. DIGITAL SUBMITTAL REQUIREMENTS

7.2.1.1. SUBMITTAL SCHEDULE

The Authority requires electronic submittal of digital files within the Authority's electronic project management system or designated file shared system with each design phase technical review submittal, or as scheduled in the Scope of Services document. Training, with reference materials, shall be provided by the Authority.

The Consultant shall meet with the APM and relevant Authority staff to review digital submittal folder structure and file naming conventions prior to the first project deliverable submittal. CAD/BIM requirements shall also be reviewed at this time.

7.2.1.2. DIGITAL FORMAT TYPES

All project deliverable submittals must be submitted digitally in their native CAD, Revit, and Civil 3D file formats. Embedded content utilized to attempt to reflect native content will result in the deliverables being rejected outright.

All deliverables must also be submitted in Portable Digital File (.pdf) Format. The .pdf files must be created as a direct export from the native platform. Scans of printed content will be rejected outright. The .pdf files must meet these following criteria:

1. The .pdf file must be bookmarked to reflect the breakdown as shown in the table of contents or drawing indexes.

2. The .pdf file page labels must accurately reflect the proper naming convention of all pages within the compiled .pdf file (ex. reflect the section and page number 0111000-1 or A101.1, and not the page number as a count of the total number of sheets).

3. The entire .pdf file must be produced utilizing OCR (Optical Character Recognition) to allow for text-search-able content.

4. The .pdf file must be produced with active, highlighted, hyperlinks to the appropriate referenced sections (Table of Contents, or relevant references within sections) or referenced drawing details and sheet references.

The .pdf file submittals shall be submitted for review via the Authority's electronic Project Management System or designated file-sharing system.

7.2.1.3. DIGITAL SUBMITTAL QUALITY CONTROL CHECK

The Consultant will perform the following quality control check on the digital submittal as required in this Chapter:

1. Compliance with digital format – Verify compliance with the digital format of the dataset. Including checks on media format and CAD format/version. See Section 7.4.4.3.

2. File naming structure – Check for compliance with the file naming structure of the dataset. The standards specify a file naming structure that defines the type of content of a digital file. The file naming structure determines the type of data that is on the file and how it will be stored. See Section 7.3.6. (BIM).

3. Layering Standards – The Authority recommends "The National CAD Standards" for producing deliverable AutoCAD drawings. AutoCAD programs and Civil 3D programs all default to the National CAD Standards.

4. Spatial and Thematic - Spatial and thematic compliance of the consultant-dataset shall be consistent with the Authority's datum. See Section 7.4.2.

Any deviation from the requirements within this Chapter may result in a rejection of the Consultant's digital submission. In that case, the Authority will return the digital submission along with an exception report defining the cause of rejection to the Consultant.

7.2.2. SUPPORTING FILES (CONSULTANT PACKAGE)

The Consultant Package is provided to the Consultants to ensure project compliance. It will typically include:

1. Title Blocks: the Authority uses one size 24" X 36"

2. Spatially accurate Planimetric data in the current Authority datum. See Section 7.4.2.

3. Horizontal Control – Runway end points and Runway Stations;

4. Terminals Floor Plans (doors, wall, and windows, grid lines);

5. Aerial, PDF and SID files; and

6. BIM Implementation Package. See Section 7.3.2.

Note: The Consultant assumes full responsibility to verify all existing conditions, dimensions, and structural details of the provided information, and assumes full liability for any problems that may arise due to possible errors on any supporting files provided by the Authority.

7.2.3. DATA REUSE, OWNERSHIP, RIGHTS OF DATA

The Authority maintains ownership of all existing CAD files, BIM Models, and Facility/OM Data as well as any authored content for this project, as defined in the contract for the project.

7.2.4. ABBREVIATIONS

The abbreviations listed in the charts on the following pages are to be included with all projects and only the abbreviations used in the project shall be listed. If necessary, words or items may be abbreviated if they appear more than three times within the project drawings.

Abbreviation	Definition
A	
AB/ABAN	Abandon
AC	Asbestos Concrete
	Asbestos Cement
ACD	Asbestos Cement Duct
ACP	Asbestos Cement Pipe
ADD	Addendum
AGGR	Aggregate
AIR COND	Air Condition
A/P	Airport
ARP	Airport Reference Point
ATCT	Air Traffic Control Tower
AL	Aluminum
AB	Anchor Bolt
ALS	Approach Light System
ASB	Asbestos
ASPH	Asphalt
AUTO	Automatic
B	
B/B	Back to Back
BC	Begin Curve
BCN	Beacon
BET	Between
BL	Base Line
	Building Line
BLDG	Building
BLK	Block
BM	Bench Mark
	Beam
BO	Blow Off
BOT	Bottom
BRG	Bearing
BRKT	Bracket
BRL	Building Restriction Line
C	
C/COND	Conduit
CAB	Crushed Aggregate Base
CB	Catch Basin
	Curb
C/B	Circuit Breaker
C-C	Center to Center
CEM	Cement
CG	Center of Gravity
CHK	Check
CI	Cast Iron
CIP	Cast Iron Pipe
CIR	Circle
CJ	Construction Joint
CLG	Ceiling
CLKG	Caulking
CLR	Clear
CNVR	Conveyor
CO	Cleanout
C/O	Convenience Outlet
COL	Column
CONC	Concrete
CONN	Connection
CONST	Construction
CONT	Continuous
CONTR	Contractor
CA/CR AGG	Crushed Aggregate
CTB	Cement Treated Base
CTR	Center
CTSK	Countersunk
CU	Copper
CW	Cold Water
D	
DBL	Double
DC	Direct Current
DEG (0)	Degree
DET	Detail
DF	Drinking Fountain
DG	Decomposed Granite
DIA	Diameter
DIAG	Diagonal
	Diagram
DIAPH	Diaphragm
DIM	Dimension
DISCH	Discharge
DIST	Distance
DN	Down
DR	Drain
DS	Down Spout
DWG	Drawing
DWL	Dowel
E	
E	East, Easting
EA	Each
EC	End of Curve

EF	Each Face
ELEC	Electric
EL/ELEV	Elevation
ENGR	Engineer
ENGRG	Engineering
ENT	Entrance
EP	Edge of Pavement
EQUIP	Equipment
EST	Estimate
EWWM	Electric Welded Wire Mesh
EXC	Excavate
EXH	Exhaust
EXIST	Existing
EXP	Expansion (joint)/Elbow
EXT	Exterior
F	
F	Fire
FA	Fire Alarm
FAA	Federal Aviation Administration
FAB	Fabricate
FD	Fiber Duct
	Floor Drain
FDN	Foundation
FDR	Feeder
FED	Federal
FED	Federal
FF	Finished Floor
F to F	Face to Face
FG	Finished Grade
FH	Fire Hose
FH	Fire Hydrant
FIG	Figure
FIN	Finish/Finished
FIX	Fixture
FL	Flow Line
FLD	Field
FLEX	Flexible
FLG	Flange
FLR	Floor
FOS	Face of Studs
FS	Far Side
FS	Federal Specifications
FS	Fire Service
FT (')	Feet or Foot

G	
G	Gas, Grid
GA	Gage or Gauge
GAL	Gallon
GALV	Galvanize, Galvanized
GEN	General
GI	Galvanized Iron
GL	Glass
GOVT	Government
GR	Grade
GRD	Ground
GUT	Gutter
GV	Gate Valve
H	
H	High
HB	Hose Bibb
HD	Head
HGT	Height
HIRL	High Intensity Runway Lights
HORIZ	Horizontal
HP	High Pressure
	Horsepower
HR	Hose Rack
HTR	Heater
HV	High Voltage
HW	Hot Water
HWY	Highway
I	
ID	Inside Diameter
IE	Invert Elevation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IN (")	Inch
INCAND	Incandescent
INSUL	Insulation
INT	Interior
IPS	Iron Pipe Size
J	
JB	Junction Box
JCT	Junction
JT	Joint
L	
LP	Low Point
	Low Pressure
	Liquid Propane

M	
M	Meter
MAINT	Maintenance
MATL	Material
MAX	Maximum
MECH	Mechanical
MH	Manhole
MI	Malleable Iron
MIN	Minimum
MISC	Miscellaneous
MLLW	Mean Lower Low Water
MON	Monument
N	
N	North
NEC	National Electrical Code
NEG	Negative
NIC	Not in Contract
NS	Near Side
NTS	Not To Scale
O	
O/O	Out to Out
OC	On Center
OD	Outside Diameter
OPNG	Opening
OPP	Opposite
ORIG	Original
OVHD	Overhead
P	
PA	Public Address
PB	Pull Box
PC	Point of Curve
PCC	Portland Cement Concrete
	Point of Compound Curve
PED	Pedestal
	Pedestrian
PERM	Permanent
PERP	Perpendicular
PH	Phase
PI	Point of Intersection
P/L	Property Line
PLAS	Plaster
PNL	Panel
POS	Positive
PP	Power Pole
PREFAB	Prefabricated
PRESS	Pressure
PRC	Point of Reverse Curve
PROJ	Project
PT	Point
	Point of Tangency
PVC	Polyvinyl Chloride
PWR	Power
P	Plate
R	
R	Range
R/RAD	Radius
RCP	Reinforced Concrete Pipe
RD	Roof Drain
	Round
REIL	Runway End Identifier Lights
REINF	Reinforcement
RF	Roof
RR	Railroad
R/W	Runway
	Right of Way Line
S	
S	Sewer
SCUP	Scupper
SD	Storm Drain
SECT	Section
SHT	Sheet
SHTHG	Sheathing
SIM	Similar
SPEC	Specification
	Special
SPR	Sprinkler
SS	Sanitary Sewer
	Service Sink
	Stainless Steel
ST	Street
STA	Station
STO	Standard
STL	Steel
STR	Structural
STWY	Stairway
SUSP	Suspended
SWBD	Switchboard
SYM	Symmetrical

T	
TAN	Tangent
TC	Top of Curb
TEL	Telephone
TER	Terrazzo
TERM	Terminal
T & G	Tongue and Groove
THD	Thread/Threaded
TOT	Total
Trans	Transformer
T/W	Taxiway
TYP	Typical
U	
U/G	Underground
UON	Unless Otherwise Noted
V	
V	Valve
VA	Vault
VCP	Vitrified Clay Pipe
VERT	Vertical
VFR	Visual Flight Rules
W	Water, West or White
WC	Water Closet
WD	Wood
WHSE	Warehouse
WP	Weather Roof
WPJ	Working Point
	Weakened Plane Joint

7.3. BIM STANDARDS—REVIT AND CIVIL 3D

7.3.1. INTRODUCTION / PREFACE

The Authority recognizes the industry shift toward the use of building information modeling (BIM). The Authority will require all programs and projects to be completed using a comprehensive BIM Process.

BIM technologies have moved projects away from a 2D-based process towards a Model based process which comprises the use of 3-dimensional modeling software and supplementary data integration tools for designing and managing digital information that can be exchanged amongst stakeholders to support an efficient decision-making process.

BIM must be understood by all stakeholders as a set of interacting policies, processes and technologies generating a methodology to manage the essential building design and project data in digital format throughout the building's life cycle.

The adoption of the BIM process ensures the integration of the shared knowledge of the Airport facilities and operations; forming the basis for decisions within each project and informing existing and future facility operations and processes.

The contract framework establishes specific functions for the Authority it's Consultants, and Contractors in an overall

continuous collaborative project development and construction environment that must be accomplished using digitally generated information extracted from the BIM models.

This chapter describes the BIM and 3D model requirements, that must be met, for the project design, construction and handover stages. To meet this overall requirement, it will be necessary to create, share and continuously update the information on a schedule agreed upon at the start of the project.

7.3.1.1. PURPOSE (GOALS AND OBJECTIVES)

This Chapter introduces BIM and serves as the record and overview of the Authority's BIM definition, interpretation, expectation, software and organizational structure for the Authority's Consultants.

1. This Chapter has two specific goals:
    a. Establish the means for a collaborative process to provide the Authority with a clear awareness and understanding of project development during design, construction and handover phases.
    b. Establish specific BIM information content (data-sets and drawings) that can be extracted by the Authority and can be used to accomplish internally defined strategic goals.

After review of this document, Consultants will understand the terminology and processes being employed by the Authority and will be better prepared to execute the Building Information Modeling Project Execution Plan (BXP), as further detailed in Section 7.3.2.. The BXP must explain the means and methods to be used by the Consultants to achieve the requirements defined herein.

2. Objectives
    a. Better Design: Through the utilization of BIM, the Authority requires model content to be utilized to develop the 2D document deliverables. Utilizing model collaboration and spatial coordination throughout design, the Authority's Consultants shall achieve enhanced design deliverables for reduced changes and cost savings.
    b. 4D Scheduling: The Authority has a large campus with multiple facilities and a large infrastructure base. In order to better manage projects internally and between one another the Authority's Consultants and Contractors must perform 4D scheduling including but not limited to: Model based scheduling, logistics and planning, safety management, and project construction sequencing.

c. 5D Model analysis: The Authority incorporates tools to provide analysis of cost control on a budget basis. In order to better manage projects from a linked schedule of values and work-in-place approach the Consultants must perform 5D model analysis (based on the Authority's Work Breakdown Structure, or WBS) including but not limited to: Quantity take off, Cost Estimating, Projected Cash Flow (Budgeted cost of work scheduled), and Earned Value analysis (Budgeted cost of work performed).

d. Asset Handover: The Authority's goal is to assure consistency in asset handover as well as project delivery.

e. Analysis – Asset Replacement: In order to better maintain existing and new assets, the Authority has embarked upon a process utilizing BIM Models and asset attributes to help determine asset conditions and asset lifecycle.

f. Export BIM files to a CAD deliverable for Authority GIS use. The Authority requires that all models created to generate 2D plan sets be properly authored in a manner that assures the proper export of all sheet sets into a comprehensive project CAD deliverable that complies with the current CAD requirements and BIM requirements defined within this Chapter of this Document.

g. Bidirectional Links To FM/GIS: The Authority requires data to be bi-directionally linked to their Computerized Maintenance Management System (CMMS) and GIS platforms. The format of the data includes the X, Y, Z real world coordinate locations of rooms (inside and outside the building), the assets inside those rooms, and their embedded parameters. The Authority's true definition of BIM links the graphical and parameter data to the facility maintenance (FM) & GIS programs; allowing BIM to provide Full Lifecycle Management of the facility by acting as the translator. Integration with the building data allows the FM and GIS programs to be more productive with the overall management and preventive maintenance of the facility. This in turn allows exposure to other management benefits including improvement of building sustainability, schedulable maintenance and overall predictable behavior of the facility.

