Smithsonian

Smithsonian Design Standards

October 2021

VOLUME 1 – DESIGN GUIDELINES & TECHNICAL SECTIONS

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EWING COLE

VOLUME 1:

Design Guidelines & Technical

Section Design Guidelines:

Technical Sections:

VOLUME 2:

Smithsonian Specifications:

NOTE: * Contact Design Manager for Specification Section

VOLUME 3:

Appendices:

1. INTRODUCTION

Since its founding in 1846, the Smithsonian Institution (SI) has grown into the world's largest museum, education, and research complex. A long, rich history has led SI to a collection of many buildings and structures that support the SI mission. Encompassing 19 museums and the National Zoo, SI preserves the nation's heritage while discovering new knowledge to share with the world.

SI facilities represent a variety of structures and sites, with some museums and projects dating back more than 100 years and other new buildings and monuments constructed within the last decade. In addition, with millions of visitors to plan and prepare for, 21st century security concerns to address, and always-evolving technology to implement, SI architects, engineers, design teams, staff, consultants, and contractors face distinct issues and traditional goals in facilities planning, design, implementation, and maintenance.

This Smithsonian Design Standards (SDS) apply to all design, construction, maintenance, and repair projects at all SI facilities. These standards provide the criteria to follow and the methodology to use to help unify, supplement, and standardize the approaches for designing and equipping SI facilities. The SDS cover all aspects of planning and design. Project teams shall use these guidelines to the fullest extent possible when designing either new facilities or major renovations of SI owned or leased facilities to ensure the highest levels of safety, consistency, and professional standards. Design teams shall determine applicable standards by reviewing all divisions that will be included in their project specifications.

Although the SI is not an executive branch of the U.S. government, it is committed to the strategic objectives and goals of federal energy and environmental mandates, standards, and guidelines to the fullest extent practicable. The *Smithsonian Facilities (SF) Codes, Standards, and Guidelines*, latest edition, shall be referenced for relevant federal requirements. In addition, *Smithsonian Institution Sustainability Plans,* latest edition, shall be consulted for updated SI sustainability policies. These standards may require adapting to local codes and regional conditions for projects outside of the Mid-Atlantic U.S. Any deviation from these standards shall be submitted to the SI Office of Planning, Design, and Construction (OPDC), via the Contracting Officer's Technical Representative (COTR), also referred to as the SI Design Manager, for review and approval. The COTR will facilitate consultation with the required discipline as required.

The SI is committed to ensuring its landmark structures last the span of time, allowing all future generations to enjoy them. Several significant structures in the SI portfolio are over a century old and are expected to last many more. Quality and durability are of the utmost importance and must be considered in all stages of project development, from planning to product selection and throughout construction. Projects should consider both immediate and long-term facility needs and be designed in a manner that does not restrict future renovation projects.

The historical and cultural significance of SI structures and collections present particular security issues that can be addressed through various aspects of planning and design. The SDS provide design guidance for limiting or mitigating the risks associated with cultural property protection, common crime, terrorist attacks, and other manmade hazards.

In addition to security criteria established here, this document should be used along with the latest versions of the *Interagency Security Committee Risk Management Process for Federal Facilities.* Where conflicts occur, the design team will immediately notify the Office of Protection Services (OPS) through the SI COTR.

The rare and priceless collections in the SI museums and the importance of the buildings and operations mandate a higher level of fire protection and life safety than the minimum standards established by building and fire codes. The SDS build upon current codes, utilizing the latest recommended industry practices and specialized fire protection engineering experience to establish an appropriate level of fire protection and life safety for all SI facilities, collections, occupants, and operations. The SDS provide for the life safety of SI staff and visitors through measures that control fire growth and ensure adequate means for egress are available for safe evacuation. The SDS strive to achieve a level of protection from fire and products of combustion commensurate with the value of the property and operations being safeguarded. Special attention is given to the protection of collections against fire and smoke, as well as the potential deleterious effects of fire protection systems.

The fire safety solutions outlined in this guide provide a balanced approach to achieving the stated goals. They rely on numerous fire safety systems to achieve a total prevention and protection scheme while still considering the need for building functionality and design flexibility. Emphasis is on fire safety systems that are simple, reliable, long-lasting, maintenance-friendly, and cost-effective. While active fire systems are key to the success of the overall protection scheme, passive measures also play a significant role by minimizing the impact of a potential fire on occupants, collections, and facility operations.

These SDS will also be used in conjunction with the current existing historic preservation policy standards, accessibility standards, and the Architect/Engineer (A/E) Special Conditions for Services. The above standards may be obtained through coordination with the COTR.

In total, these SDS are intended to provide comprehensive guidance for SI building and renovation projects. The A/E must be familiar with what is outlined in this document and work in tandem with the COTR during design to ensure SI’s high standards are met.

2. ACKNOWLEDGEMENTS

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2. ABOUT THIS DOCUMENT

2.1. PURPOSE

2.1.1. The purpose of the Smithsonian Design Standards (SDS) is to provide consistent standards and criteria to guide all design, construction, maintenance, and repair projects for the facilities of the Smithsonian Institution (SI). It includes best practices, general criteria and design requirements, space-specific criteria, and prescriptive specifications.

2.1.2. This SDS manual defines the minimum-security criteria required by the Office of Protection Services (OPS) to ensure security is consistently applied and becomes an integral part of the planning, design, and construction of all SI projects. These criteria consider security in all building systems and elements with the objective of offering cost-effective design that provides the appropriate level of protection when constructed and implemented.

2.1.3. The SDS manual identifies the fire protection and life safety design criteria required by the Office of Safety Health and Environmental Management (OSHEM) for new facility designs, upgrades, and modifications to existing facilities and spaces. It provides requirements for protecting all SI occupants and for limiting SI property loss from fire.

2.2. APPLICABILITY

2.2.1 The SDS are applicable to new construction as well as all additions, alterations, and renovations at SI facilities, including but not limited to: museums, research centers, the National Zoological Park (NZP), Smithsonian Gardens, and all other SI organizations. The SDS apply to all facilities that house SI personnel, operations, or collections whether owned, leased, or occupied through any other agreement.

2.3. AUTHORITY

2.3.1 The Director of Smithsonian Facilities (SF) is the designated official to enforce and render interpretations of SI-adopted building codes, standards and guidelines for the planning, real estate management, design, and construction services for the SI, except for all matters relating to fire protection, life safety, environmental management, and general safety. The Director of the Office of Planning, Design, and Construction (OPDC) is charged with the selection of and compliance with appropriate codes and regulations to serve as minimum design standards for SI facilities. The

Director of OSHEM serves as the Authority Having Jurisdiction (AHJ) as defined and used in the national fire codes for all fire protection, life safety, environmental management, and general safety matters and is the designated SI Fire Marshall. These responsibilities include interpreting and enforcing codes, standards, and guidelines as prescribed in SI Directives 410 and 419. A copy of these SI Directives may be obtained through the COTR.

2.3.2 The OPS Director is responsible for ensuring the adequate protection of SI facilities and grounds. In carrying out these responsibilities, the OPS Director enforces and renders interpretations of the security-related standards in this document and is guided by the SI policing statute, 40 United States Code (U.S.C.) Sections 6301 et seq., and its implementing regulations at 36 Code of Federal Regulations (CFR) Part 504.

2.3.3 OSHEM is responsible for ensuring all SI facilities operate safe and healthy environments for employees, volunteers, and the visiting public and for ensuring protection of SI collections and property. OSHEM provides safety, occupational health, environmental management, and fire protection education, technical support, and consultation services to the SI community. It keeps SI management informed of applicable fire, safety, and environmental management laws, regulations, and standards affecting SI operations. OSHEM conducts regular compliance assessment and audits of SI facilities and programs.

2.4. USING THIS DOCUMENT

2.4.1. This SDS document is organized into three volumes identified below:

- Volume 1- Design Guidelines & Technical Sections- Volume 1 of the SDS is organized into 2 sections, Design Guidelines and Technical Sections. The Design Guideline Chapters provide requirements on a variety of general topics for the designer during design. The second part of Volume 1 includes Technical Sections intended to provide guidance on requirements for specific topics. Each Technical Section is identified by the general CSI Specification division number and is divided into 3 parts: Reference Codes Standards and Guidelines, Design Requirements, and Specifications. The Reference Codes, Standards, and Guidelines in each Technical Section should be read alongside Chapter 3 of the Design Guidelines in Volume 1 for a comprehensive listing of codes and standards. The specification section in each Technical Section is not an actual specification, but rather guidance for the designer to consider when writing specifications for a project.

- Volume 2- Smithsonian Specifications- The Smithsonian has authored several specifications that should be included for each project, when appropriate, and are included in Volume 2. Each of these specification sections should be edited as needed on a project by project basis in close coordination with the COTR. The use of alternate specifications for each specification included in Volume 2 is not permitted. In addition to the sections included in Volume 2, SI has also written Division 01 Specs for both large and small projects. These sections may be obtained from the COTR at the beginning of each project. Division 01 Specifications should be edited in close coordination with the COTR. Security Specifications have also been written by SI for inclusion on each applicable project. These specifications are not included in Volume 2 for security reasons but may be obtained thought the COTR as needed.

- Volume 3- Appendices- Volume 3 of the SDS includes several informational appendices on a variety of topics that supplement the information found in the SDS.

- Throughout the SDS document Commentary is included and demarcated by a grey text box. This Commentary is intended to provide additional insight, perspective, and background to a variety of topics in the document.

2.4.2. Any Architect/Engineer (A/E) designing for the SI is expected to take a holistic approach, as no single system, piece of equipment, or assembly exists in isolation. To that end, the SDS are organized around a process that, if used properly, will lead to a highly functional result. These SDS identify the expectations, processes, and requirements specific to SF to “provide effective and efficient integrated services to design, construct, revitalize, and preserve high quality and culturally significant facilities in support of the Smithsonian’s mission.”

2.4.3. Any A/E working with the SI will have a highly developed knowledge of model codes, industry standards, and professional expectations. A listing of governing codes, standards and reference may be found in Chapter 3 of the Design Guidelines located in Volume 1. In addition, each Technical Section in Volume 1 indicates additional code and standards specific to the topic in that section.

2.4.4. Each building owned or managed by the SI houses a complex operation comprised of many, sometimes competing, factors: the building and its infrastructure, curators and conservators, administrators, program directors, facilities maintenance staff, security, and, most importantly, the public. Over the years, the SI has learned how each special interest must operate effectively. The SDS provide a roadmap to enable the A/E and the Contracting Officer's Technical Representative (COTR) to successfully navigate project complexities.

2.5. CHANGE LOG

Date of Revision	Description of Changes
2021 October	The following Standards were merged together to create this unified Smithsonian Design Standards • OPDC Facilities Design Standards • OPS Security Design Criteria • OSHEM Fire Protection and Life Safety Design Manual
2023 August	Revised Specification Section 01 56 30 – Site Protection Revised Specification Section 32 91 00 - Planting Soil (Template)
2023 January	Revised Specification Section 32 92 00 – Lawns and Grasses – Small Specification Section 32 92 00 – Lawns and Grasses – Large Projects
2023 November	The SI Standards were modified to reflect updates to OPS standards and Specifications.

3. GENERAL INFORMATION

3.1. CODES, STANDARDS, AND REFERENCES

3.1.1. General:

3.1.1.1. Smithsonian Institution (SI) facilities and museums outlast the typical design lifespan of average buildings. Many of these historically significant structures are expected to be in operation well beyond 100 to 200 years. The SI provides significant investments to these historic buildings demonstrating a dedication to historic preservation and a continuation of the institution's overarching mission. Quality and durability for all products and systems in these structures are keys to preserving them for many generations to come. As part of the deep commitment to preserving historical structures for generation, the SI has provided and continues to provide additional investment in fire protection and life safety systems as warranted in buildings with extended life spans and/or those housing irreplaceable collections to avoid functional obsolescence, protect collections and historic structures, and provide operational flexibility.

3.1.1.2. For historic structures (building or other construction designated as having historic, architectural, or cultural significance), maintenance of the historic fabric – the materials, features, and finishes that existed during the most architecturally or historically significant period – may be at odds with current codes. In these situations, the goal is to maintain the buildings, their unique characteristics, and their fabric; protect housed collections; and provide for continuity of operations by providing reasonable levels of protection. National Fire Protection Association (NFPA) 909: *Protection of Cultural Resource Properties – Museums, Libraries, and Places of Worship*, provides additional guidance on this topic and will be used in establishing and documenting the appropriate levels of protection.

3.1.1.3. All SI facility designs for new, renovation, and/or preservation construction will comply with all applicable federal, state, and local codes, regulations, guidelines, and standards, including, but not limited to those identified in this Chapter. State, local, and utility requirements vary depending on the location of the project. It is the responsibility of the Architect/Engineer (A/E) to research and comply with all applicable guidelines. Conflicting requirements will be brought to the attention of the SI Contracting Officer's Technical Representative (COTR) immediately, in writing.

3.1.1.4. All A/E communication, coordination, and interaction with the SI, its divisions, departments, and personnel will be through the project COTR.

3.1.1.5. Individual SI facilities may have specific or additional standards and guidelines applicable to their projects that are not outlined in this document. In those cases, project-applicable guidelines and standards will be provided to the A/E through the COTR. Examples include the National Mall (Mall) Streetscape Manual; facility master plans; building specific public restroom design criteria; utility rebate procedures (per local jurisdiction); Office of Planning, Design, and Construction (OPDC); Office of Facilities Management and Reliability (OFMR); and other sample guide specifications. In addition, overseas facilities (for example, the Smithsonian Tropical Research Institute (STRI)) will have specific standards and guidelines for the specific country.

3.1.1.6. The A/E will use all SI-provided standards, specifications (When applicable), and guidelines. Where these conflict with current codes and/or industry standards, the A/E will inform the COTR. The most stringent requirement will govern, unless notified otherwise. The A/E must verify that information contained in any SI-supplied guide specifications is up-to-date and accurate. Ultimately, the A/E is responsible for all information provided on the drawings and in the specifications.

3.1.1.7. The A/E is required to perform a code verification at the start of each project. Applicable governing codes and their edition must be presented to and approved by SI. For large projects, where design may last several years, the A/E shall be instructed to do a new code review at 35%, 65%, and 95% design stages and revise the drawings if necessary, to meet any new important code revisions.

3.1.1.8. Recommended practices and appendices within NFPA documents will be considered requirements.

3.1.1.9. Where conflicts arise between International Code Council (ICC) model codes and NFPA documents, the most stringent will apply unless otherwise directed by the SI.

3.1.1.10. Typical building and fire codes establish the minimum standard of performance for buildings and facilities. The codes focus on issues of life safety and firefighter safety, but do not adequately address continuity of operations, property protection, or protection for collections. These SDS are intended to address this gap.