7.3.1.2. QC (QUALITY CONTROL) REQUIREMENTS

All field-captured QC data, including but not limited to **Asset Data,** must be recorded and/or linked to the Revit or Civil 3D model as QC occurs throughout the project. It is the Consultants responsibility to coordinate the information sources and integrate the information into the Revit or Civil 3D model for transfer at the completion of the project. Failure to submit this content with the design deliverables will result in rejection of the deliverable.

7.3.2. THE AUTHORITY'S BIM IMPLEMENTATION PACKAGE

The Authority maintains and distributes a series of templates, supplemental files, and documents that outline the general modeling standards for BIM projects. The BIM Standards, as defined herein, are used by staff and Consultants engaged with the design and construction of a project, to ensure standardization of core processes producing "downstream" - usable Building Information Models, GIS Data, and Asset Data.

Upon Notice to Proceed (NTP) he BIM Implementation Package is a set of documents provided by the Authority to aid Consultants in the creation, organization and delivery of BIM projects. The documents listed below are included as part of the Consultant Package. This package should be provided to all Consultants and external service providers working on BIM projects for the Authority.

1. SAN BXP.docx (BIM Execution Plan Template)
2. SAN BXP Matrix.xlsx
3. SAN Assets.xlsx
4. SAN Templates (SAN Base.rvt, SAN C3D Base.dwg)

7.3.2.1. THE AUTHORITY'S BIM EXECUTION PLAN (BXP)

1. What is the BXP?
    a. The BIM Execution Plan (BXP) is the agreement by all parties of a project, to share in the development and use of a common Building Information Model for a specific project. It is a document intended to help plan the ownership and scope of the models involved in preparing a BIM project for the Authority. The Authority requires a BXP to be developed to provide a master information/data management plan including assignment of roles and responsibilities for model creation and data integration which include design professionals of all Consultants.

2. BXP Submission Schedule

    a. The Consultant must submit a completed BXP to the Authority within thirty (30) days following contract execution. This BXP must identify the Consultant's entire Project BIM team including all consulting engineers and any specialty Consultants. The BXP will also reflect the comprehensive understanding of the consultants efforts necessary to meet the BIM Implementation goals for the project as well as the required coordination and collaboration with contractors, subcontractors, and material suppliers.

    b. The BXP shall be considered a living document and must be regularly updated and refined throughout the project development lifecycle.

    c. Upon receipt of the BXP, the Authority will have thirty (30) days to review and approve the plan. If the BXP is rejected by the Authority, the Consultant has thirty (30) days to resubmit. The Authority has thirty (30) days to review the resubmitted plan. An approved plan must be in place within one hundred twenty (120) days unless otherwise noted in contract.

    d. For project delivery strategies where the contractor is not part of the original Consultant, the BXP also shall include roles and responsibilities of the contractor(s) even if that party has not yet been identified.

3. SAN BXP BIM Matrix.xlsx

    a. Each project model is intended to be integrated with Authority's facility software. For the Record Model to be of the most use, the entire process from conception to record model will be influenced by that end goal. Everyone on the Consultant's BIM team needs to be aware of the downstream BIM uses and develop their model input accordingly.

    b. Identify the ASTM Uniformat and SAN WBS codes for building elements and their required Level of Development (LOD) at all modeling phases.

4. SAN Assets.xlsx

    a. SAN Parameters: A list of required parameters with responsible author, parameter descriptions, and other key parameter information.

    b. Asset Types: List and naming convention of SAN Revit families that require asset capturing.

c. Revit Categories: List of Revit categories where asset information is required.

d. GIS Features and Attributes: List of GIS Features and Attributes required for infrastructure, utilities, and building systems for GIS integration.

5. SAN Templates

a. Revit Template (SAN Base.rvt) to be used for all facilities-based models at the Airport. They are defined by the location acquired from the SAN C3D Template. Failure to begin and continue designing with either of these templates will result in rejection of deliverables.

b. C3D Template (SAN C3D base.dwg) to be used for all Airside, Landside, and infrastructure-based models. This model template is the basis for facility and asset location for the Authority.

7.3.3. BIM BXP FRAMEWORK STRATEGY

7.3.3.1. PROJECT DELIVERY

The delivery method defined for a project will have a significant impact on downstream processes and coordination. All project drawing deliverables must be generated as direct output from native, first generation, modeling software. It is not acceptable to generate content in a CAD platform and copy, import, or otherwise insert that content into a secondary platform to represent native content (models with secondary sheet and/or detail content inserted will be rejected). The BXP will include and further define all content required to prescribe the means and methods of achieving the BIM Goals.

7.3.3.2. PROJECT GOALS / BIM USES

The Consultant must develop a comprehensive matrix of BIM Uses, defining the project stages, BIM uses, and responsibilities. Typical project phases and BIM Use types will include but not be limited to: Design Modeling (Existing conditions models, Design authoring, Asset data modeling, Design Model QC and analysis, and Reconciled Design models) Construction Modeling (3D Coordination, Asset Data modeling, 4D Modeling, and 5D Modeling), Commissioning and Closeout (Quality Control, Asset Data Modeling, and integration into FM and GIS)

7.3.3.3. BIM PROCESS WORKFLOWS

Process workflow maps provide a detailed plan for execution of each BIM Use and are designed to be a visual aid in understanding the workflows involved in the project. They also define the specific Information Exchanges for each activity; building the foundation for the entire execution plan. The BXP must include an Overview Map of the BIM Uses, and a

detailed Map of each BIM Use and a description of elements on each map, as appropriate.

7.3.3.4. BIM INFORMATION EXCHANGE AND COLLABORATION

The Consultant will utilize a designated Collaboration site and/or Common Data Environment (CDE) setup and distributed by the Consultant to transfer project specific information and 2D/3D/BIM/4D/5D data. The Collaboration site will be updated at the defined intervals with project information by both the Consultants and project team members. For official submissions to the Authority during scheduled project deliverables, the official Authority Document control process will be utilized (or other site as designated). The Authority recognizes that in order to achieve maximum effect of incorporating BIM-based technologies and processes into its overall lifecycle operations, management and development goals a regular review of the BIM deliverables will be necessary. This review is intended to provide technical and quality control oversight to identify and correct issues surrounding the model itself and to ensure the Authority parameter/data/standards requirements are being adhered to.

7.3.3.5. BIM DATA REQUIREMENTS

The Authority requires all Revit building projects and Civil 3D Infrastructure projects to include corresponding Data on predefined SAN Asset Types. As per the SAN Assets.xlsx and BXP, the Consultant will organize the structure and linking of all the models and appropriate Data that make up each project. Those multiple models are then to be authored with data that follows a prescribed format. All objects (equipment, fixtures, etc.) that exist within the facilities models are to be linked to their corresponding room (rooms can be both inside and outside of the building footprint) within the project. All objects (equipment, fixtures, features, etc.) that exist within the infrastructure models are to be properly geolocated and associated with the required feature attributes and labels. All assets defined within the SAN Assets.xlsx file must incorporate the object parametric attributes. Failure to provide this content will result in a rejection of deliverables and withholding of funds.

In the execution of the defined scope of work, the official submission deliverables to the Authority by the Consultants will follow the Design deliverable schedule. All project Design deliverables submitted to the Authority will include the BIM models and data spreadsheets. Between official submission deadlines, the Authority will review both the BIM models and the data spreadsheets regularly to ensure consistency and alignment with the defined process schedule.

7.3.3.6. PROJECT BIM TEAM SOFTWARE

Models must be authored using Autodesk Revit, and/or Autodesk Civil 3D. Models need to be coordinated to include all geometry, physical characteristics and product data needed to describe the design, and construction work, resulting in accurate record documents and as-built models. Baggage Handling Design models must also be generated in Revit. Failure to deliver a native Revit model (no imported CAD or IFC content) with properly associated Asset Data will be rejected and payment will be withheld.

7.3.3.7. CIVIL ENGINEERING INTEGRATION

3D Models must be created to include all geometry, physical characteristics and product data needed to describe the design and construction work to within 5' of building envelope. Models will follow the Title Blocks, Line Style, Block Libraries, Survey Data, current graphic standards and Layer, Style, Text, Naming, etc. standards within this document.

7.3.3.8. GEO-REFERENCED MODELS

A master site file in .rvt format will be provided by the Authority for all projects. All models except survey models will acquire coordinates from this file's shared coordinates. The Authority will update this file accordingly as new survey data is obtained. The current datum (outlined in Section 7.4.2. of this document) is incorporated within this file. The Project Base point (Revit) and Temporary Project Control (TPC) point within Civil 3D must be identical (within all models) in Northing, Easting, Elevation, and Rotation from North.

7.3.3.9. BIM RESPONSIBILITIES

It is the responsibility of all Consultants and contractors to have or obtain, at their cost, the trained personnel, hardware, and software needed to successfully generate and utilize BIM models for the development of the project to a level of detail as defined in the BXP.

Equipment used by the Consultants during the on-site coordination meetings must meet the requirements of the software being implemented so as not to cause delays in modeling and redrawing. All technical disciplines must be responsible for their data integration and the data reliability of their work and coordinated models.

7.3.3.10. SSI (SECURITY SENSITIVE INFORMATION) MODEL

All SSI information will be kept in a separate model as part of the Project BIM. The BXP must define the process for the creation, access requirements and dissemination of SSI content. See also, Section 7.3.6.16. —Handoff of SSI Models and Information.

7.3.3.11. SPATIAL COORDINATION

The Consultant is required to run model spatial coordination analysis throughout the design and construction phases for their respective trade system(s). The models submitted for overall coordination are required to be checked and coordinated with the architecture, structure and the Design Consultant's own work prior to submittal. At a minimum, the model shall be pre-coordinated to avoid conflicts. The Consultant will define the frequency, process, and reporting methodology for the spatial coordination processes in design and construction.

7.3.3.12. SYSTEMS MODELED AND MODEL ELEMENT DETAIL

Model Element Detail refers to the definition of the elements which must be modeled. It is the description of content expected within a model. Greater detail than the minimum shall be incorporated in the model whenever possible. Refer also to the BIM Matrix for the modeling requirements in relationship to each phase of the project. Any further Model development or scope deemed necessary and not previously defined will be addressed when identified. The Consultant will determine the effect on the Model(s) and scope and propose the appropriate response to accommodate the noted Model development and/or coordination issue.

7.3.3.13. LEVEL OF DEVELOPMENT

The timing of the level of development (LOD) required for element(s) or system(s) will be dependent upon the project delivery method used for the project, as the deliverables and their timing may be different. The LOD will be developed for any project as part of the BXP.

7.3.3.14. ONGOING DESIGN MODEL MANAGEMENT

The process of reconciling the Record Design Model derived from spatial coordination between the Design Model(s) and the Contractor-provided Construction Model(s). Includes the following requirements:

1. Each Consultant must provide a plan that outlines how the updates/ maintenance of electronic data/3D model will be completed throughout Construction Administration, including but not limited to:
    a. Incorporation of RFIs
    b. Incorporation of changes to Design and/or Scope (Bulletin, CO, CR, CCD, ASI, etc.).
2. Submittal Process
    a. Utilization of BIM for the Submittal Process

i. The process for including changes into a model identified during the submittal process is as follows: Inclusion of Model submittals takes place in 2 steps; initially the current Design Model is aligned with Construction Coordination Model to validate design intent with proposed construction. Next, upon receipt of the Construction As-built Model, the current Design Model is aligned to accurately reflect the Construction As-built Model. Incorporating approved submittals into the BIM Model (when applicable) must be completed within the number of calendar days, as defined by the Contract.

3. Minimum Discipline Alignment

   a. In general, the Consultant's responsibility is to create a technically accurate and highly detailed "Record Design Model" submission during construction administration. To the extent that the scope includes building systems, those systems will be included to the full horizontal and vertical extents of the model including but not limited to: underground utilities and roof top mounted items. The design models and trade contractor models must be developed to be within the established tolerance of variation. The Consultant will provide the tolerances between the building systems and components. This tolerance of variation will define the allowable dimensional difference between the alignment or location of objects within the contractor's and trade subcontractor's models and those same design discipline models. Example: What is the allowed variation (in inches) of the as-built plumbing subcontractor's model and the Design Engineer's plumbing model?

7.3.3.15. CONSTRUCTION PHASE

The Consultant is expected to continuously maintain and update the model(s) with changes made from official Construction Change Directives and as-built mark-ups maintained on site by the contractor(s) during construction. At an interval that is decided within the BXP or at minimum once a month during construction the updated model(s) will be published in Revit and Civil 3D formats and posted to the Project Collaboration site, or CDE.

7.3.3.16. CONSTRUCTION MODELS

Construction models include coordination, fabrication, and shop drawing models. These models will now be referred to as the Construction Models throughout the remainder of this chapter.

7.3.3.17. 4D MODELING – CONSTRUCTION PHASE

Based upon the project challenges, technology and available information, Consultant and project teams must ensure that the timing of the 4D model creation is correct. 4D models created too early or too late yield fewer benefits than those created at the ideal time. Although BIM based projects encourage developing a 3D model early on the project, 4D models created too early are generally too superficial and cannot provide insight into the project challenges. During programming and schematic design phases, when objectives and elements will constantly change, a 4D model can convey little useful information. 4D models created too late usually do not allow for changes to be made on the project from new insights or cost more to do so. The Consultant must define (during the creation of the BXP) the different types of 4D models and uses to meet the goals defined in the Goals section above. Software, Deliverables, and frequency shall be defined to achieve this.

7.3.3.18. 5D MODELING – CONSTRUCTION PHASE

Based upon the project challenges, technology and available information, project teams must ensure that the timing of the 5D model creation is correct. 5D models created too early or too late yield fewer benefits than those created at the ideal time. Although BIM based projects encourage developing a 3D model early on the project, 5D models created too early are generally broad reaching and cannot provide insight into the project challenges. During programming and schematic design phases, when objectives and elements will constantly change, a 5D model can represent low level of detail analysis. 5D models created too late do not allow for analysis of changes made on the project from new insights or cost more to do so.

7.3.3.19. CONCURRENT AS-BUILT MODEL MANAGEMENT

The Consultant must submit a plan to the Authority for review, prior to the start of construction, that outlines the process for concurrent as-built documentation. At any given time, changes in the field must be identically represented in the model. Methods for recording as-built information are left to the discretion of the consultant.

Potential options for concurrency include:

1. Periodic laser scanning of completed or partially completed primary systems coordinated with the sequence of construction.

2. Integration of model changes in RFI, CO approval processes. Responsibility of the modeling updates is determined by the BIM Project Execution Plan.

7.3.4. THE AUTHORITY QA PROCESS FOR BIM

7.3.4.1. QA MODEL REVIEWS

Model Reviews will be conducted by the Authority's BIM staff at each required deliverable submittal and will be returned within 10 business days of the submission, unless noted otherwise in the BXP. Failure to pass a QA model review shall result in withholding of payment.