3.1.1.11. This SDS works in concert with the national codes and standards to establish the minimum design requirements for life safety, firefighter safety, continuity of operations, property protection, and the protection of collections for all SI facilities. The COTR will confer with the OSHEM fire protection engineer on the applicable codes and standards and any additional requirements. Where construction is not on federal property, more restrictive codes may be required by the local jurisdictions (e.g., Metropolitan Washington Airports Authority, New York City). The most restrictive requirements and applicable codes and standards will be followed.

3.1.1.12. Original design codes, the fire protection related codes and standards in effect when facility commences (code of record), remain in effect for the life of the facility unless a significant hazard that endangers the building occupants or the public is identified or unless the building is modified. In these cases, the facility is upgraded to the current requirements of the applicable code or standard. If the code of record cannot readily be determined, OSHEM will stipulate the code to be utilized.

3.1.1.13. When upgrades or modifications are made, the current code edition applies to the upgrade or modification. When substantial upgrades or modifications are made on fire protection systems, the entire system is upgraded to the current code or standard.

3.1.1.14. When site-specific guidelines or design specifications exist, they will be included in all fire protection design packages as applicable. These guidelines can be found throughout the Smithsonian Design Standards (SDS). SI standard fire protection commissioning standards in Appendix I are to be used in new projects.

3.1.1.15. SI standard fire protection specifications, included in Volume 2, are to be used for all projects.

3.1.1.16. The following codes and standards form the basis for this SDS in relation to life safety and fire protection.

a. SI Directive (SD) 419, *Smithsonian Institution Safety and Health Program*, and SI Safety Manual

b. NFPA, *National Fire Codes and Standards*, latest version, and its annexes

c. ICC Codes, latest edition

d. International Building Code (IBC)

e. International Fire Code (IFC)

f. International Mechanical Code (IMC)

g. International Plumbing Code (IPC)

h. FM Global Loss Prevention Data Sheets

3.1.1.17. Where conflicts arise between codes and standards related to life safety and fire protection, the most stringent requirements will apply, unless otherwise directed by the OSHEM. For life safety code conflicts, where the requirements of the IBC and NFPA 101: *Life Safety Code (LSC)* conflict, the requirements of NFPA 101 will be followed.

3.1.2. Model Codes Applicable for All SI Facilities:

3.1.2.1. ICC Model Codes, including:

a. International Building Code (IBC)

b. International Existing Building Code (IEBC)

c. International Energy Conservation Code (IECC)

d. International Fire Code (IFC)

e. International Mechanical Code (IMC)

f. International Plumbing Code (IPC)

3.1.2.2. NFPA, including:

a. NFPA 13: *Standard for the Installation of Sprinkler Systems*

b. NFPA 70: *National Electric Code*

c. NFPA 72: *National Fire Alarm and Signaling Code*

d. NFPA 101: *Life Safety Code (LSC)*

e. NFPA 730 Guide for Premise Security

f. *NFPA 731 Standard for the Installation of Premise Security Systems*

g. NFPA 909: *Code for the Protection of Cultural Resource Properties*

h. NFPA 914: *Code for Fire Protection for Historic Structures*

i. All other applicable NFPA chapters, codes, standards, and recommended practices

3.1.2.3. Performance Based Design Standards:

a. Society of Fire Protection Engineers (SFPE) Engineering Guide to Performance Based Fire Protection

b. International Code Council Performance Code (ICCPC) for Buildings and Facilities

c. NFPA 101, Chapter 5

3.1.3. SI Standards and Guidelines:

3.1.3.1. A copy of each SI Standards and Guidelines identified below may be obtained from the COTR.

3.1.3.2. SD 111: *Smithsonian Metrication Policy*

3.1.3.3. SD 215: *Accessibility for People with Disabilities Policy*

3.1.3.4. SD 414: *SI Energy Management Program and Water Supply Emergency Plan*

3.1.3.5. SD 418: *SI Historic Preservation Policy*

3.1.3.6. SD 419: *SI Safety and Health Program*

3.1.3.7. SD 422: *SI Sustainable Design of Smithsonian Facilities*

3.1.3.8. Smithsonian Accessibility Program:

a. Smithsonian Guidelines for Accessible Design (SGAD), March 2011

b. Smithsonian Guidelines for Accessible Exhibition Design (SGA/ED)

c. SI Checklist for Accessible Information Desks

3.1.3.9. Smithsonian Office of Planning Design and Construction (OPDC):

a. Four External Processes Occurring During Project Design and Development in the National Capital Region

3.1.3.10. SI Office of Protection Services (OPS):

a. SI Security System Base Specifications, Sections 1-28

b. Exhibit Security Best Practices, dated July 21, 2017

3.1.3.11. Smithsonian Gardens (SG):

a. Standard technical specification sections (available from SG through the COTR)

3.1.4. Other Guidelines, Codes, Regulations, and Local Utility Requirements:

3.1.4.1. Sustainability:

a. U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED®) Rating System Reference Guides and other resources

b. USGBC Sustainable Sites Initiative (SITES)

c. Public Law 109-58: Energy Policy Act of 2005

d. Public Law 110-140: Energy Independence and Security Act of 2007 (EISA 2007)

e. Executive Order 13101: *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition*

f. Executive Order 13221: *Energy Efficient Standby Power*

g. Executive Order 13423: *Strengthening Federal Environmental, Energy, and Transportation Management*

h. Executive Order 13514: *Federal Leadership in Environmental, Energy, and Economic Performance*

i. Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding

j. 10 CFR 434: *Energy Code for New Federal Commercial and Multi-Family High Rise Residential Buildings*

k. 10 CFR 435: *Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings*

l. 10 CFR 436: *Federal Energy Management and Planning Programs*

m. 42 USC Chapter 91: *National Energy Conservation Policy*

3.1.4.2. American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) A17.1: *Safety Code for Elevators and Escalators*

3.1.4.3. District of Columbia Water and Sewer Authority (DCWASA)

3.1.4.4. Washington Suburban Sanitary Commission (WSSC) Regulations and Standard Details

3.1.4.5. Basic National Private Sewage Disposal Code

3.1.4.6. District of Columbia Regulations on Outdoor Noise

3.1.4.7. State and Local Occupational Safety and Health Agencies

3.1.4.8. State and Local Environmental Protection Agencies

3.1.4.9. Architectural Graphic Standards, Ramsey/Sleeper, Eighth Edition (pages 813-831 on metrification)

3.1.4.10. National Institute of Building Sciences (NIBS), The Metric Guide for Federal Construction

3.1.4.11. Requirements for projects in the country of Panama:

a. Environment: The Panama Environmental Agency, Autoridad Nacional del Ambiente (ANAM) has scaled requirements for preparing environmental assessment documentation depending on the magnitude of the project.

b. Zoning and Construction: Ministerio de Vivienda (MIVI)

c. Panama Canal Waterway and Operations: Autoridad del Canal de Panamá (ACP)

d. Fire Department: Cuerpo de Bomberos de Panamá (CBP)

3.1.5. Federal Government Legislation, Regulations, Standards, and Guidelines:

3.1.5.1. For accessibility, reference the SGAD and the documents below. Where conflicts arise between these two documents, the most stringent will apply (that which provides the greatest accessibility for public and staff), unless otherwise directed by the SI.

a. Department of Justice (DOJ) ADA Standards for Accessible Design

b. General Services Administration (GSA) Architectural Barriers Act (ABA) Accessibility Standards for Federal Facilities

3.1.5.2. Occupational Safety and Health Administration (OSHA) Standards and Regulations

3.1.5.3. National Environmental Policy Act (NEPA):

a. All Council of Environmental Quality (CEQ) regulations when requested by a federal agency partner who has jurisdictional or approval authority over an SI project

3.1.5.4. American Conference of Governmental Industrial Hygienists (ACGIH):

a. Industrial Ventilation Manual

b. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

3.1.5.5. U.S. Environmental Protection Agency (EPA):

a. All regulations referencing asbestos, lead, Polychlorinated Biphenyls (PCBs), wastewater, underground storage tanks, hazardous materials disposal, etc.

b. Toxic Substances Control Act
c. Clean Air Act, to include National Emissions Standards for Hazardous Air Pollutants

d. EPA, 40 CFR 50: *National Primary and Secondary Ambient Air Quality Standards*

e. Clean Water Act

f. EPA, 10 CFR 40, 1.23, 1–4, 1–16: *Procedures for Implementing the Clean Air Act and the Federal Water Pollution Control Act*

g. Resource Conservation and Recovery Act

h. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

3.1.5.6. National Council on Radiation Protection:

a. Radon Abatement Act

3.1.5.7. Nuclear Regulatory Commission Regulations

3.1.5.8. National Earthquakes Hazard Reduction Program:

a. Executive Order 12699: *Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction*, 55 FR 835

3.1.5.9. Federal Energy Management Guidelines:

a. Public Law 109-58: Energy Policy Act of 2005

b. Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding (HPSB MOU), 2006

c. Public Law 110-140: Energy Independence and Security Act of 2007 (EISA 2007)

d. Executive Order 13221: *Energy Efficient Standby Power*

e. Executive Order 13423: *Strengthening Federal Environmental, Energy and Transportation Management*

f. Executive Order 13514: *Federal Leadership in Environmental, Energy and Economic Performance*

g. 10 CFR 434: *Energy Code for New Federal Commercial and Multi-Family High Rise Residential Buildings*

h. 10 CFR 435: *Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings*

i. 10 CFR 436: *Federal Energy Management and Planning Programs*

j. 42 USC Chapter 91: *National Energy Conservation Policy*

3.1.5.10. Federal Emergency Management Agency (FEMA) Publications:

a. FEMA 178: *The NEHERP Handbook for the Seismic Evaluation of Existing Buildings*

b. FEMA 350: *Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings*

c. FEMA 353: *Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications*

3.1.5.11. Federal Archeological and Historic Preservation Legislation and Regulations including, but not limited to, the National Historic Preservation Act (NHPA), as amended, and the following:

a. Public Law 108-72: Smithsonian Facilities Authorization Act, August 15, 2003

b. The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (as amended and annotated by the National Park Service)

c. The Secretary of the Interior's Standards for Rehabilitation (36 CFR 67)

d. The Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR 68)

e. The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings

3.1.5.12. U.S. Department of Housing and Urban Development (HUD):

a. Guidelines for the Evaluation and Control of Lead-Based Paint

3.1.5.13. Public Buildings Service (PBS)

a. P100 Facilities Standards For The Public Building Services

3.1.5.14. Sustainability:

a. U.S. US Department of Energy (DOE):

1. High Performance Buildings

2. Federal Energy Management Program's Sustainable Design & Operations: http://www.eere.energy.gov/femp/program/sustainable_buildings.html

3. Building Technologies Program

b. NIBS Whole Building Design Guide

c. DOE and EPA: Energy Star Program and Resources: http://www.energystar.gov/

3.1.5.15. National Institute of Standards and Technology (NIST)

3.1.6. Industry Standards and Guidelines:

3.1.6.1. The A/E will determine the applicability of the standards and guidelines necessary to meet SI design criteria and submit them for SI review and approval.

3.1.6.2. American Society of Testing and Materials (ASTM): All codes, standards, guidelines, and recommended practices including:

a. ASTM Standards in Building Codes

3.1.6.3. American National Standard Institute (ANSI)

3.1.6.4. American Concrete Institute (ACI) Manual of Concrete Practice

3.1.6.5. American Society of Landscape Architects (ASLA)

3.1.6.6. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice

3.1.6.7. American Institute of Steel Construction (AISC) Specifications and Codes

3.1.6.8. Precast/Prestressed Concrete Institute (PCI)

3.1.6.9. American Welding Society (AWS) Standards

3.1.6.10. National Forest Products Association (NFoPA)

3.1.6.11. The Air-Conditioning and Refrigeration Institute (ARI)

3.1.6.12. Architectural Woodwork Institute (AWI) Quality Standards

3.1.6.13. American Society of Mechanical Engineers (ASME)

3.1.6.14. American Society of Plumbing Engineers (ASPE)

3.1.6.15. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): All codes, standards, guidelines, and recommended practices including:

a. ASHRAE Advanced Energy Design Guides

b. ASHRAE Green Guide

c. ASHRAE 90.1: *Energy Standard for Buildings Except Low-Rise Residential Buildings*

d. ASHRAE 62.1: *Ventilation for Acceptable Indoor Air Quality*

e. ASHRAE 55: *Thermal Environmental Conditions for Human Occupancy*

f. ASHRAE 52.1: *Gravimetric and Dust-Spot Procedures for Testing* Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

3.1.6.16. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): All codes, standards, guidelines, and recommended practices including:

a. Architectural Sheet Metal Manual

b. Standard Practice in Sheet Metal Work

c. HVAC Systems – Duct Design, 4th Edition

d. HVAC Duct Construction Standards – Metal and Flexible

3.1.6.17. National Electrical Manufacturers Association (NEMA)

3.1.6.18. National Electrical Contractors Association (NECA)

3.1.6.19. American Conference of Government Industrial Hygienists (ACGIH)

3.1.6.20. Illuminating Engineering Society (IES): All codes, standards, guidelines, and recommended practices including:

a. IES Lighting Handbook

3.1.6.21. National Roofing Contractors Association (NRCA): All codes, standards, guidelines, and recommended practices including:

a. The NRCA Roofing and Waterproofing Manual

3.1.6.22. National Sanitary Foundation (NSF) Standards

3.1.6.23. Electronic Industries Alliance (EIA)/Telecommunications Industry Association (TIA): All codes, standards, guidelines, and recommended practices including:

a. EIA/TIA Standard 568

b. EIA/TIA Standard 569

c. EIA/TIA Standard 606

d. EIA/TIA Standard 607

3.1.6.24. Factory Mutual Systems FM Approval Guide and Data Sheets

3.1.6.25. Underwriters Laboratories (UL):

a. UL 681: *Installation and Classification of Burglar and Holdup Alarm Systems*

b. UL 752: *Standard for Bullet-Resisting Equipment*

3.1.6.26. Building Commissioning Association (BCA)

3.1.6.27. Society of Fire Protection Engineers (SFPE):

a. Guide to Performance-Based Fire Protection

b. Performance-Based Fire Safety Design

3.1.7. Security Standards:

3.1.7.1. The Risk Management Process for Federal Facilities: An Interagency Security Committee Standard

3.1.7.2. Designing for Security in the Nation's Capital, National Capital Planning Commission

3.1.7.3. The Site Security Design Guide, U.S. General Services Administration, Public Building Service

3.1.7.4. Guidance for Filtration and Air-Cleaning Systems to Protect Building Environments from Airborne Chemical, Biological, or Radiological Attacks, Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health

3.1.7.5. GSA Alternative Path Analysis and Design Guidelines for Progressive Collapse Resistance

3.1.7.6. ASCE 59 Blast Protection of Buildings

3.1.7.7. Designing for Security in the Nation's Capital, National Capital Planning Commission

3.1.7.8. The National Capital Urban Design & Security Plan, National Capital Planning Commission

3.1.8. Security References

<u>COMMENTARY:</u> The security references below are tools for the design team to use to implement the best practices and minimum criteria established by this document.

3.1.8.1. Designing and Testing of Perimeter Security Elements, National Capital Planning Commission

3.1.8.2. Unified Facilities Criteria (UFC) Security Engineering: Final Design (4-020-03FA), U.S. Army Corps of Engineers (USACE)

3.1.8.3. Unified Facilities Criteria (UFC) Security Engineering: Electronic Security Systems (4- 020-04FA), USACE

3.1.8.4. ASTM F1233: *Standard Test Method for Security Glazing Materials and Systems*

3.1.8.5. Federal Specification AA-D-600D, Federal Specification, Door, Vault, Security, U.S. General Services Administration (GSA)

3.1.8.6. UL 294: *Standard for Access Control System Units*

3.1.8.7. UL 681: *Standard for Installation and Classification of Burglar and Holdup Alarm Systems*

3.1.8.8. UL 972: *Standard for Burglary Resisting Glazing Material*

3.1.8.9. UL 3044: *Standard for Surveillance Closed Circuit Television Equipment*

3.2. <u>CODE REQUIREMENTS</u>

3.2.1. <u>Types of Construction:</u>

3.2.1.1. New structures will be constructed from fire-resistive or noncombustible construction, Type I or II as defined in the IBC, unless otherwise approved by the Office of Safety, Health, and Environmental Management (OSHEM).

a. For non-separated, mixed-use buildings, the construction type will be the most restrictive type based on the use groups, building height, and area in accordance with the IBC.

3.2.1.2. Alterations, renovations, and additions to existing buildings will match the existing building construction type unless the height and area limitations of the IBC would be exceeded. In such case, the building separation requirements of the IBC will be followed.

3.2.1.3. Wood materials used for walls, platforms, blocking, furring, and similar applications will be noncombustible or fire-retardant pressure-impregnated wood. Fire-retardant coatings of intumescent paint or other surface treatments are not acceptable in lieu of fire-retardant pressure-impregnation.

COMMENTARY: Type I or II construction provides the durability, longevity, and fire resistance needed for significant SI buildings. This does not apply to minor support structures, sheds, maintenance buildings, and similar facilities.

3.2.2. Use Groups and Occupancies:

3.2.2.1. Use groups and occupancies will be in accordance with the IBC.

3.2.2.2. The LSC chapters that correspond to the IBC use group will be used to determine means of egress requirements and other special occupancy requirements.

COMMENTARY: SI utilizes NFPA 101: Life Safety Code (LSC), as the standard for life safety in its facilities and utilizes the IBC as its building code. While the IBC includes life safety requirements, the LSC more thoroughly addresses egress and other life safety aspects for the wide range of occupancy types across the SI. To enable the use of both the IBC and LSC in a consistent and coherent manner, use groups and occupancies are based on a single code, the IBC, and life safety is based on the requirements of the LSC.

3.3. LIFE SAFETY REQUIREMENTS

3.3.1. Life Safety Standards:

3.3.1.1. Facility design will comply with the requirements of the LSC (NFPA 101).

<u>COMMENTARY:</u> NFPA 101 is utilized in lieu of Chapter 10 of the IBC, which is not applicable to SI projects. This code provides in-depth guidance for various occupancies at the SI.

3.3.2. <u>Means of Egress: Basic Requirements:</u>

3.3.2.1. Unobstructed and adequately marked means of egress will be provided to ensure safe emergency evacuation.

3.3.2.2. Security measures or incidental building activities will not impede exit doors, passageways, or any other part of a means of egress.

3.3.2.3. Delayed egress doors may be used subject to OSHEM approval.

3.3.2.4. Utilities such as, but not limited to, wiring, computer/IT cables, piping, ducts, and other systems will not penetrate through exit enclosures (stairwells and horizontal exits), unless serving only the exit enclosure.

3.3.2.5. Exit doors will be arranged so they can be readily opened from the egress side whenever the building is occupied. Locks, if provided, will not require the use of a key, tool, or special knowledge or effort for operation from the inside of the building, unless permitted by the LSC.

3.3.2.6. Egress paths from public spaces will not pass through staff-only areas.

3.3.3. <u>Means of Egress: Minimum Width:</u>

3.3.3.1. The minimum unobstructed exit access width for aisles or corridors serving as the primary exit will not be less than 44 in (1118 mm), and where deemed necessary by OSHEM, not less than 60 in (1524 mm) in galleries.

<u>COMMENTARY:</u> SI enforces maintaining at least 60 in exit access width for the primary circulation path through gallery spaces to prevent bottlenecking of visitors as they move through exhibits, and to facilitate orderly evacuation during emergencies. Special circumstances, such as anticipated high-volume visitation, may warrant egress widths over 60 in to permit ease of movement through exhibit spaces.

3.3.4. Means of Egress: Accessible Means of Egress:

3.3.4.1. All accessible means of egress will comply with the IBC and LSC.

3.3.5. Emergency Lighting:

3.3.5.1. Emergency lighting illumination levels will meet the requirements of the LSC. Locations requiring emergency lighting include the following:

a. All assembly spaces (including galleries and large conference rooms)

b. All means of egress (exit access, corridors, stairs, and routes to the public way)

c. Switchgear, mechanical equipment, emergency equipment, fire pumps, and transformer rooms

d. Security control rooms

e. Emergency command centers

3.3.5.2. Emergency lighting photometric plans are required during project design.

3.3.6. Exit Marking:

3.3.6.1. Mark means of egress in accordance with the LSC. All new internally illuminated exit signs must be light emitting diode (LED), electroluminescence (LEC), or cold cathode type. Incandescent or florescent fixtures are not permitted, except for existing fixtures, which may remain in use.

3.3.6.2. Radioluminous and photoluminescent exit signs will not be used without prior approval by OSHEM.

COMMENTARY: SI limits the use of radioluminous exit signs, which contain tritium gas. These signs have to be tracked by each facility manager and reported to the Nuclear Regulatory Commission. The primary use of these signs is for temporary exhibitions, where walls are relocated several times a year, and areas with potentially flammable atmospheres. Where *permitted by OSHEM, photoluminescent exit signs and egress path marking may be installed, but must be provided with a reliable, 24-hour external illumination (charging) source of a type approved by the sign manufacturer, having a minimum illumination of 54 lux (5 foot-candles). Typically, fluorescent, metal halide, mercury–vapor, and blue LED with phosphor lights emit energy that can be absorbed and stored by the photoluminescent pigments used in this type of signage.*

3.3.6.3. Where deemed necessary by OSHEM, provide approved floor proximity exit signs and egress path marking.

3.3.7. Occupant Load Management:

3.3.7.1. Means for real-time monitoring and management of occupant loads in assembly buildings will be provided to prevent overcrowding.

COMMENTARY: Where deemed necessary by OSHEM and OPS to prevent overcrowding, automated visitor count systems have been installed and used to track and manage building-wide occupant loads.

3.4. DEFINITIONS

3.4.1. Fire Protection: A broad term that encompasses all aspects of fire and life safety, including building construction and fixed building fire protection features, fire suppression and detection systems, fire water systems, emergency process safety controls, emergency firefighting operations (fire department), Fire Protection Engineering (FPE), and fire prevention. Fire protection is concerned with preventing or minimizing the direct and indirect consequences of fire on people, property, and programs. By extension, fire protection also includes aspects of the following perils: explosion, natural phenomenon, and smoke and water damage from fire, suppression activities, or accidental discharge.

3.4.2. Fire Protection Systems: Any system designed and installed to detect, control, or extinguish a fire; to limit fire damage; to alert occupants and/or the fire department that a fire has occurred; or to otherwise enhance life safety or property protection.

3.4.3. Life Safety Systems: Any system designed and installed to alert occupants to a fire condition, provide sufficient capacity and a protected path for egress, provide structural stability, and provide passive or active defense against the spread of fire and its products. These include, but are not limited to, means of egress components, emergency lighting, exit signage, fire barriers, and structural fire protection.

3.4.4. Maximum Credible Fire Loss (MCFL): The damage to property and/or disruption to operations that would be expected from a fire, assuming that all installed fire protection systems function as designed and the effect of emergency response is omitted except for post-fire actions such as salvage work, shutting down water systems, and restoring operations.

3.4.5. Maximum Possible Fire Loss (MPFL): The value of property (excluding land) and cost of operational disruption within a fire area unless a fire hazards analysis demonstrates a lesser (or greater) loss potential. This assumes the failure of both automatic fire suppression systems and manual firefighting efforts.

3.4.6. Occupant: Any person who resides or is present in an SI owned, operated, or leased facility, or who participates in a SI activity.

3.4.7. Redundant Fire Protection: Fire protection measures implemented to mitigate the effects of fires or related perils in the event of a partial or total failure of the primary fire protection measures (e.g., two independent fire suppression systems to protect a high-risk facility).

3.4.8. Performance-Based Design: An engineering approach to fire protection design based on established fire safety goals and objectives; deterministic and probabilistic analysis of fire scenarios; and quantitative assessment of design alternatives against fire safety goals and objectives, accepted engineering tools, methodologies, and performance criteria. [See SFPE Engineering Guide to Performance-Based Fire Protection, 2007]

3.4.9. Man-passable Opening: A clear cross section area of 619 square cm (96 square in) or more with the smallest dimension exceeding 15.2 cm (6 in).

3.4.10. Accessible Opening: Any man-passable opening within 4 m (18 ft) of exterior ground surface or within 3 m (12 ft) directly or diagonally opposite a window, structure, fire escape, or roof.

3.5. ABBREVIATIONS

AAADM	American Association of Automatic Door Manufacturers
AAAMA	American Architectural Manufacturers Association
AABC	Associated Air Balance Council

AASHTO	American Association of State Highway and Transportation Officials
ABA	Architectural Barriers Act
ABAA	Air Barrier Association of America
ACCA	Air Conditioning Contractors of America
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ACP	Autoridad del Canal de Panamá (Panama)
ACQ	Alkaline Copper Quaternary
ACR	Assessment, Cleaning, and Restoration
ACS	Access Control System
ACT	Acoustic Ceiling Tile
A/E	Architect/Engineer
AFF	Above Finished Floor
AGA	American Gas Association
GMT	Architectural Glass and Metal Technician (Certification)
AHJ	Authority/Authorities Having Jurisdiction
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AHU	Air-Handling Unit
AISC	American Institute of Steel Construction
ANAM	Autoridad Nacional del Ambiente (Panama)
ANSI	American National Standards Institute
APP	Atactic Polypropylene
ARA	Area of Rescue Assistance
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASJ	All Service Jacket
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAS	Building Automation System
BCA	Building Commissioning Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America
BICI	Building Information Consulting Service International
BIFMA	Business + Institutional Furniture Manufacturers Association
BIL	Basic Impulse Insulation Level
BLCC	Building Life-Cycle Cost

BMP	Best Management Practice
CAC	Ceiling Attenuation Class
CBP	Cuerpo de Bomberos de Panamá (Panama)
CBR	Chemical, Biological, and Radiological
CCA	Chromated Copper Arsenate
CCTV	Not Used
CDC	Centers for Disease Control
CEQ	Council of Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Commission of Fine Arts
CFC	Chlorofluorocarbons
CMU	Concrete Masonry Unit
COTR	Contracting Officer's Technical Representative (also referred to as SI Design Manager
CPP	Certified Protection Professional
CPSC	Consumer Protection Safety Commission
CPTED	Crime Prevention Through Environmental Design
CRF	Condensation Resistance Factor
CRI	Carpet and Rug Institute
CRSI	Concrete Reinforcing Steel Institute
CRZ	Critical Root Zone
CSPE	Chlorosulfonated Polyethylene
CTI	Cooling Technology Institute
CWT	Certified Water Technologist
DBT	Design Basis Threat
DCWASA	District of Columbia Water and Sewer Authority
DDC	Direct Digital Control
DDOT	District Department of Transportation
DG	Design Guidelines
DGP	Data Gathering Panel
DHI	Door and Hardware Institute
DI	Deionized
DISCUS	Distilled Spirits Council of the United States, Inc.
DN	Diameter Nominal
DOAS	Dedicated Outdoor Air System
DOE	Department of Energy
DOEE	Department of Energy & Environment
DOJ	Department of Justice
DPDE	Double-Pole, Double-Throw
DSA	Division of the State Architect (California)
EAS	Environmental Assessment Statement

EDM	Electrical Discharge Machining
EIA	Electronic Industries Alliance
EIFS	Exterior Insulation Finishing System
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EMT	Electrical Metallic Tubing
ENT	Electrical Nonmetallic Tubing
EPA	Environmental Protection Agency
EPDM	Ethylene Propylene Diene Monomer
ESS	Electronic Security System
EVOH	Ethylene Vinyl Alcohol Copolymer
FCC	Fire Command Center (also called Fire Control Center)
FEMA	Federal Emergency Management Agency
FEMP	Federal Energy Management Program
FM	FM Global (formerly Factory Mutual)
FMCS	Facilities Management and Control System
FPE	Fire Protection Engineer/ing
FRP	Fiber(glass) Reinforced Plastic
FRPI	Fire Retardant Pressure Impregnated
FSC	Forest Stewardship Council
FSK	Foil Scrim Kraft
FT	Fully Tempered (Glass)
GANA	Glass Association of North America (now part of National Glass Association)
GIS	Geographic Information System
GSA	General Services Administration
GWC	Gypsum Wall Board
GWP	Global Warming Potential
Ha	Abrasive Hardness Test Unit
HDC	Herndon Data Center
HDPE	High Density Polyethylene
HID	High Intensity Discharge
HMMA	Hollow Metal Manufacturers Association
HUD	Department of Housing and Urban Development
HVAC	Heating, Ventilation, and Air-Conditioning
IAS	International Accreditation Service
IBC	International Building Code
ICC	International Code Council
ICCPC	International Code Council Performance Code
ICEA	Insulated Cable Engineers Association
ICPI	Interlocking Concrete Pavement Institute
ICRI	International Concrete Repair Institute