7.3.4.2. CRITICAL ITEMS

Of the line items in the BIM model review form, there are Critical items. A Caution or Fail on a Critical item constitutes a Fail for the entire submission.

7.3.4.3. RESUBMITTAL

The Authority will review files resubmitted within 5 working days of receipt of the initial Model Review Score and Comments. This new review score may supersede the original submittal score. Original scores will continue to be tracked for trend analysis.

7.3.4.4. INTERIM REVIEWS

The Consultant may at any time request an interim review of their files, interim review scores are not tracked by the Authority and are for the Consultant's benefit only.

7.3.4.5. FAILURE TO SUBMIT

Failure to submit content as part of a project submission will result in a score of 0 zero) percent for that project submission and will constitute a Fail.

7.3.5. PROJECT DELIVERABLE PROCESS

7.3.5.1. PURPOSE

This chapter provides a set of graphic, Revit, and Civil 3D file standards for any BIM project at the Airport. Project requirements such as naming conventions, graphic standards, file structure standards and best use practices are documented in this chapter of the BIM Standards. These minimum standards are required for all Authority BIM projects.

7.3.5.2. FOLDER STRUCTURE

This section describes the folder structure and content for the Authority's BIM deliverables and project content sharing. Files and folders described here are available, or "shared", to all Authority staff and Consultants working on the Airport's BIM projects respectively. As a point of clarification, Consultants may share content and files with each other during the various project phasing using an approved file sharing platform, such as Sharefile, Egnyte, FTP, etc. All deliverables are to be delivered using the following folder structure. Folders may be added as

needed, but never delete the original folder structure

1. Project Root Folder

    a. This is the main folder for all BIM project files. All BIM deliverable content must fall within the folder structure of the Root Folder. The folder needs to be titled with the Project Number and the project's official Project Name. Consultant to coordinated with APM for proper Folder naming convention. The image below shows the contents of this folder.

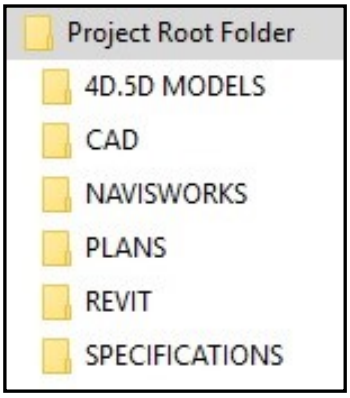

Figure 7.3.a.: Project Root Folder

2. 4D and 5D Models

    This folder must contain the 4D and 5D model content.

3. CAD

    a. This folder will contain all CAD related files (bound sheet files, C3D date files, blocks, xrefs, 3D models, plot configurations, survey data, and CAD subcontractor files). As shown in Figure 7.3.b.

        i. 00. BOUND SHEET – All project sheets associated with the project with all xrefs bound.

        ii. 01. SHEET FILES – Project sheet sets with all xrefs live pathed and relatively loaded.

        iii. 02. DATA – Houses all data incorporated into C3D. Do not delete.

        iv. 03. 2D BASE FILES – 2 dimensional CAD base files xref'd into the sheet files.

        v. 04. 2D XREF FILES – CAD files xref'd on to sheet files (blocks). Drawings shall be placed in the directory compatible with internal and external folders.

        vi. 05. 3D FILES – Civil 3D files xref'd into the Sheet Files

        vii. 06. PLOT CFGS – Plot configuration files (.cbt) used by Consultants for plotting clean, legible drawings.

        viii. 07. SURVEY SHOTS – As-built .txt files captured by the contractors through a data collector. Used for as-built validation.

ix. 08. SUBCONTRACTOR FILES – As-built subcontractor .dwgs.

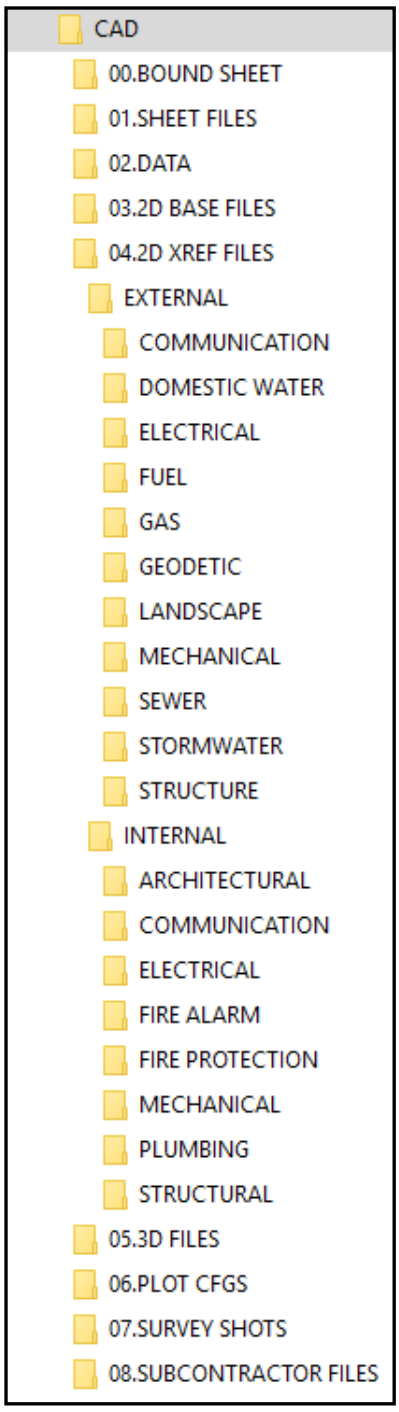

Figure 7.3.b.: CAD Folder

4. Navisworks

   This folder will contain all designer and subcontractor as-built .nwc/.nwd files for the project.

   a. DESIGN MODELS – All as-built designer Navisworks .nwc/.nwd files associated with the project

   b. SUBCONTRACTOR MODELS – All as-built subcontractor Navisworks .nwc/.nwd files associated with the project

5. Plans

   a. BUILDING PLANS – All designer as-built building plans. A copy of the .pdf Record Documents that the Authority receives as part of the deliverable language associated with the executed contract.

   b. CIVIL PLANS – All designer as-built civil plans. A copy of the .pdf Record Documents that the Authority receives as part of the deliverable language associated with the executed contract.

   c. Construction Plans [As-Builts, Shop Drawings] – All subcontractor as-built's and shop drawings. A copy of the .pdf plans that the Authority receives as part of the as-built shop drawings associated with a specific project.

6. Revit

    a. [PROJECT NAME] – All project base Revit files needed to complete an aggregate model of the project.

    b. LINKS – All .rvt files that are linked into the base files which support the creation of a complete project. For example: existing structures, roadways, grids, etc.

    c. MATERIALS – This folder must contain all materials and/or raster images used to develop the visualizations and contract documents.

    d. FAMILIES – This folder shall contain copies of all families used in developing the models that make up the record design models.

7. Specifications

    a. AS-BUILT BUILDING SPECS – A copy of the as-built building specifications. The same set of documents that the Authority receives as part of the deliverable requirements outlined in the executed contract.

    b. AS-BUILT CIVIL SPECS – A copy of the as-built civil specifications. The same set of documents that the Authority receives as part of the deliverable requirements outlined in the executed contract.

8. Deliverables

Note that all SSI models, plans and information are subject to various permissions for access. The APM will coordinate with the Consultant's BIM Manager for access rights and deliverable requirements.

7.3.6. REVIT DELIVERABLE REQUIREMENTS

7.3.6.1. REVIT FILE NAMING CONVENTIONS

Maintaining standard naming conventions allows all users to effectively find and use the project and family files.

This section outlines the naming conventions established by the Authority for Revit files.

1. Building ID (Parcel ID and BLDG ID Sequence Numbers)

    a. These numbers will be provided by the Authority and are to be captured in the BXP by the Consultants BIM Manager.

2. Building Name

    a. These (3) letters will be provided by the Authority and are to be captured in the BXP by the Consultant's BIM Manager.

3. Office of Origin Abbreviated

    a. This series of letters are an abbreviated reflection of the office of origin's company name.

4. Discipline

    a. This single letter identifier will follow the guidelines of the National CAD Standard and reflect the scope of the model. Not all discipline identifiers will be used.

5. Project Identifier

    a. This number is the assigned project contract number.

A chart to aid in the naming of the Revit Projects is shown in Figure 7.3.c.

7.3.6.2. NAMING: REVIT FAMILY FILES (RFA) NAMING

This section outlines the naming format for the Authority's Revit family files. Naming is divided and formatted into 4 categories as follows:

<CSI Identifier><dash><Type>< dash >< Description>< dash ><Category>.

Note: The required facilities assets (as defined in the SAN Assets.xlsx spreadsheet) must follow the outlined naming convention.

1. CSI Master format 2004/2010

The Authority has formally adopted the 2004/2010 update UniFormat system. The Specifications will be deployed using the e-Spec format and linked directly to parameters within all families. The samples in this section use this format.

a. CSI Identifier: 8 Digits (Required)

    i. The eight digits of the CSI 2004/2010 format 8 digit identifier are used, no spaces.

    ii. 08 13 00 13 hollow metal doors = 0813

    iii. For conditions where conflicts occur, just the first two characters are significant.

b. Type: 6 Characters Max (Optional)

    i. The primary use of this is to provide a secondary sorting mechanism in Revit's Project Browser. MEP can use this to separate out plan vs. other types of symbols. Specific types of annotation families such as title blocks can be distinguished by adding this field. Doors and windows can use this to identify with shorthand interior, exterior, single, double.

c. Description: 18 Characters Max (Required)

i. General description of the family. Use spaces within the field as necessary for clarity.

d. Category: 2 Characters Max (Optional)

i. This optional field is used to help users identify special types of families. Annotative elements may be created with Generic Annotation (GA), Detail components (DT), or even Generic Models (GM).

e. Refer to Figure 7.3.d. for additional information.

2. Component Families Examples: See to Figure 7.3.e.

<08340013-EXTDBL-MTL Security Door>

3. General Symbol Examples. Refer to Figure 7.3.f.

4. MEP Symbol (Annotation Families) Examples: Refer to Figure 7.3.g.

a. Symbols will be generic annotations with the CSI Division rounded to the hundred.

5. Title Blocks: Refer to Figure 7.3.h.

6. Name and #: Room and Door Numbering: Refer to Figure 7.3.i. and 7.3.j.

Room and door identification must be coordinated to assure maximum compatibility with all downstream Authority uses including CMMS, and GIS applications.

7. Room Types: Refer to Figure 7.3.k.

The figure shows examples of Room Type Designators used to help identify specific room types within a project:

The consultant must coordinate with the Authority to define all necessary Room type designators. This list on page 498 is for example only, there will be more types.

8. Areas

Areas will use the same naming and numbering convention as rooms unless created for special purposes such as code/egress diagrams, unique color fill presentations, or take-offs of spatial regions per project.

File Naming Element	Example
Parcel ID: To be provided by The Authority and captured in the BXP	**015**-1-RCC_DW-A_104151_C.rvt
BLDG ID Sequence: To be provided by The Authority and captured in the BXP	015-**1**-RCC_DW-A_104151_C.rvt
Building Name: To be provided by The Authority and captured in the BXP	015-1-**RCC**_DW-A_104151_C.rvt
Office of Origin Abbreviated: SAN = SDCRAA; GE = Gensler; SU = Sundt; DW = Dermattei Wong; HP = Hensel Phelps, etc.…	015-1-RCC_**DW**-A_104151_C.rvt
Discipline (Per NCS) Refer to Figure 7.4.a. "Drawing Order" of the document	015-1-RCC_DW-**A**_104151.rvt
Project Identifier: Assigned Contract Number	015-1-RCC_DW-A_**104151**.rvt

Figure 7.3.c.: Naming Revit Files Example

Example: 015-1-RCC_DW-A_104151.rvt = Rental Car Center Architectural Model created by Dermattei Wong.

CSI Identifier – Required	Type – Optional	Description – Required	Category - Optional
8 Digits	Up to 6 Characters	Up to 18 Characters	2 Characters, Revit Category Identifier

Figure 7.3.d.: CSI Identifier

Object	CSI Identifier	Type	Description	Category
Real World	8 digit max.	6 digit max.	18 character max.	2 character max.
Exterior Double Metal Security Door	08340013	EXTDBL	MTL Security Door	
Curtain Wall Entry Door	08410013	EXTDBL	CW Door	
Hydronic Piping Pump	23210014		Hydronic Pump	

Figure 7.3.e.: Component Families Examples

Object	CSI Identifier	Type	Description	Category
Real World	4 digit max.	6 digit max.	18 digit max.	2 digit max.
North Arrow	0000		North Arrow	GA
ADA Graphics Door Width Clearance	0800	ADA or ANSI	Door Pull Clearance	DT
Door Tag	0800		Door Tag	
Diffuser Tag	2300		Terminal Tag	
Keynote	0000		Keynote	
Generic Annotation Sheet Note	0000	Plan	Sheet Note	GA

Figure 7.3.f. General Symbols

Object	CSI Identifier	Type	Description	Category
Real World	4 digit max.	6 digit max.	18 digit max.	2 digit max.
Hydronic Piping Pump Plan	2300	Plan	Pump Symbol	
Hydronic Piping Pump Schematic	2300	Schem	Pump Symbol	
Electrical Transformer	2600		Transformer Symbol	

Figure 7.3.g.: MEP Example

Object	CSI Identifier	Type	Description	Category
Real World	4 digit max.	6 digit max.	18 digit max.	2 digit max.
30x42 Design (horizontal border) landscape orientation	0000	TB	30x42 SD	
30x42 CD (vertical border) landscape orientation	0000	TB	30x42 CD	
30x42 Cover Sheet	0000	TB	30x42 CS	
8 ½ x 11 Portrait	0000	TB	8x11P	
8 ½ x 11 Landscape	0000	TB	8x11L	

Figure 7.3.h.: Title Blocks

Room Number			
Building Name	Building Level	Room Type	Room Number
4 digit max.	2 digit max.	2-4 digit max.	4 digit max.
RCC	01	ELEC	105

Figure 7.3.i.: Room Numbering

Example Room: RCC_03_5E_EL05 = Rental Car Center, Level 03, Intersection of 5 and E, room 05 in this building module/grid.