IDF	Intermediate Distribution Frame
IDS	Intrusion Detection Sensor/System
IEBC	International Existing Building Code
IECC	International Energy Conservation Code
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IDF	Intermediate Distribution Frameroom
IFC	International Fire Code
ILIA	Indiana Limestone Institute of America, Inc.
IMC	International Mechanical Code
IMT	Intermediate Metal Tubing (also called Intermediate Metal Conduit, IMC)
IPC	International Plumbing Code
IPMVP	International Performance Measurement & Verification Protocol
ISA	International Society of Arboriculture
ISC	Interagency Security Committee
ISPM	International Standards for Phytosanitary Measures
IT	Information Technology
IWUIC	International Wildland-Urban Interface Council
LAN	Local Area Network
LCCA	Life Cycle Cost Analysis
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
LP	Liquid Petroleum
LSC	Life Safety Code, NFPA 101
LSL	Laminated Strand Lumber
LULA	Limited Use / Limited Application
MBMA	Metal Buildings Manufacturers Association
MC	Metal Clad
MCFL	Maximum Credible Fire Loss
MDF	Main Distribution Frameroom
MDF	Medium Density Fiberboard
MEP	Mechanical, Electrical, Plumbing
MERV	Minimum Efficiency Reporting Value
MFL	Maximum Foreseeable Loss
MFMA	Metal Framing Manufacturers Association
MI	Mineral Insulated
MIA	Marble Institute of America
MIVI	Ministerio de Vivienda (Panama
MOH	Mohs Scale of Hardness
MPI	Master Painters Institute

MPFL	Maximum Possible Fire Loss
MRL	Machine Room Less (Elevators)
MSS	Manufacturers Standardization Society
MUTCD	Manual on Uniform Traffic Control Devices
NAAMM	National Association of Architectural Metal Manufacturers
NACC	North American Contractor Certification
NADC	National Air Duct Cleaners Association
NAEYC	National Association for the Education of Young Children
NARA	National Archives and Records Administration
NASM	National Air and Space Museum
NAUF	No Added Urea Formaldehyde
NCPC	National Capital Planning Commission
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEII	National Elevator Industry, Incorporated
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NFoPA	National Forest Products Association
NGA	National Glass Association
NHPA	National Historic Preservation Act
NIBS	National Institute of Building Sciences
NIC	Noise Isolation Class
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMD	Network Management Division (of OCIO)
NMAH	National Museum of American History
NHNH	National Museum of Natural History
NPS	National Park Service
NRC	Noise Reduction Coefficient
NRCA	National Roofing Contractors Association
NRTL	Nationally Recognized Testing Laboratory
NSF	National Sanitary Foundation
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
NZP	National Zoological Park
OCIO	Office of Chief Information Officer
ODS	Ozone-Depleting Substance
OEDC	Office of Engineering, Design, and Construction
OFMR	Office of Facilities Management and Reliability
OPDC	Office of Planning, Design, and Construction

OPR	Owner's Project Requirements
OPS	Office of Protection Services
OSHA	Occupational Safety and Health Administration
OSHEM	Office of Safety, Health, and Environmental Management
OTC	Ozone Transport Commission
PACS	Physical Access Control System
PBDE	Polybrominated Diphenyl Ethers
PCB	Polychlorinated Biphenyl
PCI	Precast/Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PIN	Personal Identity Number
PIR	Passive Infrared
POD	Probability of Detection
POP	Persistent Organic Pollutants
PPE	Personal Protective Equipment
PRV	Pressure-Regulating Valve
PSP	Physical Security Professional
PTZ	Pan-Tilt-Zoom
PV	Photovoltaic
PVB	Polyvinyl Butyral
PVC	Polyvinyl Chloride
RDCC	Registered Communications Distribution Designer®
RGS	Rigid Galvanized Steel
RH	Relative Humidity
RO	Roof Observer
RO	Reverse Osmosis
RPZ	Reduced Pressure Zone
RRC	Registered Roof Consultant
SBS	Styrene Butadiene Styrene
SCCR	Short Circuit Current Rating
SCQMD	South Coast Air Quality Management District
SCS	Scientific Certification Systems
SD	Smithsonian Directive
SDI	Steel Deck Institute
SDR	Standard Dimensional Ratio
SDS	Smithsonian Design Standards
SE	Smithsonian Enterprises
SERC	Smithsonian Environmental Research Center
SF	Smithsonian Facilities
SFPE	Society of Fire Protection Engineers
SG	Smithsonian Gardens
SGAD	Smithsonian Guidelines for Accessible Design

SGA/ED	Smithsonian Guidelines for Accessible Exhibit Design
SI	Smithsonian Institution
SITES	Sustainable Sites Initiative
SLC	Signaling Line Circuit
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMS	Security Management System
SNAP	Significant New Alternative Policy
SOC	Security Operations Center
SRI	Solar Reflective Index
SSR	Security Server Room
STC	Sound Transmission Class
STRI	Smithsonian Tropical Research Institute
SWI	Steel Window Institute
TAB	Testing, Adjusting, and Balancing
TABB	Testing, Adjusting, and Balancing Bureau
TARR	Texture Appearance Retention Rating
TDD	Total Demand Distortion
THD	Total Harmonic Distortion
TIA	Telecommunications Industry Association
TMS	The Masonry Society
TNT	Trinitrotoluene
TR	Telecomm(munications) Room
TS	Technical Sections
TVSS	Transient Voltage Surge Suppression
UCR	Unit Control Room
UFC	Unified Facilities Criteria
UL	Underwriters Laboratories
ULPA	Ultra Low Penetration Air
UPS	Uninterruptable Power Source/Supply
URV	UVGI Rating Value
USACE	United States Army Corps of Engineers
USGBC	U.S. Green Building Council
UVGI	Ultraviolet Germicidal Irradiation
VASS	Video Assessment and Surveillance System
VAV	Variable Air Volume
VFD	Variable Frequency Drive
VIARC	Visitor Information and Associates Reception Center
VOC	Volatile Organic Compound
VRF	Variable Refrigerant Flow
VSS	Video Surveillance System
WAO	Work Area Outlet

WCMA	Window Covering Manufacturers Association
WCR	Withstand Closing Rating
WDMA	Window & Door Manufacturers Association
WMATA	Washington Metropolitan Area Transportation Authority
WSSC	Washington Suburban Sanitary Commission

4. DESIGN REQUIREMENTS

4.1. GENERAL REQUIREMENTS

4.1.1. The design will be in accordance with the Smithsonian Institution (SI) Special Conditions for Architect/ Engineer (A/E) Services, which is may be obtained from the Smithsonian Facilities (SF) Contracting Officer's Technical Representative (COTR). Where a conflict occurs between the A/E Special Conditions and these design standards, generally the most stringent requirement will apply. The A/E will discuss any potential conflict with the COTR to reach a resolution.

4.1.2. Any proposed deviations from these Smithsonian Design Standards (SDS) must be submitted for SI internal review, including the Office of Planning, Design, and Construction (OPDC), Engineering and Design Division Associate Director, and the Office of Facilities Management and Reliability (OFMR), Systems Engineering Division Associate Director, OPS and any other affected SF or SI units, at the discretion of these two associate directors. In considering deviations, implications such as cost and/or schedule impacts on the project will be evaluated. Any deviation from the SDS requires the approval of the SI OPDC Engineering and Design Division Associate Director.

4.1.3. Every project begins on land that has been disturbed in some way by human intervention. This antecedent history and prior use of the land forms part of its current condition and can help inform its future best use. Historic design, materials, and antecedents should be consulted to inform any new design. When deemed applicable by the COTR, a Cultural Landscape Report prepared to U.S. Department of the Interior standards may be required – if one is not already available – and its results and recommendations will underpin any new design work. This analysis should be completed and understood as part of the project record before proceeding into design.

4.1.4. When deemed applicable by the COTR, a site analysis may be required before proceeding into design. This should include program description; microclimatic data; staff and visitor, delivery, and other functions; specifically requested design elements; and any other special requirements associated with the site. Urban and local context conditions – even those that impinge from off-site – should be considered and annotated before proceeding into design. Site analysis should identify code and other regulatory frameworks that will likely apply to the project outcome. This analysis should be completed and understood as part of the project record before proceeding into design.

4.1.5. Coordinate building and facility needs and site requirements to optimize the use of exterior space, water, energy, and other utilities. Maximize fulfillment of programmatic requirements and facility mission by considering exterior space, site-planning strategies, and plantings as an extension of the facility for staff and visitor amenities, exhibition space, and work space. Translation of interior exhibits into the programming and design of the landscape in coordination with Smithsonian Gardens through the COTR is encouraged where applicable and appropriate.

4.1.6. Integrate site-planning strategies to maximize building function, enhance security, reduce energy consumption, and optimize existing resources such as stormwater, vegetation, and soils.

4.1.7. Constructability issues should be considered throughout the design process.

4.1.7.1. This is especially important for projects that do not appear to have any specific site improvement requirements. Be sure to identify full requirements for construction access as well as material and equipment staging and storage. Building-only projects often require exterior space for trailers, laydown and delivery of materials, and non-public contractor traffic. These requirements frequently impact critical outdoor spaces and potentially critical cultural and historic landscape resources by compacting and contaminating soils, disturbing existing site features and vegetation, or requiring the protection of existing site features including pavements, walls, lights, and other site elements. When appropriate, include a protection plan and a construction-staging schedule to avoid potential impacts.

4.1.8. For projects that require exterior space disturbance or site improvements, refer to Design Guidelines Chapter 8- Site in Volume 1.

4.1.9. A basic directive for design detailing and overall design will include optimizing performance and function, work effort and operations, maintenance materials and ease of maintenance, and repair and replacement with respect to the intended design over the established life of the project. Maintenance considerations will be integrated early in the design process to inform critical design and material decisions. Meaningful collaboration of maintenance and design teams will produce more resilient, attractive, and cost-effective designs.

4.1.10. These SDS apply to all SI facilities. However, since these standards have been developed and based upon environmental conditions in the Mid-Atlantic U.S., for design and construction projects located outside the Mid-Atlantic region, it may be necessary to adapt the standards to local environmental conditions and local codes.

4.1.11. These SDS apply to the National Zoological Park (NZP). However, animal facilities and exterior habitats have unique requirements that this manual might not fully address; therefore, close coordination with SI staff and NZP animal experts will be required for the design of animal facilities. All required coordination shall be facilitated through the COTR. The COTR will also help the A/E obtain standards for animal safety and animal facilities from the NZP. Projects at the NZP must coordinate with all concerned departments, which include, but are not limited to, Planning & Strategic Initiatives, Horticulture, Exhibits, and Animal Programs.

4.1.12. The rehabilitation of historic buildings will utilize best practices and technologies in retrofitting to promote the long-term viability of the buildings and to reduce deterioration of the building structure.

4.1.13. The design of alterations to SI historic buildings will adhere to the Secretary of the Interior’s Standards for the Treatment of Historic Properties. A copy of Smithsonian Directive 418 SI Historic Preservation Policy for guidance on historic preservation projects can be obtained from the COTR. A number of SI facilities have a Historic Structures Report that identifies important historic spaces in the building and the historic character-defining elements.

4.1.14. All new construction, exhibits, barrier removal, alterations, repair, and restoration of facilities and grounds, whether owned or leased by the SI, must adhere to the Smithsonian Guidelines for Accessible Design (SGAD), latest edition, which includes the Smithsonian Guidelines for Accessible Exhibit Design (SGA/ED) and the SI Checklist for Accessible Information Desks, and incorporates both the Department of Justice (DOJ) ADA Standards for Accessible Design and the General Services Administration (GSA) Architectural Barriers Act (ABA) Accessibility Standards for Federal Facilities.

4.1.15. Fundamental commissioning, as defined by the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) rating systems, of all relevant design and construction projects is required, even if the project is not eligible to pursue LEED certification. Enhanced

Commissioning (as defined by the LEED rating systems, including the requirement for a third-party commissioning provider) is required for larger projects pursuing LEED certification, based on the size and complexity of the project.

4.1.15.1. The SI may develop the Owner's Project Requirements (OPR) related to commissioning for a given project and provide it to the A/E with the A/E scope of work or program statement when requesting a fee proposal for design services. Alternatively, the SI may require the A/E team or the third-party commissioning provider to assist in developing the OPR for a given project as part of pre-design services.

4.1.16. A Life Cycle Cost Analysis for a given project, including total owning and operating cost, will be submitted to the SI for evaluation. Building system and large component design will be evaluated on the total owning and operating cost based on at least a 20-year design analysis. Refer to the Special Conditions for A/E Services and the A/E Scope of Work, provided by the COTR, for a given project for specific deliverable requirements.

4.1.16.1. Refer to Design Guidelines Chapter 8- Site in Volume 1 for incorporation of life-cycle considerations for exterior spaces.

4.1.17. The design of any new SI building or landscape to be located on the National Mall or any proposed change to the exterior of any existing Mall building or landscape will be reviewed by the National Capital Planning Commission (NCPC) and the Commission of Fine Arts (CFA) as well as by the DC State Historic Preservation Office. In addition to Mall facilities, the NCPC will review designs for all SI facilities within the National Capital Region.

4.1.17.1. District of Columbia (DC) projects whose design or construction process includes changes affecting pedestrian or vehicular traffic may require review by the District Department of Transportation (DDOT) and/or the National Park Service (NPS), coordinated through the COTR by the SF Master Planning Office, depending on jurisdiction over streets and sidewalks.

4.1.18. During the planning process, environmental documentation will be prepared for projects in accordance with the requirements of the National Environmental Policy Act. The design must implement specific mitigation measures listed in the Environmental Assessment Statement (EAS) and/or in the Environmental Impact Statement (EIS).

4.1.19. The SI has issued risk assessment reports for many SI facilities. These reports contain specific recommendations for risk mitigation. The reports may be obtained for each applicable project by the COTR.

4.1.20. The standards listed in this section apply to new construction and major renovation projects and may apply to some repair and maintenance projects. A/E will refer to International Building Code (IBC) Alteration Levels to define major renovations as part of the comprehensive code analysis required at the beginning of every project.

4.1.21. The design team will implement the multi-disciplinary approach of Crime Prevention Through Environmental Design (CPTED) to integrate safety and security into the built environment. A fundamental concept of CPTED is that "the proper design and effective use of built-in environmental factors lead to the reduction in fear and incidence of crime and an improvement of the quality of life." CPTED strategies include elements of natural territoriality, natural surveillance, natural access control, maintenance, and activity support.

4.2. DOCUMENTATION REQUIREMENTS

4.2.1. The design will be in accordance with the SI A/E Special Conditions, which is provided to the A/E by the COTR.

4.2.2. The SI Directive 111 Metrication requires that measurements will be in the metric system. Any decision to deviate from this requirement must be made by the OPDC Director, through the COTR, and will be made on a case-by-case basis.

4.2.3. The A/E will prepare a systems design narrative and a design analysis book, including calculations and fixture cut sheets, when appropriate for the project and when required by the A/E scope of work, as outlined in the SI A/E Special Conditions.

4.2.4. All design projects are required to complete a checklist for each discipline's services (i.e., architectural services, mechanical services, plumbing services, electrical services, fire protection services, etc.) at each design development submission as part of the SD-410 review. The checklist can be provided by the COTR.

4.2.5. Every new facility or major facility renovation will be designed so that all components comprise an integrated solution that works in conjunction with specific building programs, so that facility operation, energy usage, and other criteria may be optimized. Full integration and optimization of site improvements should be included in the project if they are required. See Design Guidelines Chapter 8- Site in Volume 1 for further guidance.

4.3. FIRE PROTECTION EQUIPMENT REQUIREMENTS

4.3.1. All fire protection designs will use equipment that has been tested and listed or approved for its intended use by a Nationally Recognized Testing Laboratory (NRTL) (e.g., UL, FM).

4.3.2. All equipment components specified in designs will be compatible with existing equipment and installed as required by the applicable National Fire Protection Association (NFPA) codes and standards and manufacturer recommendations.

4.3.3. System reliability, longevity, and serviceability will be included as criteria in design decisions and when specifying fire protection and life safety system components.

4.3.4. Written acceptance tests and/or operating procedures will be prepared and executed for all new system installations and/or modifications to verify that the system performs as required. Acceptance test procedures will be required as a separate submittal from the contractor based on the specified system performance and the specific equipment installed. Any deficiencies noted during the tests will be documented and tracked until resolved or corrected. Operating procedures will be required as part of the as-built documentation submittals.

4.4. FIRE PROTECTION DESIGN ANALYSIS

All designs require a fire protection design analysis, separate from other disciplines. This analysis must address the fire protection requirements of the project as set forth in the SDS. A summary of the analysis will be provided with the concept submission. Where applicable, the analysis will discuss the following minimum fire protection provisions (including prescriptive requirements vs. protection provided):

4.4.1. Building code analysis (i.e., type of construction, height and area limitations, and building separation or exposure protection)

4.4.2. Occupancy classifications

4.4.3. Requirements for fire-rated walls, fire-rated doors, fire dampers with their fire-resistive ratings, smoke compartmentation, and smoke barriers

4.4.4. Means of egress in accordance with NFPA 101, Life Safety Code (occupant loads, exit capacities, etc.)

4.4.5. Analysis of automatic sprinkler systems and other suppression systems and protected areas, including hydraulic analysis of required water demand

4.4.6. Water supplies, water distribution, and location of fire hydrants

4.4.7. Smoke control methods and smoke control systems

4.4.8. Fire alarm systems (including types of alarm systems and locations of fire alarm equipment)

4.4.9. Fire detection systems (including the types of detection systems and locations of detectors)

4.4.10. Standpipe systems and fire extinguishers

4.4.11. Interior finish ratings

4.4.12. Connections to and descriptions of fire alarm supervising systems

4.4.13. Occupancies and hazardous areas associated with the facility

4.4.14. Coordination with security and antiterrorism requirements

4.4.15. Fire Department access

4.4.16. Unique requirements applicable to the project or facility (e.g., animal housing facilities)

4.5. PERFORMANCE-BASED DESIGN

4.5.1. It is permissible, often necessary, and usually desirable that performance-based fire safety design methods be applied to the renovation, restoration, remodeling, or modernization of existing facilities to address the evaluation of a subsystem, system, or complete building when it is not possible to meet the provided prescriptive requirements for new construction. Design approaches will follow the methodologies established in the Society of Fire Protection Engineers' *Guide to Performance-Based Fire Protection* or *Performance-Based Fire Safety Design* and will allow adequate time and input from all stakeholders.

4.5.2. Performance-based approaches to meeting the goals and objectives outlined in NFPA 909, *Protection of Cultural Resource Properties – Museums, Libraries, and Places of Worship*, or NFPA 150, *Fire Protection and Life Safety for Animal Housing Facilities*, will be permitted, subject to the approval of OSHEM, through the COTR. Performance-based fire safety design methods must not be used to eliminate the retained prescriptive requirements as described in the performance-based chapter of NFPA 101, *Life Safety Code*.

4.5.3. Required design fire scenarios, performance criteria for acceptance, and input parameters for fire models used in the performance-based analysis will be approved in advance by OSHEM, SI curatorial staff, and other stakeholders, through the COTR.

COMMENTARY: Fire protection design analysis determines if the significant fire protection features for proposed buildings and modifications are addressed at the early stages of the project, minimizing the potential impact of fire protection changes. When addressed early, these features can often be included in an efficient and cost-effective manner, and code-permitted offsets can be maximized.

4.6. PLAN REVIEW REQUIREMENTS

4.6.1. All new projects, renovations, and modifications, including associated scopes of work, will be submitted to the COTR for Office of Safety, Health, and Environmental Management (OSHEM) review and approval.

4.7. FIRE SAFETY DURING CONSTRUCTION AND RENOVATION

4.7.1. Coordinate, through the COTR, with the facility prior to and concurrent with design.

4.7.2. Continuity of Fire Protection:

4.7.2.1. Project designs and phasing plans must give priority to maintaining the operability of existing fire suppression, detection, and alarm systems.

4.7.2.2. Where impairment of a fire suppression, detection, or alarm system is unavoidable, projects will be planned to ensure all combustibles are removed from an area prior to impairing automatic sprinkler protection, and hot work will not be conducted during these periods.

4.7.2.3. Where demolition operations require the removal or impairment of fire detection and alarm systems in an area, temporary fire detection/alarm systems will be provided.

4.7.2.4. Temporary fire alarm systems will be monitored by the building's existing fire alarm panel.

4.7.2.5. Wireless fire alarm systems may be used to provide temporary protection during construction.

4.7.3. All occupied areas will be separated from demolition, renovation, or construction activities by temporary smoke-tight construction partitions of gypsum board or other approved non-combustible or limited-combustible material in accordance with the requirements of NFPA 241, *Safeguarding Construction, Alteration, and Demolition Operations*. Barrier design will be detailed in project documents.

4.7.4. Temporary construction barriers/partitions will be full height, extending through suspended ceilings to the floor slab or roof deck above and will be one-hour fire rated, unless sprinklers are installed and are operational on both sides of the temporary partition, whereupon the partition may be permitted to terminate at the ceiling in accordance with NFPA 241.

<u>COMMENTARY:</u> This requirement is due to the inherently greater potential for fire or hazardous materials incidents associated with the combustibles and operations of demolition/construction. This risk is heightened by the likelihood of compromised fire protection systems and fire/smoke-resistant barriers. This does not obviate the need to provide other protective measures to contain dust and debris as specified under other SI requirements.

4.7.5. Sprinklers will be considered operational when they are installed and maintained in accordance with NFPA 13, *Installation of Sprinkler Systems* (including spacing, protection, distance from the ceiling, and adequate automatic water supply).

4.7.6. Construction will be phased as necessary to ensure that exits are not obstructed or reduced in width. If exits must be obstructed during construction, alternate exit routes will be provided during each phase of construction and alternate routes identified on the construction drawings.

COMMENTARY: The impact of construction on nearby occupied areas must be evaluated to ensure adequate egress is maintained for occupants in these spaces. Temporary egress paths may need to be provided. Where adequate egress cannot be maintained, it may be necessary to temporarily close areas adjacent to the construction.

4.7.7. Disruptions to fire alarm and sprinkler system service will be minimized or avoided. Delineate construction phasing to ensure that new system installations are expedited, and where possible, maintain existing systems in service until the replacement system is operational. If fire protection systems are to be impaired, follow the SI Fire System Impairment Permit to ensure procedures are implemented. Maintain equivalent levels of fire protection and provide formal notification to the facility while systems are down via the fire protection system impairment process.

COMMENTARY: Impairment of fire systems during modifications and construction activities can subject SI facilities and occupants to greater risk. Application of these guidelines manages this risk to allow continued facility operations concurrent with construction. Providing adequate exits and sprinkler protection are especially effective in ensuring adequate fire protection and life safety.

4.7.8. Contractors will furnish their own fire extinguishers when an area is vacated for renovations. SI-owned fire extinguishers will be removed from the vacated area and returned (or replaced with new extinguishers) prior to re-occupation by SI.

4.7.9. Hot work operations involving open flames or spark-producing processes will be minimized by using offsite fabrication or alternate work methods.

COMMENTARY: Hot work has been a major cause of fires at the SI since its establishment in 1846. Constant attention to this source of ignition is a strict requirement for all SI work. Modifying projects to avoid or reduce hot work is preferable to conducting such high hazard operations on site.

4.8 SECTION NO LONGER USED

5. QUALITY REQUIREMENTS

5.1. GENERAL REQUIREMENTS

5.1.1. The quality level of buildings and sites shall correspond directly to the type of building or site, its primary purpose, and its anticipated service life expectancy. There are four building categories that are broadly defined by a combination of their central function and average service life:

5.1.1.1. Principal structures and sites constitute major, monumental buildings of historic significance that are characterized by a very long service life of more than 100 years.

5.1.1.2. Support structures and sites maintain staff and related activities and are characterized by a long service life of approximately 50 to 100 years.

5.1.1.3. Service buildings and sites support service and maintenance functions and are characterized by a service life of 25 to 50 years.

5.1.1.4. Research categorization refers to buildings and sites with special conditions based on usage and determined on a case-by-case basis.

5.1.2. All equipment will be new unless the project scope identifies equipment that can be reused. All new equipment will be of the best quality and the latest design with proven technology and must be readily available for use. Equipment will be inspected prior to delivery to the job site to ensure that there are no defects in workmanship or materials.

5.1.2.1. All equipment and products specified and installed will be standard items of production that have a minimum of three years' proven, successful field experience that involved operation or usage under conditions equivalent to those of the project on which they are applied.

5.1.2.2. All equipment will be specified and installed strictly in accordance with manufacturer recommendations.

5.1.3. All materials and finishes will meet performance criteria established in these Smithsonian Design Standards (SDS), which are based on industry standards for museums and other large public buildings with high visitation. The criteria address design, durability, ease of maintenance, and safety issues.

5.1.3.1. The Architect/Engineer (A/E) shall provide manufacturers' cut sheets and third-party certification(s) to substantiate performance claims.

5.1.3.2. Areas of concern for each proposed material and finish include, but are not limited to: hardness, durability, wear, use of recycled materials, ease of material replacement, material fire properties (flame spread, smoke development), coefficients of friction, UV protection, color permanence, effects of natural and artificial light, indoor air quality, low VOC content, cleaning solvents, and best maintenance practices.

5.1.3.3. Energy efficient materials will be used where possible when such materials meet the user's performance requirements.

5.1.3.4. Products containing asbestos will not be specified or used.

5.1.3.5. Materials containing lead – including finishes, coatings, or paints – will not be specified or used.

5.1.4. As much as possible, existing soils, vegetation, and site hydrology should be considered resources to be preserved, conserved, and enhanced through the choice of design strategies, the selection of materials, and the development of performance criteria systems selection and assembly. See Design Guidelines Chapter 8- Site in Volume 1 for further guidance.

6. SUSTAINABILITY

6.1. SUSTAINABILITY AND ENERGY PERFORMANCE REQUIREMENTS

6.1.1. The Smithsonian Institution (SI) Directive 422 *Sustainable Design of Smithsonian Facilities* affirms SI's commitment to environmental stewardship by incorporating principles of sustainability and energy efficiency into all building projects.

6.1.2. Although the SI is not an executive branch of the U.S. government, SI is committed to following the strategic objectives and goals of federal energy and environmental mandates, standards, and guidelines to the fullest extent practical. The latest SI sustainability directives and the latest edition of Smithsonian Facilities (SF) Codes, Standards, and Guidelines will be referenced for relevant requirements.

6.1.3. As of the publication of this document, applicable federal energy and environmental mandates, standards, and guidelines include those listed in Design Guidelines Chapter 3- General Information in Volume 1.

6.1.4. The SI has set goals for Leadership in Energy and Environmental Design (LEED) certification for eligible new construction, major renovation, and interior renovation projects as well as selected existing buildings. Eligible projects with construction budgets less than $2.5 million will have a goal to become LEED Certified. New construction and major renovation projects with construction budgets equal to or greater than $2.5 million but less than $5 million will have a goal of LEED Silver Certification. Projects with construction budgets equal to or greater than $5 million will have a goal of LEED Gold Certification.

6.1.4.1. All projects pursuing LEED certification must be registered on the LEED online system by the 35% Design Submission milestone date.

6.1.5. Projects that cannot pursue LEED certification, such as exhibitions, nevertheless shall follow the SI sustainability goals and the best practices and recommendations cited in LEED documentation regarding sustainable design.

6.1.5.1. Wherever possible in exhibition construction, the reconditioning and reuse of existing equipment and furniture as well as the use of low-VOC, recycled, or locally sourced materials and of energy-saving lighting and equipment will be encouraged.

6.1.6. Sustainable land design, construction, and maintenance practices will be the foundation of all new design work.

6.1.6.1. For projects with a site work component, Sustainable Sites Initiative (SITES) principles will be incorporated as applicable and appropriate.

a. Adoption of SITES metrics for tracking site-specific sustainable site practices is strongly encouraged to ensure tracking that may be missed through LEED point systems. The SITES tracking should be seen as parallel and complementary to LEED tracking.

6.1.7. Consider site design strategies that demonstratively reveal healthy functioning and sustainable site ecological systems. Utilize on-site interpretive materials to highlight environmentally sensitive practices. This may include maps, models, or brochures that explain sustainable features or processes, operations, and/or maintenance.

6.1.8. Consider materials and products that minimize resource use and decrease damage to the environment caused by material harvesting, production, installation, and use.

6.1.9 Sustainable strategies and products continue to evolve. Consider new approaches and technologies that might be more effective in meeting the goals and standards of the project.

7. PLANNING

7.1. BUILDING SPACE REQUIREMENTS

7.1.1. The mechanical system will be considered an essential element of each building. Adequate space will be allocated for it in a manner that will permit installation of a well-designed system capable of being operated and maintained.

7.1.1.1. Space will be planned around each piece of equipment based on either the manufacturer's recommendation at the minimum per code or the space required for service, whichever is greater.

7.1.2. The Fire Control Center (FCC) will be located near the designated entrance in each building.

7.1.3. The Smithsonian Institution (SI) Space Guidelines, latest edition, provide space standards for offices, and can be provided to the A/E by the COTR.

7.1.4. Collections storage rooms will be dedicated to the specific purpose of storage of collections. See Design Guidelines Chapter 9- Space Requirements in Volume 1 for more information.

7.1.4.1. It is recommended that related activities, such as the processing, research, and conservation of objects, take place in collections spaces adjacent to the storage rooms.

7.1.5. For planning purposes, a 3657-mm (12 ft) cube will be used to determine the space requirements for the loading dock area, the freight elevator, and collections corridors.

7.1.5.1. This space requirement allows for movement of collections objects through the building.

7.1.6. Separation between public spaces and non-public, more secure spaces shall be a planning consideration for new museum facility and major renovation projects.

7.1.6.1. Public areas such as lobbies, loading docks, mail rooms, garages, and retail areas must be separated from more secure areas.

7.1.6.2. Public-use spaces, such as exhibition halls, conference centers, auditoria, IMAX theaters, and food service areas must be separated from other areas of the building during public events held after hours.