Door Number				
Building Name	Building Level	Room Type	Room Number	Door Number
4 digit max.	2 digit max.	2-4 digit max.	4 digit max.	3 digit max.
RCC	01	ELEC	105	09

Figure 7.3.j.: Door Numbering

Example Door: RCC_03_5E_EL05B = Same room, second door in that room

Room Names	Room Type Designator
Storage Room	STOR
Office	OFF
Corridor	CR
Electrical Room	ELEC

Figure 7.3.k.: Room Types Designator

7.3.6.3. REVIT VIEW NAMING

1. Naming of views should make sense with the project.
    a. The name of the view will be the default title of the view when placed on a sheet
    b. Review Project Browser organization functions prior to naming views based on a filterable parameter that already exists (sheet number).
    c. All views that are temporary, and/or lowercase shall be purged prior to final submission of As-Built models and Reconciled Design Models.
2. Capitalization
    a. All views that are CAPITALIZED are views to be placed on sheets.
    b. All views that are not capitalized are working views and can be assumed not to be placed on sheets.
3. Temporary Views (Plans, Sections, Elevations, Schedules etc.)
    a. Create temporary views that allow you to do your work. The intention of a temporary view is to create a view at a different scale or visibility graphic settings when a working view is in use by another member of the team.
    b. Name these views: **t_<your_Initials>_description**
    c. If you create one of these views, it is your responsibility to delete it when you are through with it.
4. Schedules Naming

    In addition to the above conventions:
    a. "Key" in a schedule name indicates the scheduling of Revit Keys rather than building components.
    b. These will likely never be placed on a sheet. If a key schedule needs to go on a sheet, it must be renamed to all caps.
5. Lower case, and or "_" prefix denotes a working schedule.
    a. These will never be placed on a sheet. The project BIM leader for the project may delete these if not used by the project.
6. "t_<your_Initials>" prefix denotes a temporary schedule
    a. If you create a temporary working schedule, it is your responsibility to delete it when you are through with it.

7.3.6.4. REVIT GRAPHIC STANDARDS

Many of the Authority's graphic standards are established in the template file. The base set of line weights, line types, fill patterns along with the standard set of annotation and tag symbols described here are part of the template files. Although part of the template files, the graphic standards have been separated from the template discussion for clarity.

The templates establish the standard for line weights, text styles, dimensions styles and annotative objects in the Revit model. With proper approval, Consultants are permitted to use their own.

1. Sheet Notation

   Annotation shall follow the National CAD Standards current version (V6)

   a. The notes may provide:

      i. information

      ii. identification

      iii. instruction

   b. There are five types of notes: general notes, general [discipline] notes, general sheet notes, reference keynotes, and sheet keynotes. General notes, general [discipline] notes, and general sheet notes do not directly correspond to a graphic representation and are not directly "linked" by symbol (or other identifier) to other drawings or specifications. Should these three types of notes appear on the same sheet, they are listed in the following hierarchical order:

      i. **General Notes –** Located within the G-Series, General Drawing's sheet types.

      ii. **General [Discipline] Notes (such as General Architectural Notes)** – General [Discipline] notes appear on the first or 0-Series sheets within a particular design discipline and apply to all subsequent sheets within that discipline. For example, general civil notes appear on sheet C-001 and apply to all civil sheets within the drawing set.

      iii. **General Sheet Notes -** General sheet notes are used to communicate sheet-specific information or instructions. General sheet notes are tabulated sequentially within the note block. General sheet notes follow the other types of general notes (general notes or general [discipline] notes) and precede any reference keynotes that may appear in the note block.

c. Sheet Notation General Rules

i. If you can place the note directly next to the object, use complete text within the drawing area.

ii. It is acceptable to use Revit Keynote functionality. If you cannot put the full text of the note within the drawing area it will become either a Reference Keynote or a Sheet Keynote.

iii. To allow the most flexibility for all firms and disciplines working with the Authority, the following Revit components have been identified to fill the roles established by the National CAD Standard for Reference Keynotes and Sheet Keynotes:

a) Sheet Keynotes will be Generic Annotations and Note block schedules.

b) Reference Keynotes will utilize the Revit's Keynote functions.

2. Text

All projects are to use the following font, size, and types for text standards

a. All Revit fonts are to be Arial

b. 3/32" – Normal text, Notes, Dimensions

c. 1/8" – Subheadings

d. 5/32" - Headings

3. Room Tags

The SAN Room Tag uses a concatenation of all room parameters outlined in Figure 7.3.l.

Room Tag	Results
SAN Room Tag	ELEC205 SAN-FMDA-01-ELEC205

Figure 7.3.l.: Room Tag

4. Door Tags

The SAN Room Tag uses a concatenation of all room parameters outlined in Figure 7.3.m.

Door Tag	Results
SAN Door Tag	101 SAN-FMDA-01-ELEC

Figure 7.3.m.: Door Tag

5. View Callouts

This section addresses the symbol representation of the specific view types that follow.

6. Section Callouts

   a. Building Section—Refer to Figure 7.3.4.

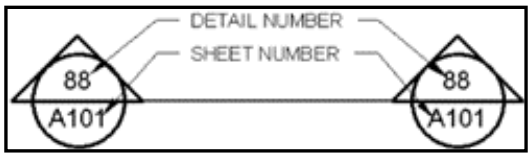

Figure 7.3.n: Building Section

   b. Section Cut (Wall and Detail) - Refer to Figure 7.3.o.

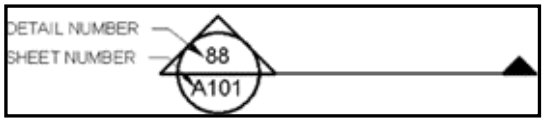

Figure 7.3.o.: Section Cut

   c. Section Cut (Wall and Detail) - Refer to Figure 7.3.p.

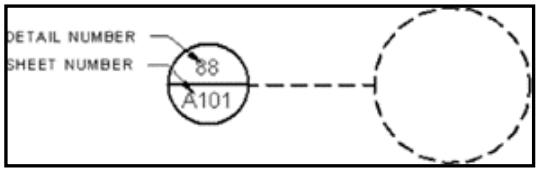

Figure 7.3.p.: Section Cut

7. Elevation Callouts

   a. Projection Exterior Elevation— Refer to Figure 7.3.q.

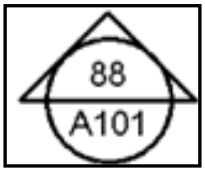

Figure 7.3.q.: Projection Exterior Elevation

   b. Design Exterior Elevation— Refer to Figure 7.3.r.

Figure 7.3.r.: Design Exterior Elevation

   c. Interior Elevation— Refer to Figure 7.3.s.

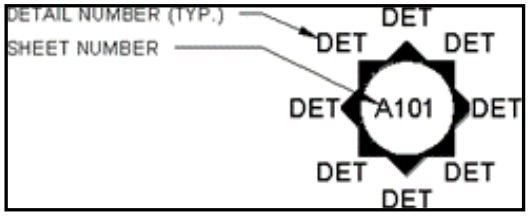

Figure 7.3.s.: Interior Elevation

8. View Titles

The standard Authority view titles available in all templates are shown below:

   a. Default—Refer to Figure 7.2.t.

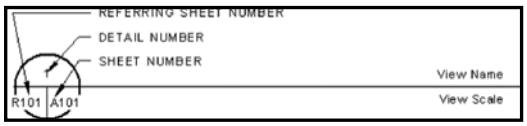

Figure 7.2.t.: Default View Title

   b. No Reference— Refer to Figure 7.2.u.

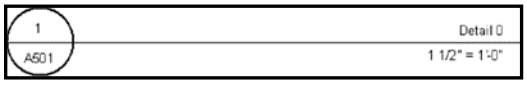

Figure 7.2.u.: Nor Reference View Title

7.3.6.5. AUTHORITY TEMPLATES

Revit and Civil 3D templates are instrumental in establishing standards. Consistency in worksets and design options organization and use has a great impact on the ability of teams to effectively utilize the model. Because the models will become part of the facilities tools, it is important that the base set of standards established by the Authority templates are maintained through the design and construction process.

Inherent in the Revit project template files are:

1. Graphic Standards (discussed in the previous section)
2. Organization of the Views, Legends, Schedules and Sheets

7.3.6.6. VIEWS

Keeping all views of a model organized is as important as having an organized structure in a DWG based project. The structure outlined in this chapter is for projects started with the Authority Architecture template file. Other Authority templates may have only subsets of the views, legends schedules and sheets described here. While schedules, legends and sheets are technically views to the Revit database, they are given separate sections in this document because their conventions and rules differ from the views listed in this section; which include Plans, Elevations, Sections, and Details.

1. Views: General Standards

   The following conventions apply to all views in the project regardless of the view type; plan section, legend, or schedule.

   a. Creating New Views

      i. When creating a new view/ sheet by duplicating or creating new from scratch, do not just create the view and rename it. Open its properties and fill in the element properties which are used by your project for sorting and organization.

   b. Level Names

      i. Level Names once set by the project team are sacred. This means that the names that appear in elevations/sections should not be changed. Revit attempts to keep the name of a view coordinated with its Associated Level. The message in Figure 7.3.v. appears when changing a view name that is the same as its Associated Level.

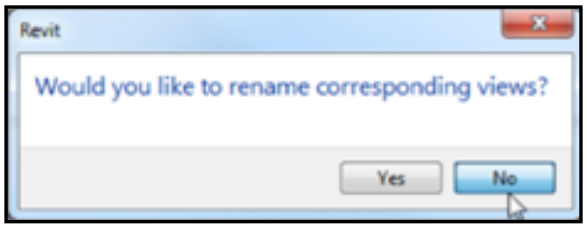

Figure 7.3.v.: Level Names Message

ii. The answer is NO. Answering with YES will change the Level Name and that is usually not what is desired. A Yes response will cause Revit to keep any views that have a matching name coordinated.

2. View Organization Parameters

a. Most of the view types (Plans, Sections, Elevations, Detail and Drafting views) have two custom parameters **Category** and **Sub Discipline** which are used extensively to sort and organize the default views provided in any template. Refer to Figure 7.3.w.

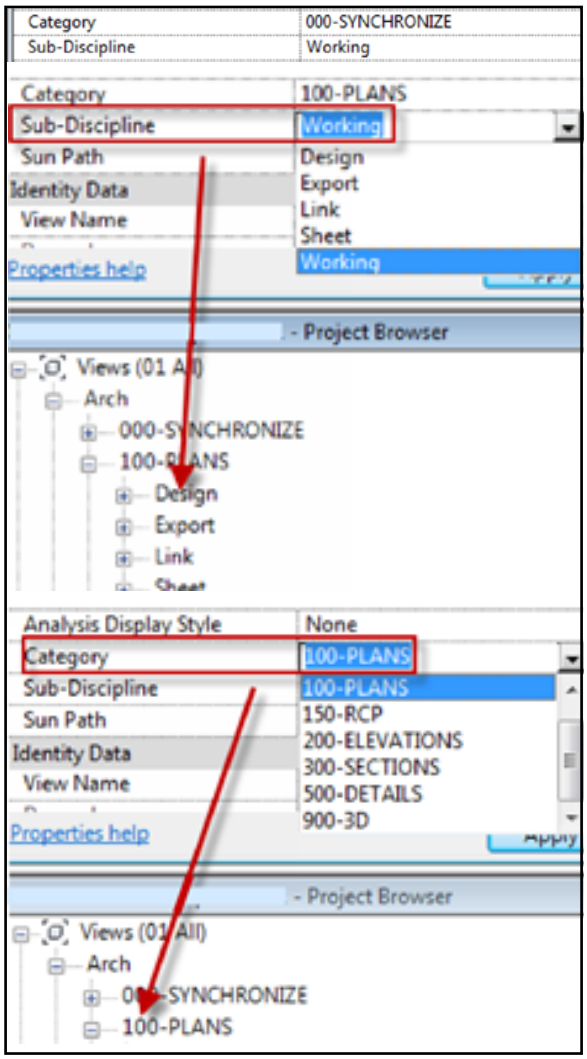

Figure 7.3.w.: Revit Organization

7.3.6.7. PLANS

1. View Type Descriptions Plans

Projects will require multiple plan views of each level of the project. Each plan view may only be placed on a single sheet. To create a first floor existing plan and a first floor dimension plan will require two different floor plan views.

These divisions are a common starting point for any project and are organized around the National CAD Standards (NCS) sheet set organization system. These categories are described in the following section. Any project may add to or modify these basic organizational sets for project specificity.

2. Design – These views are intended to be used for Presentation views, which may include colors, shading/shadows, and other Conceptual and/or Schematic Design information.

3. Export – These views are intended to be used for exporting to other CAD formats. There may be times when the export does not contain the same information as the construction document set.

4. Link – These views will be used for:

    a. Linking in other CAD formats.

    b. A view with the active Revit Links made visible.

5. Sheet – These views are intended to become the Construction Document set. They are to contain final annotation, dimensions, and these individual sheets are exported to .dwg format as part of the record deliverable.

6. Working – These views are intended to be used for the day-to-day creation of the model. These views are never placed on sheets, so any visibility graphic changes you make will never affect the printed set. The tasks completed in a working view are primarily model element manipulations. Annotations, dimensions and notes need to be placed in sheet views. Refer to Figure 7.3.x.

Figure 7.3.x.: Revit Plans

7.3.6.8. ELEVATIONS

Two different Exterior elevation types exist in the templates. Design elevations are intended to be used for color presentations. Sheet elevations are construction documents. Refer to Figure 7.3.y.

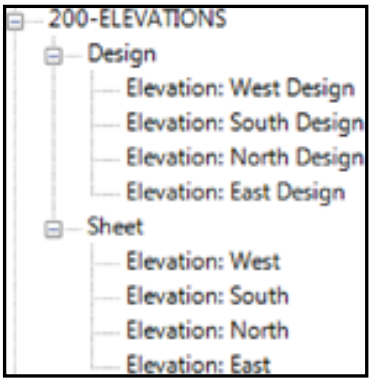

Figure 7.3.y.: Revit Elevations

7.3.6.9. SECTIONS AND DETAILS

Revit section views and detail views are added with the section tool. The type definition determines the look of the mark as well as where the view appears in the project browser.

1. Drafting Views – Views for design and drafting. May or may not be placed on a sheet.
2. Drafting Views (Detail) – Standard detail view for 2D details.
3. Synchronize - This drafting view type is used specifically as the view that is the last open view when a file is saved at the end of the day. It is then always the view opened when a project is opened

7.3.6.10. LEGENDS

The naming conventions used in the template are the same as views in general. Legends for sheets are named with ALL CAPS. Legends which are informational or working legends not for sheets are lower case.

7.3.6.11. SCHEDULES

Most data entry will happen through a schedule interface. Room Renumbering, Door Renumbering, Programmatic Requirements for rooms and areas are all tasks completed with a schedule. It is essential that everyone on the project understand how to effectively use a working schedule to sort and filter only the information they are working with.

Schedules break many of the rules associated with views.

1. Schedules can be placed on multiple sheets
2. Schedules have no "title on sheet" parameter. Renaming the schedule renames the title.
3. Schedule will sort alphabetically, not with the project browser organization.