7.1.6.3. Egress paths from public spaces will not pass through staff-only areas.

7.1.6.4. Elevators are not allowed to be used for staff/public separation.

7.1.6.5. The follow table identifies requirements for space planning. Group staff-only areas together to reduce the public/staff transition points as much as operationally feasible which minimizes electronic access control requirements. The aggregate groupings of staff spaces will provide both vertical and horizontal access controls to enable adequate public and staff separation points.

Classification	**Public**	**Staff Only**	**Not on Exterior Wall**
Animal Holding		X	
Audio Visual		X	
Collection Management Space		X	X
Control Room		X	
Control Room, Security		X	X
Day Care		X	
Dwelling		X	
Exhibit	X		
Exhibit, Object		X	
Laboratory		X	
Laundry		X	
Library/Archives		X	X
Live Collections		X	
Locker Room		X	
Lounge		X	
Mechanical/Electric		X	
Medical Facility		X	
Office		X	
Publication		X	
Recreation		X	
Retail	X		

Classification	Public	Staff Only	Not on Exterior Wall
Roof		X	
Security		X	
Shipping/Receiving		X	
Shower		X	
Storage		X	
Storage, Collections		X	X
Telemarketing		X	
Utility Closet		X	
Veterinary Facility		X	
Visitor Services	X		
Waste Room		X	
Workroom		X	

7.1.7. Design building systems with consideration for future revitalization projects that occur throughout the building's evolution. Oversize systems and spaces housing systems as much as is feasible. Give careful attention to location of systems and access to easily facilitate routine maintenance for the lifespan of the system and potential for future expansion. Select systems for durability, longevity, and ease of replacement when necessary. Also strongly consider compatibility with existing systems.

7.2. PLANNING REQUIREMENTS

7.2.1. SI integrates safety and security into the planning process of every project. Proper planning and design provide a solid foundation for preventing, and if necessary, reacting when an emergency, criminal, or terrorist incident occurs. Effective design of building layout and orientation can significantly reduce opportunities for and reduce the impact of criminal or terrorist events.

7.2.1.1. Not Used.

7.2.2. Incorporating safety and security into the planning process integrates measures that may not require additional cost if done at the beginning of the design process and integrated with other requirements. Alternatively, decisions made during planning can have a negative impact on safety and security, decreasing the ability to provide a safe facility or make it very expensive.

7.2.3. The planning and design process must involve local government agencies, OPS, security consultants, and facility engineering personnel.

7.2.4. The measures presented here are not all-inclusive, and additional technical information for implementation can be found in the referenced documents.

7.2.5. Master Planning. Accommodate present and future security needs for new and existing facilities. Consider threats and levels of protection for facilities. For site planning this may include standoff from parking, perimeters, entry control facilities, utilities, and the location of high value assets.

7.2.6. Off-site. Consider adjacent properties as they impact potential threats and can present opportunities or additional requirements for the facility's security requirements. Such as a high threat of terrorist or criminal activities, proximity of adjacent structure impact on standoff distances, providing views of critical assets, or providing screening, traffic control, and sharing surveillance operations or access control. Consult with OPS on specific concerns or opportunities from off-site properties.

7.2.7. Site. Integrating security into the site plan helps to make the site inviting and not intrusive or intimidating. Site planning includes:

7.2.7.1. Locate and orient the building to support standoff distances, natural access control, and natural surveillance.

7.2.7.2. Where possible, provide underground, concealed, and protected utility infrastructure; located away from high value assets.

7.2.7.3. Provide redundant utility systems that have physically separate feeds.

7.2.7.4. Defining vehicle and pedestrian traffic patterns to support territoriality, natural access control, and provide space of security screening and queuing.

7.2.7.5. Locate parking facilities, passive & active vehicles barriers to support standoff distances and provide protection against vehicle ramming attacks.

7.2.7.6. Identifying space for exterior pedestrian queuing and consider providing protection against vehicle ramming attacks.

7.2.7.7. Locating spaces for public use that support natural surveillance and does not create 'hiding' areas.

7.2.7.8. Use fencing to define private areas, reinforce territoriality, provide a physical barrier and psychological deterrent.

7.2.8. Building. Incorporating security requirements into the building can include blast resistance, walls, windows, and openings, CBR detection and protection, protecting utilities, lighting, and backup power requirements.

7.2.9. Interior. Planning the interior layout and space adjacencies enhance security by layering security within the building, potentially reducing electronic mitigation measures. This includes limiting building entrances, providing space for lobby queuing and screening, separating public and nonpublic areas, and locating critical areas away from public areas.

8. SITE

8.1. SITE REQUIREMENTS

8.1.1. Protect and restore the natural ability of soils, vegetation, and associated topography to absorb rainfall, remove pollutants, evapotranspirate, and recharge groundwater. When possible and appropriate, manage on-site stormwater to reduce flow to storm sewers by creating absorbent soils and landscape conditions or by using man-made facilities.

8.1.2. Use data gathered during site inventory and analysis to inform all design decisions for all water needs. Water analysis should focus on quantification and evaluation of absorptive capacity, surface permeability, and drainage. See Technical Section 32- Exterior Improvements in Volume 1 for more information.

8.1.3. Manage water as a site resource. Consider surface and stormwater management, potable water needs, irrigation, and wastewater disposal.

8.1.3.1. A viable, sustainable water budget will be established for the project within the context of the overall facility. Some portion of the water budget will be apportioned for landscape construction and maintenance. Irrigation design will adhere to the approved water budget.

8.1.3.2. Review the historic site conditions to identify previous drainage patterns and soil and vegetation conditions.

8.1.3.3. Conduct a baseline analysis of current water conditions and context that focuses on absorptive capacity, surface permeability, and drainage. Gather data pertaining to supply stream, drainage area, hydrologic features and flow paths, neighboring sites and structures, sewers, tidal conditions, and zoning and code requirements.

8.1.3.4. Design projects to decrease sewer overflows that contribute to stream contamination and flooding. Designs should improve groundwater recharge, evapotranspiration, and water harvesting for plantings.

8.1.3.5. Whenever possible, increase the absorption capacity of the site through the use of a porous soil matrix that allows for infiltration and plants that absorb and evapotranspirate moisture. Decrease areas of unnecessary impermeable surfaces in order to reduce runoff.

a. Retrain and infiltrate stormwater into subsurface layers to reduce the volume of runoff entering the sewers and to increase groundwater recharge.

b. Capture runoff from storm events and provide water quality treatment while slowing and reducing discharge.

c. Use tanks, cisterns, rain barrels, and other vertical containers to harvest and store runoff from buildings during rain events. Dry wells may also be used to temporarily store and slowly infiltrate runoff.

d. Use stormwater as a resource by directing stormwater runoff to plant beds where infiltration, limited ponding, detention, and pollutant filtering can occur.

8.1.4. Soil characteristics play a major role in the health of vegetation and in water management. It is essential to determine soil conditions early in the design process and is critical to achieving a high-performance landscape. See Technical Section 32- Exterior Improvements in Volume 1 for more information.

8.1.5. Soil is a dynamic natural system that will be managed as a site resource. An understanding of the quality, contamination, percolation, and bearing capacity of existing soils shall guide design, construction, and maintenance.

8.1.5.1. To the greatest extent and wherever possible, minimize soil disturbance to preserve and protect soil resources from damage by limiting the area of site disturbance and controlling erosion and compaction during construction. This critical step preserves soil structure and maintains infiltration and groundwater recharge. It can be a costly and time intensive process to recreate the structure and function of natural soil.

8.1.6. Identify, assess, and protect existing vegetation for aesthetic, cultural, historic, and ecological value. Preserve existing on-site vegetation and its stormwater management, air quality, and microclimate benefits. See Technical Section 32- Exterior Improvements in Volume 1 for more information.

8.1.7. Manage existing and new vegetation as a resource.

8.1.7.1. Identify vegetation that should be preserved or enhanced and mitigate invasive vegetation as necessary.

8.1.7.2. Create species-specific, critical root zone (CRZ) protection areas to prevent construction damage and soil compaction.

8.1.7.3. Develop site plans and building locations to preserve existing trees and other significant vegetation together with existing stormwater drainage patterns to preserve existing water resources for vegetation.

8.1.7.4. Plan site stormwater management, water harvesting, and irrigation strategies around vegetation needs.

8.1.7.5. Ensure adequate watering of vegetation during establishment periods for new plantings, even for landscapes that will ultimately not be irrigated.

8.1.8. To ensure that projects are cost-effective and easily buildable, integrate construction planning into the design phase as early as possible. This allows for the establishment of realistic and comprehensive project goals, budgets, schedules, and cost or time-saving strategies.

8.1.8.1. Create detailed construction staging and scheduling plans to understand and control site work to protect soils, vegetation, and water resources throughout the duration of construction. This should improve the understanding of the scope of work, the needed construction documentation, and the accuracy of bidding and scheduling information.

8.1.8.2. Refer to Technical Section 02 - Existing Conditions in Volume 1 for temporary tree, vegetation, and soil protection requirements.

8.1.9. Not Used.

8.1.10. All projects dealing with building exteriors and all exterior staging areas must coordinate, through the Contracting Officer's Technical Representative (COTR), with Office of Facilities Management and Reliability (OFMR) personnel, including building management and Smithsonian Gardens personnel. Projects must adhere to the Smithsonian Institution (SI) Gardens standard technical specification sections, available through the project COTR, and which include, but are not limited to: Protection of Flora, Fauna, Irrigation Systems; Topsoil; Tree Protection; Lawns and Grasses; and Irrigation.

8.1.11. Register all applicable District of Columbia (DC) projects online with the Department of Energy & Environment (DOEE) Stormwater Database, listing the appropriate Smithsonian Facilities (SF) official as the owner's representative.

8.1.12. The design, location, and layout of all infrastructure will minimize the need to remove or replace finished surfaces and or plantings when upgrades or repairs are required. This consideration applies to elements adjacent to infrastructure as well as accessible pathways to the infrastructure.

8.1.13. All site infrastructure systems will be selected for durability and longevity as SI facilities are expected to last the test of time.

8.1.14. All sites will incorporate universal accessibility requirements as outlined in the Smithsonian Guidelines for Accessible Design (SGAD). In addition, consideration will be given to providing family-friendly amenities such as stroller parking. Specific requirements to make sites family friendly will be defined on a project-by-project basis through discussions with project stakeholders.

8.2. SITE PLANNING REQUIREMENTS

8.2.1. CPTED. Apply principles of Crime Prevention Through Environmental Design (CPTED) where appropriate. CPTED is a crime prevention strategy that uses architectural design, landscape planning, security systems and visual surveillance to influence human behavior to reduce crime. CPTED usually involves the use these principles:

8.2.1.1. Territorial reinforcement (using buildings, fences, different paving material, changes in street elevation, signs, and other landscaping to express ownership by distinguishing to potential offenders' private spaces from public spaces).

8.2.1.2. Natural surveillance (placing physical features, activities, lighting, and people to preclude blind spots or hiding spots to keep intruders easily observable).

8.2.1.3. Natural access control (strategic placement of entrances, exits, fencing, landscaping, and lighting to create in potential offenders a perception of risk); Target hardening (use of features that prohibit entry or access, such as perimeter boulders/large rocks, streetscape furniture, art ornaments, etc.).

8.2.1.4. Maintenance (trimming or otherwise removing vegetation that obstructs visibility for security forces, local law enforcement, employees, concerned citizens, or video surveillance; or interferes with lighting or intrusion detection systems).

8.2.2. Landscape. Landscaping may be used as a protective measure to obstruct views from outside a facility or as a physical barrier. A balance must be achieved between its usefulness in protection and its potential negative impact on security measures.

8.2.2.1. Design pedestrian and vehicle circulation to support emergency operations.

8.2.2.2. Use a combination of active and passive barriers to enforce standoff distances, control access, and separate public and nonpublic areas. These security measures should not impede access to public entrances or pedestrian flow on adjacent sidewalks.

8.2.2.3. Design landscape elements to provide visual screening of sensitive areas without creating hiding spaces.

8.2.2.4. Avoid dense vegetation near buildings.

8.2.2.5. Ensure the long-term growth of vegetation will not interfere with natural surveillance, create hiding spots, or interfere with video surveillance cameras, or lighting.

8.2.2.6. Use physical and symbolic barriers to define public, semi-public, and private spaces.

8.2.2.7. Consider wide pathways and colored paving to improve natural surveillance and wayfinding.

8.2.2.8. Place trash receptacle as far away from the building as possible; trash receptacles should not be placed within 30 feet of a building.

8.2.3. Site Lighting. Design site lighting to support security requirements while controlling light pollution, and site-specific hierarchy.

8.2.3.1. 8.2.4.1 Enhance visibility, provide wayfinding, and support video surveillance.

8.2.3.2. Illuminate potential areas of concealment.

8.2.3.3. Enhance the observation of security patrols.

8.2.3.4. Provide for the safety of personnel moving between adjacent parking areas, streets, alleyways, and around the facility.

8.2.3.5. Maintain a uniformity ratio (average: min) of – 4:1.

8.2.4. Site Utilities

8.2.4.1. Protect utilities by placing them underground.

8.2.4.2. Secure manhole covers 10 inches or more in diameter to prevent unauthorized opening.

8.2.5. Fencing

8.2.5.1. Fences are a traditional choice for security barriers, primarily intended to discourage or delay intruders or serve as a barrier against standoff weapons or hand-thrown weapons. Familiar fence types include Chain-link, Monumental, Anti-climb, and Wire.

8.2.5.2. These fence types are primarily intended to delay intrusion, but they can act as a psychological deterrent when an aggressor is deciding which building to attack.

8.2.5.3. Use fences to restrict access to sensitive areas or direct pedestrian traffic to authorized areas or entrance.

8.2.5.4. Fences provide very little protection against vehicles but can be constructed as engineered anti-ram systems.

8.2.5.5. Provide open space (clear zone) inside and outside the fence for both maintenance and visual surveillance. Twenty (20) feet on both sides of the fence is desired. Coordinate minimum requirements with OPS.

8.2.5.6. Higher levels of protection, intended to prevent determined intruders, are achieved using anti-climb fences or razor/barbed wire.

8.2.6. Anti-ram Vehicle Barriers (Active and Passive)

8.2.6.1. Anti-ram barriers (also known as Crash Barriers) protect the site against vehicle with explosive devices or vehicle ramming attacks.

8.2.6.2. The location of anti-ram barriers is based on standoff distance requirements, the design base threat (DBT) gathering areas, and available space.

8.2.6.3. The design must consider emergency evacuation and access for first responders in the event of an incident.

8.2.6.4. Implement traffic calming measures to reduce vehicle speeds throughout the site.

8.2.6.5. Passive barriers are fixed in place, do not allow for vehicle entry, and are used to provide perimeter protection away from vehicle access points. Examples include:

- Walls, berms, engineered planters,
- Fixed bollards, heavy objects, reinforced street furniture, fixtures, and trees
- Water obstacles
- Anti-ram fences

8.2.6.6. Active barriers are mechanical devices used at vehicular access control points within a perimeter barrier system, or at the entry to specific buildings within a site, such as a parking structure or a parking garage within an occupied building, to provide a barrier for vehicle screening or inspection. Examples include:

- Retractable bollards
- Plate barriers
- Wedge barriers
- Finger barriers
- Crash beams
- Crash gates

8.2.6.7. Active devices must be used in conjunction with signage, light signals, guard booths, and security personnel.

8.3. SITE CONSIDERATIONS

8.3.1. Provide access for emergency vehicles to SI buildings and additions, including Annex D, in accordance with the International Fire Code (IFC). Emergency access designs will include roads, fire lanes, and turn-arounds that can accommodate the weight and turning radius of fire apparatus. Consult local fire department for fire apparatus requirements. At a minimum, one of the long sides of every building will be accessible to fire department equipment.

8.3.2. The distance between structures, the fire ratings of exterior walls, the protection of openings from fire exposures, and other separations will comply with the International Building Code (IBC).

8.3.3. Urban wildlife interface clearances from combustible brush, trees, and other vegetation will be maintained per the International Wildland-Urban Interface Code (IWUIC).

8.3.3.1. If there are discrepancies between SI and another Authority Having Jurisdiction (AHJ), such as the National Park Service (NPS) or the Washington Metropolitan Area Transit Authority (WMATA), concerning the application of this code, then a wildland hazard assessment shall be completed and submitted to the Office of Safety, Health, and Environmental Management (OSHEM) for review.

8.4. WATER SUPPLY FOR FIRE PROTECTION

8.4.1. Private water distribution systems and water supplies will be installed in accordance with National Fire Protection Association (NFPA) 20 – *Standard for the Installation of Stationary Pumps for Fire Protection*, NFPA 22 – *Standard for Water Tanks for Private Fire Protection*, and NFPA 24 – *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*.

8.4.2. The water supply for fire protection shall have a minimum supply duration of two hours. New primary distribution mains will in no case be smaller than 12 in (300 mm); building/facility loops will be 8 in (200 mm) or larger; and fixed suppression feeds will in no case be smaller than 6 in (150 mm).

<u>COMMENTARY:</u> SI enforces at least a two-hour minimum water supply to sprinkler systems from a reliable/acceptable water source. Total required site-wide water supply volumes will be adequate to meet sprinkler and firefighting needs (flow rates and duration), based on an evaluation of national and local codes. Consult OSHEM prior to conducting such an evaluation.

8.4.3. Fire protection water supply distribution systems for all new installations will be looped to provide two-way flow, with sectional valves arranged to provide alternate water flow paths to any point in the system.

<u>COMMENTARY:</u> This allows for failure or maintenance on the water distribution loop while maintaining an alternate path to ensure a source of water is available at all times to fire protection systems.

8.4.3.1. A single feed may be allowed, provided the system is reviewed and approved by OSHEM.

8.4.3.2. Underground plastic pipe meeting the requirements of NFPA 24 is acceptable.

8.4.4. Facilities having a Maximum Possible Fire Loss (MPFL) in excess of $50 million shall have two independent sources of fire protection water.

<u>COMMENTARY:</u> Water supplies may be compromised during in-house or municipal repair and maintenance operations, placing entire facilities at significant risk. Providing a redundant water source for major facilities ensures fire suppression systems remain active at all times, reducing risk of property loss and business interruption.

8.4.5. <u>HYDRANTS</u>

8.4.5.1. Fire hydrants will be UL listed, FM approved, or listed or classified by a Nationally Recognized Testing Laboratory (NRTL) and must have two 2-1/2-in (65 mm) hose outlets and one 4-1/2-in (115 mm) suction connection with national standard fire hose threads in accordance with NFPA 24 and NFPA 1963, *Fire Hose Connections*. Hydrant connections will meet the standards of the local municipal water authority and fire department.

8.4.5.2. Wet-barrel or California-type hydrants are preferable in areas where there is no danger of freezing. Dry barrel or traffic-type hydrants must be used in areas where there is a danger of freezing. Hydrants must be the above-ground type.

8.4.5.3. Hydrants must be installed adjacent to paved areas, accessible to fire department apparatus. Hydrants must not be closer than 3 ft (1 m) nor farther than 7 ft (2.1 m) from the roadway shoulder or curb line. Hydrants must be installed with not less than 6-in (65 mm) connection to the supply main and valued at the connection. Barrels must be long enough to permit at least 18-in (450 mm) clearance between the center of the 4-1/2-in (115 mm) suction connection and grade. The ground must be graded so that any surface drainage is away from the hydrant.

8.4.5.4. Installation must be in accordance with NFPA 24. Suction connection will be perpendicular to the street to allow straight line connection to the pumper.

8.4.5.5. A sufficient number of hydrants must be provided so that hose stream demand can be met without taking more than 1,250 gpm (4,740 L/min) from any single hydrant. Hydrants must also be spaced in accordance with the following requirements:

a. All parts of the building exterior must be within 350 ft (106 m) of a hydrant, with consideration given to accessibility and obstructions. Hydrants must be located with consideration given to emergency vehicle access.

b. At least one hydrant must be located within 150 ft (45 m) of the fire department connection due to hose connections available on each fire truck, unless the local AHJ requires a shorter distance.

c. Hydrants protecting storage facilities will be spaced a maximum of 300 ft (91 m) apart.

d. Hydrants located adjacent to parking areas or other vehicle traffic areas must be protected by bollards. The bollards will not be located directly in front of an outlet.

9. SPACE REQUIREMENTS

9.1. GENERAL BUILDING SPACE REQUIREMENTS

9.1.1. Spaces for public functions, including conference facilities, exhibition halls, auditoria, restaurants, and retail areas, will be located near the main building lobby to the greatest extent possible. When not feasible, these amenities will be located adjacent to secondary lobbies or major public gathering spaces such as atria. Adjacencies will be carefully considered and reviewed with the Smithsonian Institution (SI).

9.1.2. Careful consideration will be given to the placement of any food service-related function within a museum, including, but not limited to, dining spaces, kitchens, and food prep spaces. Design teams will be mindful of odor to adjacent spaces when locating these functions and will design appropriate mechanical systems to mitigate this concern. Design teams will consider routine maintenance of all infrastructure systems and will place systems in easily accessible areas that do not put collections and exhibits at risk or necessitate downtime when service is needed. Pathways for deliveries and trash will be considered during design to mitigate impacts to adjacent museum spaces and to address pest migration concerns.

9.1.3. Elevator and escalator lobbies will be adjacent to the main lobby. It is preferred that elevators and escalators will be visible from the main entrance.

9.1.4. Shipping and receiving space will be located adjacent to the building loading dock.

9.1.5. Spatial requirements for various storage needs will be considered, including the following:

9.1.5.1. Smithsonian Enterprises (restaurant, retail, and theaters) requires sufficient back-of-house space to include on-site staff offices, cash rooms, materials handling, and storage space. Refer to Appendix J- Facilities Design Standards Smithsonian Enterprises Supplement in Volume 3 for specific, detailed Smithsonian Enterprises (SE) requirements.

9.1.5.2. Building management in each facility requires storage space for supplies and for items kept in stock such as lighting fixture replacement lamps, paper products, and cleaning products.

9.1.5.3. Museum programs require storage space for exhibit cases (although the amount of space for this purpose in museums on the National Mall is limited).

9.1.5.4. Special events at museums require storage space for furnishings and equipment such as tables, chairs, and stanchions.

9.1.6. Separations between finished or public spaces and building support spaces will address the following concerns:

9.1.6.1. Provide separation between equipment or mechanical rooms and finished or public spaces to prevent staff needing to access equipment for maintenance and repair from moving through office, exhibit, or collections storage spaces as well as through public restrooms.

9.1.6.2. Provide a buffer between mechanical and finished space to prevent potential problems of noise, vibration, and odors.

9.1.7. Place areas of high visitor activity away from key assets.

9.1.8. Locate assets in areas where they are visible to more than one person.

9.1.9. Eliminate hiding places within the building.

9.1.10. Stairwells required for emergency egress should be located as remotely as possible from areas where high risk incidents might occur and, wherever possible, should not discharge into lobbies, parking, or loading areas.

9.1.11. Consider sheltering in place and assembly areas in space planning.

9.1.12. Main Utilities:

9.1.12.1. All main utilities, such as the main distribution frame (MDF) or electrical switchgear, incoming electrical transformers, etc. will not be located adjacent to public spaces. This requirement does not include utility closets.

9.1.12.2. When feasible, utilities will be located internally to provide maximum protection from natural and manmade risks. When building codes or operational efficiencies require, main utilities will be located on exterior walls or the roof of the building where exposure to natural and manmade risks are mitigated.

9.1.12.3. Where feasible, utilities will be collocated to consolidate security protection requirements.

9.1.13. Location / Adjacency matrix

Space	Prohibited Adjacencies Do not located closer than 15.25 m (50 ft) horizontally or directly above or below	Acceptable Adjacencies
Emergency Generator and Fuel Storage	Main Entrance Lobby Loading Dock Mailroom Security Server Room Security Operations Center / Unit Control Room Security UPS Room	
Loading Dock	Fire Control Room Security Server Room Security Operations Center / Unit Control Room Security UPS Room Generators UPS Water Supply Main Electrical Switchgear Main Utility Service Entrances Emergency Egress Routes Flammable Liquids or Gas Storage Fresh-air Intakes	Trash Containers Freight Elevators Non-critical Bulk Storage Mailroom Non-critical Support Areas (i.e., maintenance spaces)
Mailroom	Fire Control Room Security Server Room Security Operations Center / Unit Control Room Security UPS Room Generators UPS Water Supply Main Electrical Switchgear Main Utility Service Entrances Emergency Egress Routes Flammable Liquids or Gas Storage Fresh-air Intakes	Trash Containers Freight Elevators Non-critical Bulk Storage Loading Dock Non-critical Support Areas (i.e., maintenance spaces)
Security Server Room	Main Entrance Lobby Loading Dock Mailroom Exterior Wall	
Security Operations Center / Unit Control Room	Main Entrance Lobby Loading Dock Mailroom Exterior Wall	

Space	Prohibited Adjacencies Do not located closer than 15.25 m (50 ft) horizontally or directly above or below	Acceptable Adjacencies
Security UPS Room	Main Entrance Lobby Loading Dock Mailroom Exterior Wall	

9.2. SPACE REQUIREMENTS- MUSEUM/EXHIBITION

9.2.1. Refer to the Comprehensive Master Plan or Comprehensive Development Master Plan for facility and program planning requirements for individual SI museums. The COTR will facilitate the A/E in obtaining these documents.

9.2.2. In new museum design and major renovations, consider a separate entrance for large visitor groups.

9.2.3. The design of permanent exhibition halls will incorporate durable materials that will meet the life expectancy of 25 to 30 years.

9.2.4. Provide a secure staging area at each museum or storage facility for crating and uncrating exhibitory and collections objects as they enter and leave the building.

9.2.5. The design of atrium spaces and other high-ceiling areas generally requires a smoke management study. In addition, the design must identify the means and methods for cleaning skylights, replacing lamps, and maintaining fire alarm devices, etc. These tasks need to be accomplished without the use of scaffolding.

9.2.6. In new facility design and major renovations, consider the location of a catering kitchen on each floor where special events will be held.

9.2.7. All water-bearing equipment and piping must be located outside of exhibit, gallery, and archival areas. Sprinkler piping locations must be carefully coordinated to minimize the risk to collections and exhibits from leaks.

9.3. SECTION NO LONGER USED.

9.4. SPACE REQUIREMENTS- SUPPORT SPACES

9.4.1. The minimum space requirements for building support spaces are as follows:

9.4.1.1. The minimum size of a janitor closet will be 1.7 m2 (18 sq ft).

9.4.1.2. The minimum size of an electrical closet will be 5.6 m2 (60 sq ft).

9.4.1.3. The minimum size of a communications closet will be 14m2 (150 sq ft). Communications closets will be stacked vertically where possible.

9.4.1.4. The minimum size of a security closet will be 3.7 m2 (40 sq ft) with a minimum ceiling height of 2,438 mm (8 ft). Security closets will be dedicated to security equipment.

9.4.1.5. All mechanical equipment rooms will have a minimum height of 3,658 mm (12 ft) and will be accessed through a pair of doors, each leaf having a minimum width of 1,067 mm (3 ft 6 in) and a minimum height of 2,134 mm (7 ft).

9.4.1.6. Provide storage space for equipment required for site maintenance including mowers, snow removal equipment, tools, fertilizers, herbicides, pesticides, etc.

9.4.1.7. Provide space within plumbing closets or separate irrigation equipment rooms for backflow preventers or reduced pressure zone (RPZ) devices and system controllers. Provide adequate space for personnel access and the ability to link systems to data systems for remote monitoring and controls.

9.4.1.8. Provide an area that is a minimum of 0.5 sq m (6 sq ft) for recycling containers in staff break rooms and vending areas.

9.5. SPACE REQUIREMENTS – OFFICE/ADMINISTRATION

9.5.1. The SI Space Guidelines, latest edition, provide space standards for offices. These guidelines may be obtained from the COTR.

9.5.2. Consider the planning module of the building – the internal dimensions for the placement of structural columns and window mullions – when establishing space standards for both existing buildings and new construction. Furniture workstations and closed offices will be planned early in the design to align with the planning module and bay size dimensions of the building.

9.5.3. Building space efficiencies will be determined by the following: plan configuration, floor plate depth, planning module, and circulation patterns. The historic character of an existing building may create significant inefficiencies in terms of established circulation, which can be wider than the current established corridor width standards, affecting the amount of available usable space for planning offices and/or workstation layouts. However, an historic building's design attributes will not be compromised to achieve greater space efficiencies.

9.5.4. Incorporate daylight and access to views of outdoor spaces in all regularly occupied areas of the building.

9.5.4.1. Maximize natural light in open space plans by keeping workstation partitions at lower heights, from 1,067 mm (42 in) high to 1,651 mm (65 in) at the spine that has overhead storage.

9.5.4.2. To maximize light when closed offices are required, offices will not be located at the perimeter window line. Rather, they will have an interior location at the core of the floor.

9.5.5. Circulation paths will be clearly recognizable and distinguishable from work areas.

9.5.6. Consider space for recycling receptacles during the planning process.

9.5.7. Consider long-term flexibility for future reconfigurations when designing office space. Demountable partitions may be used to meet this requirement.

9.5.8. Open plans with a high use of workstations, rather than closed offices, have a greater degree of efficiency and flexibility and provide easier distribution of heating, cooling, and natural light to the work areas.