7.3.6.12. SHEETS

Sheets, like views, have their own parameters which are used for sorting and organizing the sheets in the project browser. The same parameters used to sort and organize the sheets in the project browser are used to organize the sheets in the Drawing Index schedules.

7.3.6.13. WORKSETS

Workset enabled files are Revit's way of allowing multiple people to work on the same project.

1. General Workset Standards
    a. The BIM Leader for the project is responsible for creating and maintaining the worksets of the project.

b. Do NOT unload a linked Revit file and Synchronize with Central (use visibility graphics or opened=No).

c. Do NOT use worksets like layers. Small projects can be accomplished with the two default worksets.

d. The two factors determining the number of worksets are scale of the project and the number of people working on the project.

e. Do NOT create a workset for annotation or notes.

2. Standard Worksets

All workset-enabled projects will have at least the default worksets Shared Levels and Grids and Workset 1. These are appropriate for small projects. As project complexity increases worksets are added from the following list. Projects may have other worksets, but are to use the workset names and general guidelines here before adding additional workset names.

a. **SHELL** – Shell elements as the term is used in tenant improvements: Floors, Roof, Exterior walls, and shaft walls not part of core (exterior/ perimeter stairs).

b. **CORE** – Core elements to the building, elevator shafts, stairs, etc.

c. **FFE** – Furniture, Fixtures, and Equipment

d. **LANDSCAPE** – This workset allows the landscape designer to isolate their model work.

e. **LINKED DRAWINGS** – This workset will appear in most workset enabled files. This workset will be created OFF by default in all views. This is never set as the active workset. Link a DWG to all views, and then change its property to assign it to this workset.

f. **LRA/LRS etc.** – Linked Revit Files. Create one workset per linked Revit model. These worksets will appear in ALL workset files where another Revit file is linked allowing users to use visibility graphics to turn off a linked Revit model or use the worksets.

i. Simple: LR <Discipline> such as LRA for Linked Revit Architecture, LRS for structure etc.

ii. Complex: LR <Discipline> <Name> for projects where discipline models are broken into parts.

g. **INTERIORS** – Walls, doors windows and other building components interior to the shell not included in the core or FFE worksets. This is

only needed for very large projects or if TI is not used.

h. **TI <name>** – Used only in projects where the model contains both the shell building as well as multiple tenant improvements in the same model.

7.3.6.14. DESIGN OPTIONS

Design Options allow the creation of studies of multiple alternates within the Revit file. All design options must be purged or incorporated into the model prior to submission to the Authority.

1. Design Options Best Practices

    a. Create a null design option where no work is performed and keep it as the Primary design option. Create as many new views as are needed to present the different design options but leave the primary option untouched so work can continue while the decision is under consideration. Design Options are limited to area-specific modifications for wholesale building changes, use Save As. Design Options are meant to be used for short term decisions which are cleaned from the project by "accepting Primary" which deletes the unaccepted options. Limit the use of rooms in design options to avoid additional processor time spent on detecting room option conflicts. Preserve design options only as long as they are useful to the project. Consider whether options should be preserved long term in separate models which can be linked as needed. Unless specifically requested by the APM, design options should be eliminated from the model file prior to submittal to the Authority.

7.3.6.15. LINKS AND LINKING REFERENCES

This section outlines some rules for linking AutoCAD drawings for the intent of coordination (particularly site Civil 3D models).

1. General Rule in Linking AutoCAD Files

    a. Linking

        i. Clean and purge the drawing prior to use in Revit;

        ii. Limit the number and duration of DWG files in Revit;

        iii. Bring the DWG in as a link for reference then remove the link when you are through with it; and

        iv. Import the DWG into a single view then delete it when you are through with it. Do not leave imported DWG files in the Revit

models. Delete all imported layer styles and types left over from imported content.

b. Colors: Inverse, Preserve, Black and White

i. To convey to everyone on the project, know the intended purpose of a drawing in the Revit file. A rule of thumb that helps out in working with dwgs:

a) Use Preserve Color setting for Reference-only drawings

b) Use the Black and White setting for drawings that will be placed in views and plotted (civil, survey).

2. Link vs. Import

a. Link

i. Always "LINK" AutoCAD files into Revit. The exception might be creating Revit versions of standard details. This should be done in a separate project file and the resulting drafting view should be added to a project or project template afterward to avoid polluting the Revit environment with undesirable ACAD line styles, line patterns, fill pattern, object styles or text styles.

b. Do Not Import

i. NEVER "IMPORT" AutoCAD files into Revit. Doing so makes it much harder to remove them later. Revit will copy the vector data in these files regardless of whether the file is linked or imported.

3. Don't Explode

a. NEVER EXPLODE an IMPORTED AutoCAD file. Doing so will pollute your Revit project with unwanted ACAD line styles, line patterns, fill pattern, object styles or text styles.

4. All Views or Current View Only

a. The answer to this is: it depends. In a non-workset file, the answer is always current view only except when you are using a civil file to generate topography in which case you MUST link to all views.

b. In a worksharing enabled file:

i. If you have a drawing that is only needed in a single view for reference, then link to current view only. In this case the drawing will be treated as if it is annotation and will belong to the workset of the view. If you have a .dwg that must appear in many views (large floor plate,

several people referencing same drawing in many views), link to all views on workset that is off by default in all views. Place All DWG Links on Separate Workset (DWGS Linked to all views). Depending on the complexity of the DWG in use, this could be one workset or several per drawing file. This workset when created should be set to off by default in all views.

5. Limit Size to Fewer Than 5 Mbs.

    a. Large DWGs will slow down Revit performance. If needed, break up ACAD files into smaller drawings. An example might be a drawing with floor plan and ceiling plan in the same drawing with layers control. Wblock out the floor plan (no hatches) switch layers and Wblock out the ceiling plan (no hatches). Divide into area plans if necessary.

6. Linking Revit Models

    a. General Rules

        i. One Workset per Revit File

        ii. Put Each Revit linked Model on Separate Workset.

        iii. Use VG to turn on or off workset per view.

        or

        iv. Use workset dialog box to make workset NOT OPENED. Whether this workset is on or off by default in all views is a judgment call per file.

    b. Multi and Split Building General Rules

        Each project will have unique challenges. These are very general rules only for projects with multiple building files.

        i. This is true if there are:

            a) Multiple buildings

            b) A single building split into wings

            c) A single building split vertically (podium, tower)

        ii. Master File/Site

        Any project with multiple buildings requires a master file. This will often be the site Revit file. This file will commonly contain:

            a) Shared Coordinates - The master file will control shared coordinates and relationships between buildings.

b) All Building RVT files are linked into this file.

c) Spanning Views

All views which need to see more than one building are held in the master file.

iii. Buildings Linked into Buildings

a) Only Link all buildings into the site model. NOT into each other.

b) Plan your sheets for a campus building not to depend on the adjacent buildings showing up in the printed sheets. Having to maintain a building model linked into another building model will slow performance noticeably. Keep connector elements as separate RVT files that may be linked into each larger building as needed.

iv. LINKS AND SHEETS

a) Each building will have its own sheets and also require sheets in the master or site files. Prepare for this. You cannot number sheets the same. Site cannot hold sheet A110.2 for building 1 and A110.2 for building 2.

v. Temporary Referencing

a) If you need to link in another building for reference, remove the link before you save to central. Link changes saved to central by one person are propagated to all other users when they save to central.

7.3.6.16. HANDOFF OF SSI MODELS AND INFORMATION

This section is created to provide an introduction to SSI collaboration and serve as the record and overview of the Authority's SSI collaboration expectation, process and organizational structure for Authority staff and Consultants.

This section provides an understanding of the terminology and processes employed by the Authority to collaborate, design and document SSI data in a BIM environment.

1. SSI Organizational BIM Strategy for the Authority

   This overview provides a summary of the overall strategy of SSI BIM integration/collaboration at the Airport. It is to be used in conjunction with the BXP, and as a reference document for the internal departments involved in the transition and use of SSI BIM at the

Airport. Understanding the sensitive nature of SSI and the need to maintain security over SSI data, the files that contain the data and the folders that contain the files, as well as certain limitations in the Revit environment that require intermediate steps to maintain secure collaboration of SSI equipment data in the BIM environment,

The Authority has put in place workflows and processes to maintain a distinct separation of, and secure access to, SSI data.

2. Starting an Authority SSI Revit Project File

   This section outlines the process for starting a new SSI Revit Project file using the Authority's Revit MEP template. The workflow for creating a new SSI file is similar to starting any Authority project, and can be organized into (3) main groups of tasks.

3. SSI BIM Collaboration – Illustrated Sequence of Steps. Refer to Figure 7.3.z.

   a. Creating Link & Discipline Specific Worksets

      i. In Revit MEP, go to Collaborate>Worksets

      ii. Create Arch Design & SSI specific worksets

   b. Linking Arch Design Model / Pin Link / Room Bounding / Assign to Workset

Create Project from Template	Early Project Tasks	Start the Building Model
Create Link and Discipline Specific Worksets Establish Origin/Shared Coords. Link in Arch Design Model Turn on Room Bounding in Arch Design Link Type Properties Pin Architectural Design Link	Create/Coordinate Levels Views w/ Architectural Design Link Set up Appropriate SSI Levels and Views Create/Load SSI Specific Project/Shared Parameters	Copy/Monitor Appropriate Security Devices Apply SSI Coordination View Templates & Filters Create & Set up Space/ Embedded Security Device Schedule

Figure 7.3.z.: SSI BIM Collaboration

i. In Revit MEP, go to Insert>Link Revit. In the dialog, select the appropriate Arch Design model, and check Positioning Auto - Origin to Origin.

ii. Acquire Shared Coordinates from the Arch Design Link File

iii. In the Drawing Area, select the Arch Design Link. Check Pin Tool On from the Modify| RVT Links tab.

iv. In the Drawing Area, with the Arch Design Link selected, check Room Bounding from the link Type Properties

v. With the Arch Design Link selected, assign to appropriate Workset in the link Type Properties

c. Copy/Monitor SSI Devices

i. On Collaborate>Coordinate select Coordination Settings

ii. Specify Allow Batch Copy and Copy Original for Behavior of Security Devices and any other category of applicable device/ fixtures.

iii. On Collaborate>Copy/Monitor, pick Select Link and choose the Arch Design link.

iv. Select Copy/ Monitor>Tools>Batch Copy

v. Select Copy the Fixtures from the dialog and Finish the Batch Copy tool.

7.3.7. CIVIL 3D STANDARDS

7.3.7.1. CIVIL 3D DELIVERABLE REQUIREMENTS

1. In Profile Views do not use a clipped grid.

2. For Pipes in Profiles use the boundary option rather than the model option

3. Label Styles - create a No Label style to give you the option of turning off labels without deleting the label

4. For Point Label Styles put all text components in a single component instead of separate components.

5. File naming must conform to standard drawing naming convention as specified in Section 7.4.

7.3.7.2. SURFACE DATA

1. TINs are more memory intensive than DEM

2. Use external ASCII point files rather than point objects in the drawing

3. Create a surface snapshot after sampling the point file. The file size

increases but the rebuild times improve.

4. Adding contour data - Understand the settings for Minimizing Flat Areas

5. Avoid Surface Editing - filling gaps and adding points is much faster than swapping edges. Plus you have no evidence for what has been altered.

6. Minimize points used to create surfaces

7. Surface Simplification is an Editing tool which decimates points without affecting accuracy

8. Create a grid surface if you do not need the precision of a TIN Surface. You can grid a surface by exporting it to a DEM.

9. Display of triangles and contours can slow down the display. Minimize displayed data when appropriate

10. Use an outer boundary to reduce data processed in the surface.

11. Use Data Clipping instead of Masking the surface

12. Cropped Surfaces are linked to a parent surface but process a smaller portion of the data

13. Query GIS Data to create a surface

7.3.7.3. CORRIDOR DESIGN

1. In Subassembly styles use solid fills instead of hatch patterns.

2. Turn off Rebuild Automatic

3. Isolate Regions so you are not processing the entire corridor

4. Reduce Cross Sections in the corridor drawing during preliminary design

5. Xref the corridor into a separate drawing and sample sections in that drawing. Use a data shortcut for the alignment.

7.3.7.4. CIVIL 3D BEST PRACTICES

1. Layoutregenctl is best set to 1

2. Proxy Graphics should be turned off until you are ready to share your drawing with other non-Civil 3D users

3. Turn off Tool Tips and Event Viewer if not needed

    a. Data Management Methods

        i. Using 1 drawing is best suited for small projects.

        ii. Using Data Shortcuts is best for sharing data across multiple drawings.

        iii. Using Data Management Server applies the same principals as

Data Shortcuts but has the requirement of a Server Component that may be undesirable for teams without adequate IT support.

b. Civil 3D Labels and Block Attributes

i. Automatic labeling capabilities are found throughout Civil 3D Label Styles control the behavior and content of these labels. Civil 3D Label Styles and Settings are located under the Settings Tab within the Toolspace palette. All AEC Objects and blocks used must have Block attributes. The Block attribute will be equivalent to the unique Mark that defines the object, network, or element. Refer to Figure 7.3.aa.

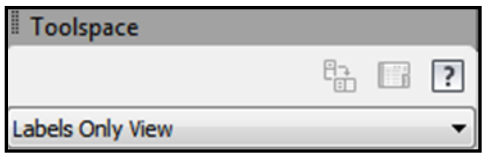

Figure 7.3.aa.: Toolspace

ii. To view a list of just label styles choose the drop-down list on the Settings tab of the Toolspace and select Labels Only View.

iii. Consultants must use the current approved version of AutoCAD Civil 3D for deliverables.

c. Stationing

i. Stationing shall be indicated in relation to the scale as follows:

Scale	Station at
1" = 50'	Each 100 ft
1" = 100' or greater	Each 500 ft.

ii. The station shall be identified by a tick mark 1/8" long. The numerals shall be 3/32" high. Station equalities shall be shown as a 1/8" open square. The equation shall be shown on a fine line drawn perpendicular to the stationed line.

d. Civil 3D Styles and Settings

i. The Civil 3D drawing template contains the pre-configured command settings and style definitions compliant with the Authority's CAD / Civil 3D Standard. Begin all model files using this Civil 3D template.

e. Survey Descriptor Codes

i. The Civil 3D drawing template provided in this Standard contains the Description Key Set defining the Survey Descriptor Codes.

f. Trigger Points where Horizontal Data is pushed to GIS:

Design deliverable phases shall identify the following trigger points where Horizontal Data is pushed to GIS: Beginning with the Preliminary Design Phase, excluding the Bid Phase, and including the Record Documents services provided throughout the Construction Phase as specified in the contract documents. Additionally, GIS Data should be updated when new or revised data is captured during Operations & Maintenance.

i. Preliminary Design Phase

ii. Contract Documents Phase

iii. Construction Phase

a) Record Documents

iv. Operations and Maintenance

7.3.8. QUALITY CONTROL

7.3.8.1. REVIT FILE QUALITY CONTROL

This section outlines the best practices which affect the health and/or organization of the project.

1. Use View Browser Organization

Use the view parameters and browser organizations to keep views orderly. It is expected that projects will have views that can be sorted and organized using the default browser organizations in the project.

2. Review and Fix Warnings (Daily Use)

Each user is responsible for maintaining the health of their models. Realize that some errors are more important than others. Revit maintains an internal list of warnings and can be a HUGE drain on performance. Keep your project warnings to a minimum. While it is the project BIM Lead's responsibility to track warnings, it is the responsibility of the Consultant to keep these numbers down.

a. Fix Warnings: Select BY ID. Often times it is difficult to see what element is causing a warning.

i. Export the warning report then enter a 3D view.

ii. Open the report with word or excel.

iii. Use copy and paste to get the id in the report into the tool found in Manage > Inquiry > Select by ID

iv. Once the item is selected, use temporary isolate to find it in the 3D view

b. Closing Files: The following process should be followed when closing a workset enabled file:

i. Open and maximize the project's closing view (drafting view or legend)

ii. Close hidden windows

iii. In the Synchronize with Central box:

a) Verify you are relinquishing all elements

b) Select "Save Local file before and after synchronizing with Central

iv. Close the Revit file.

3. BIM Manager Project Maintenance & Quality Assurance

Project Maintenance includes items to be completed by the Project BIM Leader or the most experienced Revit user on the project.

a. Review Warnings

i. Recommended time frame; weekly

ii. Prioritize a warning list and delegate the resolution of items to the team.

b. Remove Unused Families and Types

i. Remove unused families and types as needed and per development of model and prior to submittals.

c. Remove Unused Links

i. Recommended time frame; as needed and per development of model.

ii. CAD links of background and reference drawings should be reviewed. Remove unused background and reference drawing links.

d. Audit

i. Recommended time frame 1x per week.

e. Compact Central File

i. Compact the Central Files every couple weeks for small projects, weekly for larger projects. All users must save and exit their local projects while this is taking place and must create new local files once the compaction is complete.

f. Families

i. 2D in plan view, if possible, 3D if it makes sense

a) Develop 3D families only to 1/8" scale unless otherwise identified in the BXP.

ii. Family before Group

a) Use families first over groups. BIM Lead needs to use experience and judgment when determining family or group.

iii. Model Performance

a) Families that HOST are more memory intensive. Families that Cut Host are the MOST intensive. Parametric families are valuable, but use a lot of memory. Limit their use.

iv. Asset Data Parameters

a) Objects that are defined as Assets must have the proper data parameters associated and filled in per the SAN Asset Data spreadsheets (part of the Consultant Package).

v. 3D CAD Blocks

a) Do not use flat 2D CAD blocks. No exceptions. All blocks and/or AEC objects must contain a unique attribute feature called "Name" that will be used to link asset attributes and GIS attributes. Refer to BXP and SAN Assets.xlsx for further description.

g. Constraints

i. Constraints are memory intensive and are best avoided. Constrain to layout, but then remove the constraint. All of the following should either be used and deleted, or not used at all.

a) Dimension EQ: Any dimension that is equalized adds a constraint. This is a very useful tool in design and when laying out components. Remove constraint when done. It is acceptable to use on grids and levels.

b) Align & Lock : Align is fine, be cautious with align and lock.

c) Dimension Lock: This constraint is very useful in conceptual design and when building the initial building model. Unlock when you are done with the relationship.

4. Reviewing Project Views

   Review samples provided by templates. Delete those that will not be used by the project.

   a. Legends

      i. As part of a general project setup, the views provided by the Authority's templates should be reviewed, delete unnecessary views and modify the remaining views based on the needs of the project.

   b. Schedules

      i. Add/delete as needed for your project, Keep in mind that some schedules may not be used for several months.

   c. Plan Views

      i. Add/delete as needed. If creating a project which will issue both design views and construction documentation views, do not delete the Production plans because you do not need them now. Leave them in the browser organization which does not display them.

5. Complete Project Information

   The Project Information contains parameters used by all title blocks.

   a. Fill Out Project Information

      i. The data held in Project Information will populate areas of the title block on all sheets. Verify this information is included in the proper locations within the titleblocks/sheets. Access this information via Manage>Project Information.

      ii. The group of parameters at the upper area of Project Information controls the consultant name and address for all title blocks and cover sheets. The other engineer/ consultant information is used to fill in the cover sheet's title blocks.

   b. Project Location

      i. Manage>Project Location Panel>Location

      ii. This dialog box has three tabs. The first [Location] should be set for the project location. The second tab [Weather] can be ignored, and the third tab [Site] is used by the shared coordinates and can be ignored for now.

6. Starting the Building Model

   Once the central and local files have been created the project is ready for

design. This can be with massing or areas for space studies or with walls and curtain walls. This section provides a general outline of how to get started.

7. Adjusting Number of Levels

   The SAN Architectural Template, provided as part of the Consultant package, includes predefined levels that may be adjusted or deleted to suit the project needs.

8. Locating the Building Model

   When creating a model, you will need to know its orientation (Project North Vs True North) and where origin 0, 0 should be in reference to the building. Keep in mind Revit can have two origin 0, 0's. One for the project and one for the shared coordinates (usually the site 0, 0, survey or civil 0, 0).

   Generally, project 0, 0 will be at the lower left corner of the building. This is a common industry convention, not a standard. If the team wants all CAD drawings exported from the model with 0, 0 at the survey point 3 miles to the south by southeast, use the shared coordinates for that point. Do not draw the building 3 miles from the project 0, 0 point. Moving and rotating a developed model is not easy. Refer to Figure 7.3.bb. and 7.3.cc.

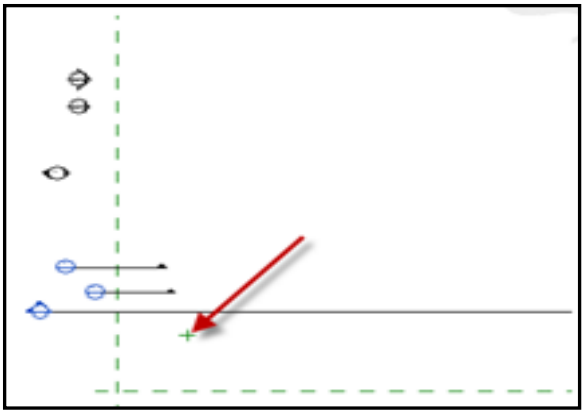

Figure 7.3.bb.: Locating the Building Model

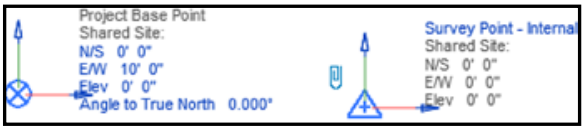

Figure 7.3.cc.: Locating the Building Model

   a. Revit Origin and Project 0, 0

      i. A Revit project started from any of the Authority's templates has two reference planes at the lower left corner of the plan views. These two reference planes are the Project 0, 0.

   b. Layout the Building or Site

      i. Layout the building as it will appear on the greatest number of sheets (project north). For landscape or site plans (separate Revit models), layout the project with true north up for graphic presentation. All models will be generated in real world coordinates and reflect

accurate geospatial world placement.

9. Saving and Closing Projects

Closing and saving projects needs to follow a set sequence of commands.

a. Standard Closing Workset Files Procedure

i. Prior to closing your project:

a) Fully open the Open/Save drafting view or legend for your project.

b) Close Hidden Windows

c) Reload Latest

d) Synchronize with Central (use the option to save before and after synchronize)

e) Close the project

7.3.8.2. CIVIL 3D FILE QUALITY CONTROL

Each Consultant generating model content must maintain an established review process to determine and report the quality and compliance levels of project data. Each BIM team member is also responsible for having a management plan for quality control.

Visual inspection through examining the models/surfaces using 3D perspective views and orbits. The Z (elevation) can sometimes be exaggerated during these operations to show discontinuity in the surfaces where problems might exist.

Visual inspection through examining the models/surfaces using drive through and fly through view manipulations and animations. Other simulation techniques can be employed also.

Visual inspection of the model using Virtual Reality or Augmented Reality to fly through and view the model in a simulated reality.

Contouring the surface models and examining the resulting contours.

Surface display by means of rendered/ stylized surfaces (and solids). In some software these views can be thematically colored and or shaded, indicating slope or elevation change.

Cross Section and Profile extraction – Do these extractions corroborate the contract plans? Equally, are plan sections and profiles contemporary with the model?

“Rain Drop” analysis to see where water distributed over a surface would flow or accumulate if the surface were treated as if it were impervious and perfectly smooth.

Representing elements in either wire-frame or as solid bodies, where they can be examined for conflict or “interference”

relative to neighboring or crossing elements.

Use of temporary dimensioning and labels to test the model's elements for appropriate length, elevation, slope, etcetera.

Visualization can be embellished with applications of various rendering materials, lighting, and shading.

Visual inspection and earthwork quantity corroboration using Trimble Business Center or equivalent construction software.

OVERKILL (command) – Removes duplicate geometry as well as overlapping lines, arcs, and polylines. Also, combines partially overlapping or contiguous ones.

7.3.9. PROJECT CLOSE-OUT

The Consultant must update their respective models with contractor recorded changes (Record Documents). Republish record documents in paper and PDF formats as defined in the executed contract.

In addition to any submissions required per the Authority's professional services contract the Consultant will submit:

1. Contractor's As-Built Models
2. FM / GIS Data spreadsheets
3. A reconciled record design model
4. A facilities model
5. Standalone SSI model
6. Exported CAD sheet files for GIS consumption.
7. Exported CAD Content to reflect Model content for GIS consumption

7.3.9.1. RECORD DESIGN MODELS

All Record models must be submitted in the native authoring file format (i.e. .rvt and Civil3D.dwg).

The Record Model submitted to the Authority must be cleaned of extraneous "scrap" or "working space" views, stories, abandoned designs, object creation and testing places, and other content which is typically produced in BIM production.

7.3.9.2. RECONCILED RECORD DESIGN MODELS

The Consultant must submit a plan to the Authority for review, prior to the start of construction, that outlines the process for reconciling the Record Design Models with the contractor's As-Built Models. Upon approved completion of these processes, the Design Model becomes the Record Design Model for final submittal.

7.3.9.3. FACILITIES MODELS

1. A facilities model must be submitted in either .dwg or .rvt format with all required Asset Data filled in.
2. The Facilities BIM submitted to the Authority must be cleaned of extraneous "scrap" or "working space" views, stories, abandoned designs, object creation and testing places, and other content which is typically produced in BIM production.
3. All sheets must be removed from these models.
4. All plan, section, elevation, detail and drafting views except for the facilities plan views of each level must be removed from these models.
5. All schedules and legends must be removed from these models.

7.4. DRAWING STANDARDS

7.4.1. DRAWING GENERAL REQUIREMENTS

The minimum Level of Completion drawing requirements shall include:

1. Cover sheet
2. Site plan showing limits of work, bench marks, and horizontal survey control including elevations and descriptions
3. Notes giving the basic design data, assumed loads, allowable stresses, design references, and requirements
4. ADA / Title 24 notes and project requirements
5. Plans, elevations, details, schematics, and all essential dimensions
6. Log of soil borings (if part of project)
7. Traffic control plans (as necessary)
8. Stormwater Pollution Prevention Control Plan (where required)

7.4.1.1. DRAWING NAMING CONVENTION / ORDER OF DRAWINGS

Consultant shall use the order and symbols shown in Figure 7.4.a. when naming each type of drawing.

Type of Drawing	Symbol
Cover Sheet, Site Plan & Index Sheet	G
Demolition Sheets	D
Civil	C
Structural	S
Architectural	A
Mechanical	M
Electrical	E
Plumbing	P
Fire Alarm	FA
Fire Protection	FP
Graphic & Signage	GS
Baggage Handling	BH
Special Systems Demolition	SSD
Special Systems	SS

Figure 7.4.a.: Drawing Order and Symbols

7.4.1.1.1. TITLE SHEET

The minimum Level of Completion cover sheet shall include:

1. Project Title
2. Vicinity Map
3. Airport Site Plan
4. Project Site Location
5. Project Address / APN
6. Contact Information / Address : Owner
7. Contact Information A&E and Consultants
8. Current Codes / Ordinances / Regulations
9. ADA Compliances Statement
10. Scope of Work Statement
11. Project Occupancy / Type of Construction / Floor area / Height/ Occupant Load
12. Coastal Commission Permit No.
13. DSD Liaison Contact Information
14. The words "San Diego County Regional Airport Authority" printed in large bold letters.
15. Authority's Seal
16. The drawing number

Refer to Figure 7.4.b

The Authority will provide CAD files for the title blocks. There are only two acceptable sheet sizes: 24" x 36" and 30" x 42". Only one sheet size shall be used for the entire drawing set, unless otherwise directed or approved by the APM. The Authority will provide the Consultant with appropriate AutoCAD File for the Cover Sheet layout, which will include Vicinity and Location Maps. Also, the AutoCAD base file for all other sheets will be provided to the Consultant. The Drawing number, Specification number and Work Order number will also be provided. The Consultant should recommend the

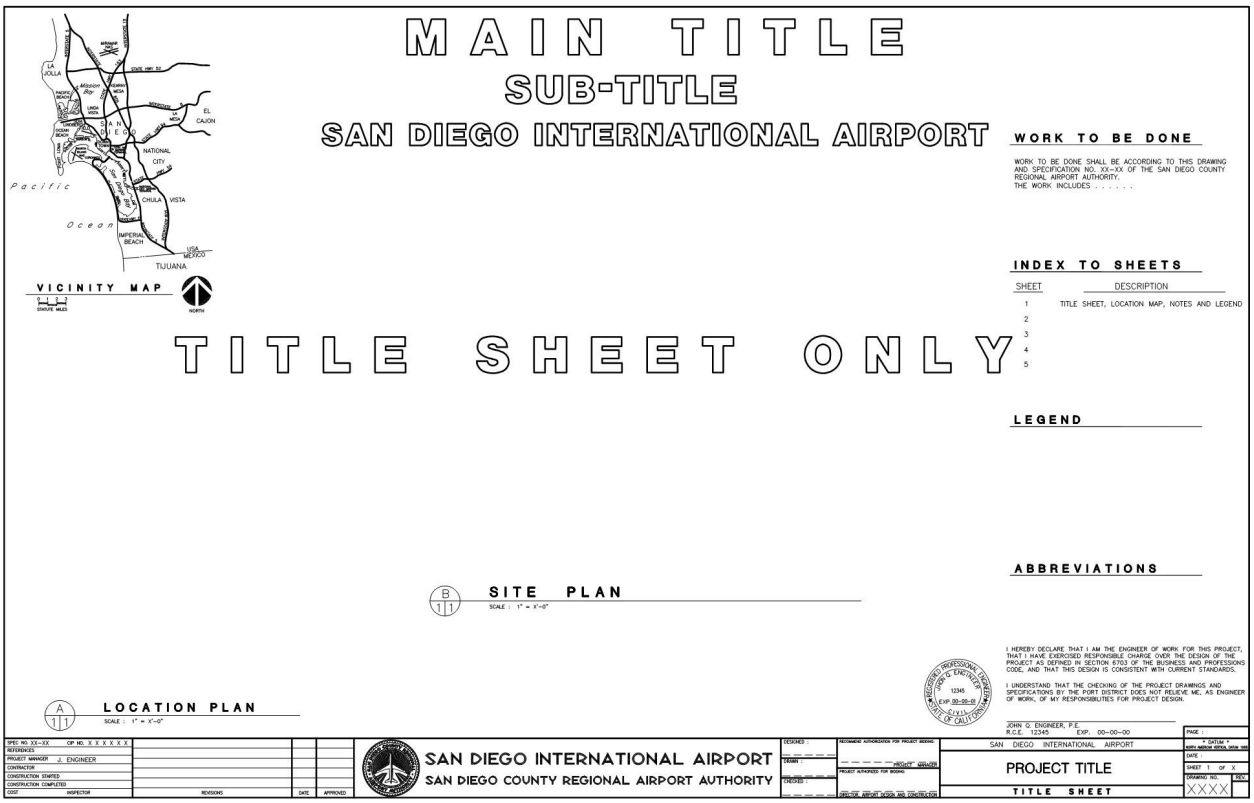

Figure 7.4.b.: Title Sheet

appropriate sheet size and the APM should recommend the appropriate "Signature Block" depending on the Airport Design and Construction personnel signing the drawings.

7.4.1.1.2. SITE PLAN

A site plan shall be included with all drawing sets. The site plan shall be drawn using the largest scale possible. All new work shall be located by coordinates or by dimensions from prominent existing structures. The site plan shall clearly distinguish new facilities from existing facilities and shall indicate, as applicable:

1. Building locations
2. Major equipment locations
3. Primary utility locations
4. Access roads including Contractor's access route
5. Contractor's storage and stockpile areas
6. Location for Contractor parking
7. Sidewalks
8. Finished floor elevations
9. Survey control, including complete horizontal and vertical survey control, identifiable on the ground, with sufficient ties to the new construction to permit stake out
10. Benchmarks including descriptions and elevation

7.4.1.1.3. DESIGN INFORMATION

As applicable, the following design information shall be shown on the drawings:

1. Loadings-roof and floor live loads (vertical and horizontal) and wind loads
2. Seismic Zone 4
3. California Building Code Occupancy Classification
4. California Building Code Type of Construction Classification
5. Soil data including allowable soil pressure for spread footings and allowable bearing or friction values for piles.
6. List of hazardous materials to be used in project.
7. California Building Code required special inspections and special observations.

7.4.1.1.4. EXISTING, DEMOLITION, AND DESIGN DRAWINGS:

The drawings shall clearly differentiate between existing, demolished, and new construction.

1. Consultant shall verify existing data and clearly note on the drawing.

2. Demolished items shall be separated from the existing facilities. They shall be moved to a new separate drawing designated Demolition per discipline, for instance, Demo-Electrical, Demo-Mechanical, Demo-Architectural, etc. In addition, the extent of each demolished item shall be clearly defined. Within the drawing, demolished items are to be placed on separate layers within the AutoCAD file. For example, for water discipline there should be a separate layer for each item: Demo-Water_Pipe, Demo-Water_Valve, etc.

3. The design file naming convention shall conform to the applicable discipline (e.g., structural, architectural). Within the drawing, new items are to be placed on separate layers within the AutoCAD file. For instance, for water discipline there should be a separate layer for each item: New-Water_Pipe, New-Water_Valve, etc.

7.4.1.1.5. DRAWING FILE DIRECTORY STRUCTURE

All deliverables are to be delivered using the folder structure per Section 7.3.5.2.

7.4.1.1.6. DRAWING FILE NAMING CONVENTION

Drawings shall be named with the Authority's project number (four-digit) followed by three-digit reference number 4193-C02.dwg or (4193-C02.pdf), or sheet number 4193-008.dwg or (4193-008.pdf)3

Figure 7.4.e.: Drawing File Naming Convention

7.4.2. COORDINATE SYSTEMS

7.4.2.1. DRAWING SPATIAL REQUIREMENTS

Spatial compliance ensures the proper placement of features using coordinate system and units of measurement. All disciplines indicated in CAD drawings shall be spatially accurate and in the current datum and epoch.

7.4.2.2. HORIZONTAL DATA RELATIONSHIPS

The Consultant shall prepare their drawings using the North American Datum of 1983 (NAD 83), Zone VI, of the California Coordinate System (CCS83), Epoch 2010. Each drawing shall reference the horizontal

datum used. Consultant's drawings must relate the horizontal coordinates to one or more existing survey benchmarks from the table in Figure 7.4.f.

Historically, and most recently, Consultants performing work at the Airport have used the North American Datum of 1983, Epoch 1991.35 (NAD 83, 1991.35). As of 2015, the Authority adopted NAD 83, Epoch 2010 as the accepted Horizontal Datum. It is extremely important that the Consultants understand that the average difference between the two datums is approximately 2.513 feet. A graphic representation of the difference is shown in Figure 7.4.g.

The California State Plane Coordinates have been converted from Epoch 1991.35 to Epoch 2010 based on displaced values calculated from the National Geodetic Survey's Horizontal Time Dependent Positioning Toolkit. The Consultant is directed to Record of Survey Map No. 16668, recorded July 25, 2000 as File No. 2000-0390905, Record of Survey Map No. 17055, recorded June 29, 2001 as File No. 2001-0443551, filed in the Office of the County Recorder of San Diego County.

7.4.2.3. VERTICAL DATA RELATIONSHIP

The Consultant shall prepare drawings using North American Vertical Datum (NAVD) 88 as the vertical datum. Each drawing sheet shall reference the vertical datum used. Consultant's drawings must relate the elevations used in the design to one or more existing survey benchmarks.

Figure 7.4.h. and Figure 7.4.i. are a comparison of Authority vertical datum relationships:

CCS NAD 83 EPOCH 2010			
Survey Benchmark	Northing*	Easting*	Description
SDUPD-006	1847204.981	6268147.445	3" Brass Disk
SDUPD-007	1846335.344	6271653.589	3" Brass Disk
SDUPD-008	1849871.186	6273163.504	3" Brass Disk
SDUPD-009	1848347.863	6276488.294	3" Brass Disk
SDUPD-010	1845666.054	6275691.16	3" Brass Disk
SDUPD-036	1846494.234	6269522.573	3" Brass Disk
SDUPD-038	1846382.479	6273296.621	3" Brass Disk
SDUPD-039	1850668.442	6274354.975	3" Brass Disk
SDUPD-040	1846500.829	6277518.046	3" Brass Disk
SDUPD-058	1847698.796	6275441.203	3" Brass Disk
SDUPD-059	1847587.615	6272151.236	3" Brass Disk
SDUPD-060	1848656.021	6267997.232	3" Brass Disk

Figure 7.4.f.: Survey Benchmarks

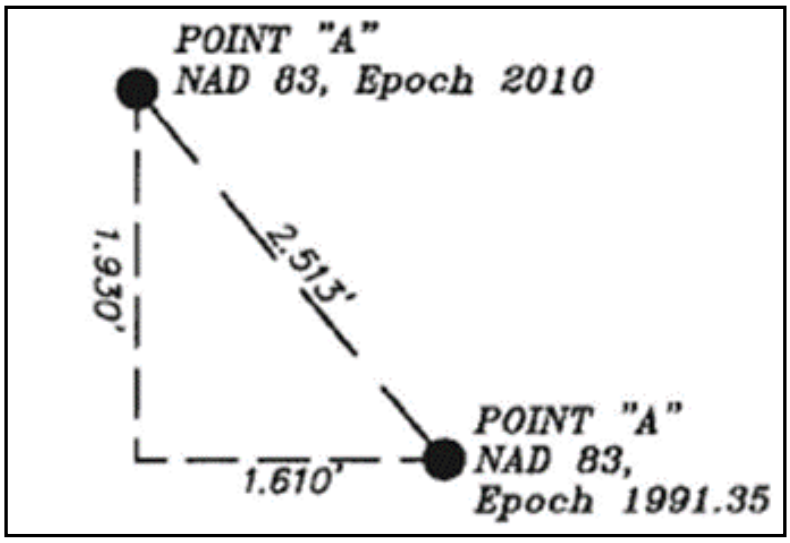

Figure 7.4.g.: Relationship between NAD 83, Epoch 1991.35 & NAD 83, Epoch 2010

Elevation	Datum	Usage
Elev. 13.17	MLLW Unadjusted	Airport historical construction drawings*
Elev. 12.88	MLLW Adjusted	Port of San Diego outside the Airport
Elev. 12.13	NAVD 88	Current Airport Layout Plan / Airport GIS aerial base map
Elev. 10.00	MSL Adjusted	Historical Airport Layout Plans

Figure 7.4.h.: Authority Vertical Datum Relationship

Legend		
MLLW	Mean Lower Low Water	Originated from NGVD 29; Used by the Port of San Diego, Army Corps, and Tide Charts.
MSL	Mean Sea Level	Originated from NGVD 29; Used by the City of San Diego, and the FAA
NGVD 29	National Geodetic Vertical Datum of 1929, AKA, Sea Level Datum of 1929	This is a fixed datum adopted in 1929 as a national standard reference for heights. Numerous adjustments have been made since originally established in 1929.
NAVD 88	North American Vertical Datum of 1988	At the Airport, the Consultant shall prepare their drawings using the North American Vertical Datum of 1988 (NAVD 88). The Consultant is directed to Record of Survey Map No. 16668, recorded July 25, 2000 as File No. 2000-390905, Record of Survey Map No. 17055, recorded June 29, 2001, as File No. 2001-0443551, filed in the Office of the County Recorder of San Diego County. The Consultant is also directed to the Authority's Vertical Control Plan, Sheet 2 of 2, on file in the Airport Design and Construction Department.
Adjusted, Unadjusted	Sea Level Datum	MSL and MLLW are adjustable datum's and should not be confused with fixed national datum's of NGVD 29 and NAVD 88. MSL and MLLW have been adjusted over the years to reflect the rising sea level.

Figure 7.4.i.: Legend

*Many of the projects associated with the original construction of Terminal 2 West, including the redesigned roadways, overpasses, and parking lots were designed using the ADJUSTED MLLW datum, even though Terminal 2 West drawings were based on UNADJUSTED MLLW. Also, many of the prior paving projects in the AOA areas were done using the UNADJUSTED MLLW datum.

7.4.3. DRAWING REQUIREMENTS

7.4.3.1. TEXT STYLES

Lettering styles for digital submittals are RomanS and RomanD.

1. RomanS: Is the default text for all work including notes, dimensions and callouts and the minimum height is 0.1".
2. RomanD: shall be used for notes and titles

7.4.3.2. SCALES

Located directly under the title of each plan, elevation, section, detail, etc., shall be the scale of the object drawing. Engineering scales shall be used for engineering drawings. Architectural scales shall be used for architectural drawings. The use of architectural or engineering scales shall be consistent with industry standards.

Graphic scales shall be placed near the title block on each sheet and on the lower left-hand corner. Graphic scales shall include every scale used on the sheet. Refer to Figure 7.4.j.

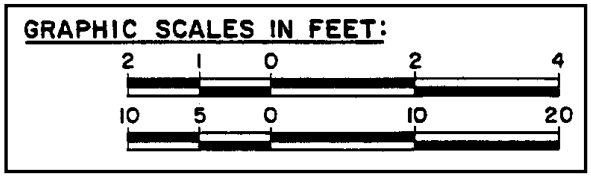

Figure 7.4.j.: Graphic Scale

7.4.3.3. NORTH ARROW

The North Arrow shall be simple and without any adornments. Whenever possible, the North Arrow shall point upwards to the top of the sheet. Refer to Figure 7.4.k.

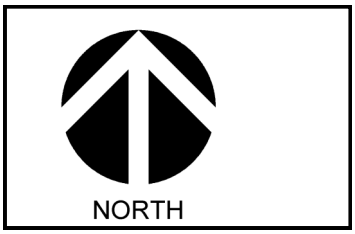

Figure 7.4.k.: North Arrow

7.4.3.4. LINETYPES

The Authority recommends the use of AutoCAD default linetypes.

7.4.3.5. TITLE BLOCKS

Title block layouts to be used are illustrated below. Each section will be defined in greater detail in the sections that follow. Refer to Figure 7.4.l.

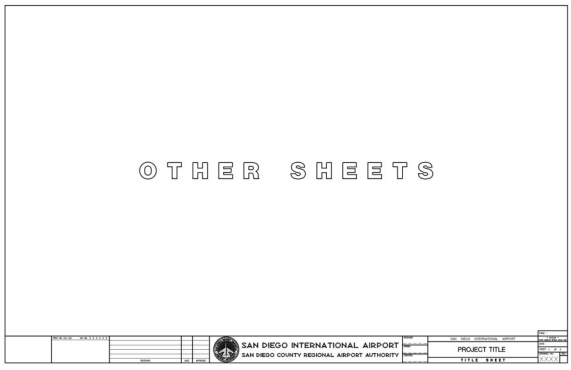

Figure 7.4.l.: Title Block

7.4.3.6. DRAWING NUMBERS

The Drawing number, Specification number and Work Order number issued for a project shall appear on each drawing, as shown below. Lettering size and type for digital submittals is defined within the CAD Sheet Template. Refer to Figure 7.4.m.

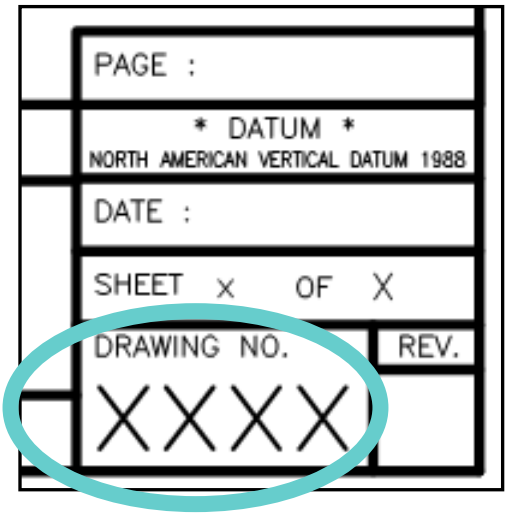

Figure 7.4.m.: Drawing Numbers

7.4.3.7. SHEET AND REFERENCE NUMBERS

Sheets shall be numbered in the space provided in the title block, i.e., “Sheet 1 of 23”, etc. The Consultant shall use “A-01”, “M-06”, etc. reference numbers for architectural, mechanical, etc. drawings and shall place them in the “Page” field above “Datum” in the title block, Refer to Figure 7.4.n.

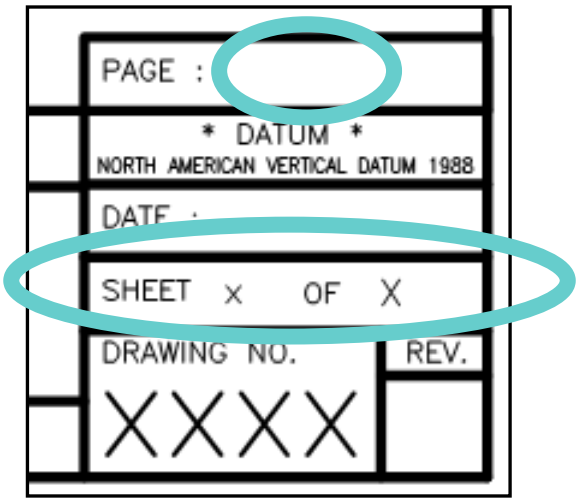

Figure 7.4.n.: Sheet and Reference Numbers

7.4.3.8. SECTION/DETAIL IDENTIFICATION

The section or detail identification circles shall be 7/8" in diameter. The circle on which the section or detail is shown shall be 1/2" in diameter. These sizes are for full size drawings (“D” or “E” size). For smaller size drawings, the circles should be reduced proportionally; suggested size is 9/16" for section or detail identification and 7/16" size for section or detail location. Section identification shall be identified as shown in Figure 7.4.o.

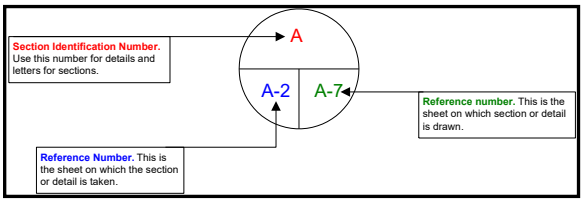

Figure 7.4.o.: Section/Detail Identification

7.4.3.9. DRAWING SYMBOLS

In producing drawings, common geometric figures may be used to simplify the number of call outs or when items are typical, or used multiple times, or to identify items to be demolished, removed, protected in place, constructed, and so on. The symbols to be used are circles, ellipses, hexagons, squares, and diamonds. These symbols are shown, from left to right, in Figure 7.4.p.

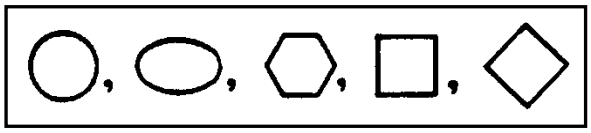

Figure 7.4.p.

These figures should be large enough to accommodate a letter or number for identification on the plans and a legend. The same symbol shall be used throughout the project to identify a particular item or condition. The triangle shall not be used; it is used to indicate revisions, addenda, or change orders.

7.4.3.10. DRAWING ORIENTATION

All drawings, sketches, plans, enlargements, reductions, insets, etc., shall be oriented with the north arrow pointing upward or to the right. All individual drawings within a sheet must be oriented in the same direction; the north arrow shall consistently point in the same direction.

7.4.3.11. KEY PLAN

All plans, for all disciplines, shall include a key plan to assist with the orientation of the plan in regards to the overall layout of the building.

7.4.3.12. DRAWING ADDENDA OR REVISIONS

If there are any changes or amendments to the set of plans after they have been distributed to the bidders, or the bid has been awarded, these changes shall be indicated by a "cloud" and the revisions shall be indicated by a number inscribed in a triangle. A brief description of the change along with the date and initials indicating approval shall be shown on the revision block. The number of the revision must also be shown, but without the triangle. If the change affects more than one sheet, the delta number of the change shall be the same on all sheets.

7.4.4. CAD SUBMITTAL REQUIREMENTS

7.4.4.1. QUALITY ASSURANCE

Deliverables shall be provided in a digital format that conforms to the standards specified in the Consultant's Package. The Consultant shall submit their internal quality control/review program and procedures to the APM prior to any QC reviews or submittals by the firm. This submittal shall outline how the firm will conduct its internal

QC review and provide cross-checking to assure comments have been incorporated into the deliverables. Consultant shall specifically address how proper and adequate QC reviews will be completed for design work done by its sub-Consultants or other third parties. The Consultant firm shall conduct QC reviews and provide assurance of QC review for each of the following submittals (unless otherwise directed by the APM, submittals outlined in Chapter 6 of this document) stages of the development of the project.

7.4.4.2. DRAWING SUBMITTAL FORMATTING

The Consultant shall deliver AutoCAD digital files that are in conformance with the applicable standards and the Consultant's Package. The Designer shall use the latest version of AutoCAD software approved for use by the Authority. The Authority will ultimately convert all Projects from CAD to the Authority's GIS database. Conforming to the Authority's CAD standards, drawing file naming and directory structure are crucial to this conversion.

1. The following procedures shall be performed for ALL submittals (outlined in Chapter 6 of this document): before files are placed on the deliverable digital media.

    a. Remove all extraneous graphics outside the border area and zoom to extent.

    b. The drawing files are named with the Authority's project number (four -digit) followed by the three-digit sheet number, see Section 7.4.1.1.6

    c. Design Submittals and Record Drawings shall be placed in a directory structure compatible with the Authority's structure (Refer to Figure 7.3.b.)

    d. All CAD drawings are spatially accurate and shall be in the current datum and epoch, See Section 7.4.2.

    e. Include all files, both graphic and text, required for the project (such as plotting tables, font files, user command files, Drawing File Index, Drawing/Layer Matrix). It is recommended to use AutoCAD E-Transmit functionality on the first design sheet of each discipline.

    f. The Consultant shall deliver PDF files that conform to the applicable standards. It is recommended that PDF creation takes place after all AutoCAD edits have been completed.

7.4.4.3. RECORD DRAWINGS PROCEDURE

The following drafting guidelines shall apply:

1. Transfer all "As-built" (field redlined) revisions to the Record Drawing set

with revision symbols (deltas), and Consultant shall transmit the signed record drawings, the construction As-Built (field red-lined) set, and the updated electronic files back to the APM.

2. Remove clouds, if any, from previous revisions, but not the revision symbols (deltas).

3. Work deleted by Change Order shall be enclosed in boxes marked: "N.I.C.".

4. In revision block use "Record Drawing" if there are no revisions and delta Δ "Record Drawing Revisions" for any revisions.

5. On first sheet only, complete block in lower left-hand corner to show Spec. no., Contractor's name, dates of contract, cost, and name of Inspector.

6. AutoCAD E-Transmit functionality on the first design sheet of each discipline.

The Consultant shall provide a signature in the record drawing revision block on all sheets. Refer to Figure 7.4.q.

7.4.4.4. RECORD DRAWING REQUEST

The Authority has developed a record drawing mapping application (Geographic Information System, or GIS) to assist Consultants with available information which is available upon request.

Item	Record Drawings
Record Drawings (CAD), All Sheet Signed and Stamped	X
Record Drawings (PDF), All Sheet Signed and Stamped	X
XREFs per Discipline	X
FAA Design Report (if applicable)	X

Figure: 7.4.q.: Record Drawings Requirements

7.4.4.5. CONSULTANT SIGNATURES AND CERTIFICATION OF DRAWINGS AND SPECIFICATIONS

The Prime Consultant shall have the drawing sheets and specifications signed and stamped by the State of California licensed architect or registered professional engineer who is the responsible person in charge of the project. The Consultant shall also have every cover sheet of each discipline, such as Civil, Mechanical, Structural, and Electrical, along with a specification certification sheet, stamped and signed by the responsible registered State of California professional engineer that is in responsible charge of that portion of the project.

CHAPTER 08:
CONSTRUCTION REQUIREMENTS

8.1. INTRODUCTION
8.2. PURPOSE

8.1. INTORDUCTION

The Authority is committed to the combined goal of safety, quality and productivity. The safety goal for every construction jobsite is "Ask Yourself, "What is at Stake?" - EVERYTHING." Practice Safety In All You Do. Your Loved Ones Rely On You.

Authority Management strives to promote a workplace environment in which individuals will be trained and motivated to work together for continuous improvement toward this safety goal.

Authority Management will set a personal example for safe behavior, show its commitment to safety, and enforce safe operations and job procedures. Practices to be implemented by the Contractor will include: setting safety goals; establishing and monitoring safety, accountability, and a discipline system; and planning for safety. Planning for safety includes: identifying job hazards in advance; setting priorities for safety along with productivity, quality and scheduling; and eliminating unsafe shortcuts of methods.

Authority Management recognizes training as a key element in reducing accidents. Authority Management will provide informal and formal training to all individuals on construction jobsite. This training includes, but is not limited to, training on: new equipment or work practices, non-routine or high hazard

operations, the proper use of personal protective equipment, and emergency procedures.

Authority Management also expects individuals to be responsible for his/her safety, as well as the safety of others. The first step in meeting this expectation is for individuals to read and follow all applicable safety regulations, including those in this Construction Safety Manual. The second step is for individuals to be aware of and eliminate his/her unsafe acts. The third step is for individuals to identify and eliminate unsafe conditions caused by his/her actions or the actions of others before the unsafe conditions cause accidents.

In closing, the safety practices and procedures outlined in this Construction Safety Manual are minimum standards and are not meant to be exhaustive of all safety requirements. If a situation arises that an individual deems unsafe for himself/herself or others, yet is not covered in the guidelines, the individual should bring the situation to the attention of his/her supervisor or Authority management. If the individual deems the situation to be immediately dangerous to life or health, the individual shall not continue to work, immediately call his/her supervisor or Authority Management, discuss with his/her supervisor or Authority Management and work to ensure appropriate actions are taken.

By working together Authority Management and individuals can control job hazards and reduce or eliminate accidents and injuries in the workplace. This joint effort will result in a safer environment for all involved.

8.1.2. PURPOSE

The purpose of Construction Safety Manual is to set forth the minimum standards that the Contractor's Site-Specific Safety Program / Injury and Illness Prevention Program (IIPP). must meet. This Construction Safety Manual is not intended as a substitute for the Contractor's Site-Specific Safety Program / IIPP and is not all –inclusive. The Contractor is responsible for; ensuring its Site-Specific Safety Program; and IIPP meets all applicable Federal,; State, and local requirements. Where a; conflict exists between this document and; referenced documents or between; referenced documents, the more stringent; requirement shall apply.

Public has access to the Construction Safety Manual for Airport Design & Construction Version 3.05 / January 2020 can be accessed at this link: https://www.san.org/Airport-Projects/ConstructionSafety-Manuals

Where a conflict exists between this document and referenced documents or between referenced documents, the more stringent requirement shall apply.

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CHAPTER 09:
IT AND SECURITY PERFORMANCE REQUIREMENTS

9.1. INTRODUCTION
9.2. BASIC COMMUNICATIONS REQUIREMENTS
9.3. COMMUNICATIONS SYSTEMS
9.4. STRUCTURED CABLING
9.5. DATA COMMUNICATIONS
9.6. VIDEO SURVEILLANCE
9.7 TELECOMMUNICATION SERVICES

9.1. INTRODUCTION

9.1.1. SCOPE

This Chapter provides design guidelines and requirements for designing infrastructure for Information Technology (IT) and Security Systems for the Authority. It is not the intent for this document to replace existing technical specification, more so, to allow technical specification to be written by utilizing these guidelines as a base.

The Consultants shall research and validate the current Basis of Design Manufacturers and Products for acceptability by the Authority prior to product submission, due to the frequent changes with technology.

1. Architects, engineers, planners, consultants, installers, tenants, and staff are among the intended audience.

To access the full IT and Security Performance requirements visit this link.

CHAPTER 10:
AVIATION SECURITY AND PUBLIC SAFETY

10.1. GENERAL AIRPORT SECURITY

10.1. GENERAL AIRPORT SECURITY

The Federal Government has established strict and detailed security requirements that all air carriers and airport operators must comply with to guard against terrorist acts and other threats to civil aviation security. Security regulations and requirements have been designed and implemented to prevent or deter unlawful acts against civil aviation. These regulations include prohibiting persons from gaining unauthorized access to an aircraft or to restricted areas of the airport (any area where aircraft operate or park, including: runways, taxiways, ramps, hangars, aprons and other aircraft parking areas). All activities of contractors, vendors, consultants and service providers must comply with these security regulations as they apply to their work at the Airport.

For further information on these policies visit this link.

CHAPTER 11:
AIRPORT OPERATIONAL SAFETY AND SECURITY REQUIREMENTS

11.1. INTRODUCTION

11.1. INTRODUCTION

11.1.1. PURPOSE

This chapter of the Design Standards and Construction Requirements has been prepared to:

1. Define standards and specify procedures for, and acceptable means of compliance with, Federal Aviation Regulations (FAR) governing operational safety on airports during construction. Said regulations may include, but are not limited to applicable provisions of FAR Part 139, construction safety measures described in FAA Advisory Circular (AC) 150/5370-2G, Operational Safety on Airports During Construction, and in the Airport's -Airport Certification Manual (SAN-ACM] and Airport Security Program (SAN-ASP);

2. Provide contractors, construction project sponsors, construction administrators and inspectors, and other persons associated with any construction activities at the Airport with guidelines by which the above mentioned regulatory requirements may be met; and

3. Support and facilitate construction activities while continuing to maintain the level of safety and security required for airport and aircraft operations.

11.1.2. APPLICABILITY

The requirements, standards, procedures set forth herein pertain to all construction projects occurring within the Airport's Air Operations Area (AOA) or its restricted areas as further defined below. They also apply to consultants, contractors, their subcontractors, suppliers, and all other persons under their control, who conduct any activities within the AOA or restricted areas of the Airport. For the purposes of this document, "construction" shall also include "maintenance" activities.

11.1.3. ADDITIONAL INFORMATION

Additional information or clarification regarding the above-mentioned standards and procedures may be obtained by contacting the Airport Office of the Director, Airside & Terminal Operations.

To access the entire document visit this link: https://www.san.org/Portals/0/Documents/Commercial%20Business/Operational_Safety_Security_Requirements.pdf?ver=2019-10-28-130636-190

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