9.5.9. Excluding circulation and support spaces, the average net workstation in a federal building is 7 m2 (75 sq ft).

9.5.10. Open-plan office areas will allow for ample circulation and open space between groups of workstations.

9.5.11. Space planning of open-plan office areas will consider that copy equipment rooms will be enclosed in order to meet the Indoor Environmental Quality Leadership in Energy and Environmental Design (LEED) standard.

9.5.12. Large conference rooms will be designed to meet audio-visual and teleconferencing program requirements. Phone and data outlets will be provided.

9.5.13. Disperse small meeting rooms outfitted with phone and data outlets throughout open-plan office areas. These rooms can be used for meetings, conference calls, and privacy.

9.5.14. Provide a staff break room equipped with refrigerator, microwave, and sink in office areas.

9.6. SPACE REQUIREMENTS – COLLECTIONS STORAGE

9.6.1. Consider the following guidelines when designing the layout of collections storage areas and selecting collections storage equipment:

9.6.1.1. Store as much of the collections as possible inside noncombustible files or cabinets.

9.6.1.2. Store items of extreme value in fire-resistive vaults, containers, or safes.

9.6.1.3. Planning of all new and renovated collections storage areas and facilities will be in accordance with Appendix D, Collection Storage Risk Levels in Volume 3, and with SI Directive 600, *Collections Management Implementation Manual: Collections Space Security Standards*.

9.6.1.4. When practicable, all designs for collections storage will follow the intent of the SI Strategic Plan, 2010 – 2015--

particularly the grand challenge of "Strengthening Collections" by striving to optimize the usage of collections spaces and appropriate temperature and humidity controls for the collections to be housed in those spaces with a pan-institutional focus on shared resources.

9.6.2. The preliminary design of collections storage areas must address the floor load requirements of the collections storage system.

9.6.3. In consultation with Collecting Unit staff and Smithsonian Facilities (SF), provide appropriate seismic measures in the design of collections storage facilities and equipment, including provisions for restraining items on open shelving and anchoring storage equipment.

9.6.4. Neither water nor sanitary waste piping is allowed to run over collections areas. Fire sprinkler piping is an exception.

9.6.5. Neither building utilities nor mechanical units that require regular service will be located in collections storage areas. If this is absolutely required, the equipment must be electrical. Refer to Technical Section 23- Heating, Ventilation and Air Conditioning (HVAC) in Volume 1 for specific requirements.

9.6.6. Refer to Technical Section 23- Heating, Ventilation and Air Conditioning (HVAC) in Volume 1 for specific requirements for temperature and humidity sensors and automated control systems to serve collections storage rooms.

9.6.7. Locate collections storage rooms near the freight elevator serving them.

9.6.8. Provide a separate, dedicated storage space adequately sized for the anticipated volume of crates resulting in boxing and unboxing of collections.

9.6.9. The design of doors leading into collections storage areas will meet these requirements:

9.6.9.1. All collections storage doors will have door closers and door sweeps for pest management.

9.6.9.2. All collections storage doors will be minimum 1,067 mm (3 ft 6 in) in width to facilitate material movement and handling.

9.6.9.3. All collections storage doors shall carefully consider the threshold to minimize the vibration of moving collections on rolling carts.

9.6.10. Collections storage areas will not be located in proximity to breakrooms, kitchens, or any other spaces where food may be present.

9.6.11. Provide 1,219 mm (4 ft) high, minimum 16-gauge stainless steel corner guards at all outside corners of collections storage areas and associated corridors.

9.6.12. No egress paths will traverse through a collections storage area.

9.6.13. Collections storage rooms will be relatively free of mechanical and plumbing systems that pose a risk of water damage. Additionally, this minimizes access to these areas. When necessary, systems should be located to minimize potential risk to collections to the greatest extent possible.

9.6.14. The design of Collections storage rooms require the assignment of risk to a collections storage area. Collections management staff and Office of Protection Services (OPS) will jointly assign the appropriate risk level for each collections storage area. Refer to Appendix D- Collection Storage Risk Level and Appendix E- Smithsonian Declaration on the Collections Preservation Environment in Volume 3 for more information.

9.6.15. Collections storage rooms will be dedicated to storage. Object processing, packing, and unpacking; crate and packaging storage; research performed on objects; object conservation; and any other similar activities will not be conducted in collections storage rooms. Separate spaces will be designed for these purposes.

COMMENTARY: *The focus on both active and passive fire protection systems is for redundancy. Active systems such as smoke detectors and fire sprinklers will detect and/or control a fire. Should these fail, then passive fire protection measures, such as fire-rated construction, smoke barriers, and limited storage areas, will prevent fire and smoke from spreading to adjacent compartments and damaging collections beyond the area of origin.*

9.6.16. The storage of collections and high-value items (including art, artifacts, rare books, archival materials, specimens stored in alcohol solution, live animal collections, and objects of historic value) will be protected by passive and active fire protection measures. These measures include the following, unless determined otherwise by the Office of Safety, Health, and Environmental Management (OSHEM):

*<u>**COMMENTARY:**</u> The focus on both active and passive fire protection systems ensures redundancy. Active systems such as smoke detectors and fire sprinklers will detect and/or control a fire. Should these fail, then passive fire protection measures, such as fire-rated construction, smoke barriers, and limited storage areas, will prevent fire and smoke from spreading to adjacent compartments and damaging collections beyond the area of origin.*

OSHEM is currently developing a set of risk-based fire protection measures for the storage of collections at SI. When this document is complete and approved by the collections community, it will replace the requirements below.

Store as much of the collections as possible inside enclosed non-combustible (metal) files or cabinets to provide an additional level of separation and protection within collections and collateral areas. Coordinate protection of these items with SI security requirements.

Replacement of wooden quarter units is advised. New steel quarter-units can reduce the risk of fire involvement/spread and can reduce smoke damage should a fire occur.

9.6.16.1. Separate collections storage from non-collection areas with minimum two-hour fire-smoke barriers. Higher fire ratings may be required depending on the materials stored and hazard presented, as determined by OSHEM.

*<u>**COMMENTARY:**</u> If a collection or portion thereof is considered high value or in the high-risk category, higher fire ratings and supplemental fire protection systems will be considered to protect the objects.*

9.6.16.2. Collections stored in remote facilities or buildings may not require fire-rated construction, as physical separation from other facilities or areas may serve as acceptable protection in lieu of passive features.

9.6.16.3. The maximum size of any single collections storage space shall be 2,790 m2 (30,000sq ft). Smaller spaces may be required depending on the value of collection items stored.

*<u>**COMMENTARY:**</u> This room size limits the loss of artifacts should a fire occur. The above area is*

based on the National Archives and Records Administration (NARA) requirement for collections storage, which is 20,000-40,000 sq ft, with a maximum storage volume of 250,000 cubic feet of records.

9.6.16.4. Protect with early warning smoke detection.

COMMENTARY: Early warning smoke detection is defined as either closely spaced, spot smoke detectors, or an aspirating smoke detection system (such as VESDA). Providing early warning gives OPS and the fire department more time to respond to a fire, minimizing damage to collections. Air aspirating smoke detection, in comparison to spot smoke detectors, offers shorter activation time and greater ease of maintenance, and is therefore typically the preferred option for SI collections storage spaces.

9.6.16.5. Minimize or eliminate ignition sources within the collections storage space.

COMMENTARY: Examples of ignition sources are computers and any other electrical equipment that are not necessary to housing and/or preserving the collection.

9.6.16.6. Protect with an automatic sprinkler system.

9.6.16.7. Protect with additional fire suppression systems such as gaseous fire suppression or other approved active systems when deemed necessary.

COMMENTARY: Another supplemental type of fire suppression is the clean agent gaseous system, which may be more appropriate for certain collections. These types of systems are designed to activate before sprinklers to suppress a fire during its early stages. The objective is to cause little or no damage to the collections. OSHEM and the collections staff will make the determination as to where supplemental fire suppression is necessary.

9.6.16.8. Provide compatible portable fire extinguishers.

COMMENTARY: Standard dry chemical extinguishers can leave residue that could damage collections or be difficult to remove from objects. Water mist extinguishers might be more appropriate depending on the collection.

9.6.17. Items deemed by the museum curator to be of extreme value will be stored in fire-resistive vaults, containers, or safes. Coordinate protection of these items with SI security requirements.

9.6.18. Collections processing areas, or other rooms where collections will be inventoried, processed, restored, cleaned, or undergo similar activities, will be protected with one-hour, fire-rated construction. Smoke barriers will also be constructed. Higher fire ratings may be required depending on the materials in process and hazards present, as determined by OSHEM.

9.7. RACK AND COMPACT SHELF STORAGE

9.7.1. Compact (mobile) storage systems present a high fire protection challenge since they combine large fire fuel loads with severe and variable obstructions to the sprinkler system. Collections stored on compact shelving will be protected in accordance with NFPA 909, *Protection of Cultural Resources Properties, Museums, Libraries, and Places of Worship* and this section.

9.7.2. Consider the design of the automatic sprinkler system together with the design of the shelving system to provide proper protection.

COMMENTARY: The spacing and longitudinal/transverse separation of each compactor must be taken into consideration during design. The shelving design works in concert with the sprinkler system to limit fire spread and permit adequate sprinkler water distribution for effective suppression.

9.7.3. The options listed below summarize design options but do not include all detailed design requirements. Refer to Appendix I- Compact Storage Units (Mobile Shelving) Design Supplement in Volume 3 for all sprinkler system and compact shelving design requirements.

9.7.3.1. Enclosed Shelving:

a. Appropriate for collections storage

b. Fully enclosed metal cabinets on compact shelving frames

c. Standard SI sprinkler requirements

d. Minimum clearance between compactor units is 0 inches.

9.7.3.2. Moderate-Density Sprinkler System with Wide Spacing:

a. Appropriate for collections storage consisting of books, file archives, and other similar types of materials

b. Compact shelving must have a solid metal canopy top, full-height metal longitudinal divider, and full-height metal transverse divider every 20 ft.

c. Automatic sprinkler density of 0.3 gpm/sq ft over 1,500 sq ft

d. Minimum 4-in spacing between compactor units

9.7.3.3. High-Density Sprinkler System with Close Spacing:

a. Appropriate for collections storage consisting of books, file archives, and other similar types of materials

b. Compact shelving must have a full-height metal longitudinal divider and full-height metal transverse divider every 15 ft. The units must not have a canopy top.

c. Automatic sprinkler density of 0.7 gpm/sq ft over the shelving area

d. Minimum 1-in spacing between compactor units

COMMENTARY: The design options presented here include protection options outlined in the Annexes of NFPA 909, Protection of Cultural Resources Properties, Museums, Libraries, and Places of Worship.

9.7.4. Storage of combustibles within high storage racks will comply with NFPA 13, *Installation of Sprinkler Systems and/or Factory Mutual Global Loss Prevention Data Sheets*.

9.7.5. Aisles between storage racks (excluding compact storage units and library stacks) will be a minimum of 1 m (36 in) wide.

9.7.6. Coordinate during the design of racks and compact shelving to ensure that proper fire sprinkler coverage can be provided in the proposed shelving location. Consider head spacing and ceiling clearance above the shelving.

9.7.7. Material storage will not exceed the capabilities of the fire sprinkler system available.

9.7.8. A minimum 100 mm (4-in) unobstructed transverse and longitudinal flue space will be maintained in storage racks. Larger spaces may be required based on the depth of shelves and the results of a fire hazard analysis. The method of achieving this required spacing will be determined as part of the design.

9.7.9. Compact Storage Units (Mobile Shelving) for General Use

9.7.9.1. Sprinkler System Design:

a. For the general storage of non-archival collections or items consisting of paper files, magazines, books, and similar documents in folders and miscellaneous supplies with no more than five percent plastic, compact shelving may be installed according to the requirements and limits stated in the NFPA 13 section on Compact Storage of Commodities (20.6 in the 2013 edition). Per this standard, the shelving area is limited to 250 sq ft.

b. The design sprinkler density is required to be a minimum of Ordinary Hazard II.

COMMENTARY: *NFPA 13 does not specify a density in this section. Providing a minimum of Ordinary Hazard II sprinkler density allows for flexibility in future designs should the use of the space change.*

9.7.9.2. Other Fire Protection Design Options:

a. Shelving and sprinkler designs based on successful, full-scale fire tests may be utilized subject to OSHEM review and approval. The design Fire Protection Engineer (FPE) will provide for review a copy of the fire test report along with a summary of the storage configuration and sprinkler system design basis criteria.

b. Designs may utilize the design objectives stated in NFPA 909.

9.8. SPACE REQUIREMENTS WET COLLECTIONS

Fluid-based, flammable liquid collections (i.e., "wet collections") will be stored in areas approved by OSHEM.

9.8.1. Storage areas may include, but are not limited to, flammable liquid warehouse areas, flammable liquid cut-off rooms, flammable liquid storage lockers, and approved flammable liquid cabinets.

9.8.2. Wet collections storage spaces less than 46.5 m2 (500 sq ft) will comply with NFPA 30, *Flammable and Combustible Liquids Code*. Spaces will be protected with fire detection systems appropriate to the hazard.

COMMENTARY: Wet collection storage areas are Class 1, Division 2, Zone 2 locations, and all equipment must be approved for use.

9.8.3. Design of wet collections storage facilities greater than 46.5 m2 (500 sq ft) will be closely coordinated with SI and OSHEM and will incorporate the protection concepts outlined below:

9.8.3.1. Building Construction:

a. Separate buildings of Type I (four-hour) reinforced concrete construction. Building separation with a four-hour Maximum Foreseeable Loss (MFL) wall. Exception: IBC requirements for fire separation distance may be followed and may reduce exterior wall fire resistance ratings subject to OSHEM approval.

COMMENTARY: NFPA 30 requires that larger flammable liquids rooms be enclosed by higher-rated fire barriers due to the increased amount of liquids being stored.

b. Subdivide the building into compartments, with each compartment having two-hour walls. Compartments will not exceed 5,000 sq ft.

COMMENTARY: This is the same concept as employed with general collections storage spaces to limit fire losses by using passive fire protection.

c. Incorporate floor-to-floor separation of four hours.

d. Bulk alcohol storage rooms will be constructed with three-hour walls, a three-hour ceiling, and explosion-venting panels along an exterior wall.

*<u>**COMMENTARY:**</u> NFPA 30 requires the above fire-rated construction when flammable liquid storage areas exceed 500 sq ft; the building is then designated as a flammable liquids warehouse for which additional requirements apply. NFPA 101 is utilized in lieu of Chapter 10 of the International Building Code (IBC), which is not applicable to SI projects. This code provides in-depth guidance for various occupancies at the SI.*

9.8.3.2. Fire Protection Systems:

a. Provide sprinkler protection for compact storage units (mobile shelving) or tank storage with sprinkler system design density of 24.5 lpm/sq m (0.60 gpm/sq ft) over an area of 315 sq m (3,400 sq ft) in wet collections areas.

*<u>**COMMENTARY:**</u> The basis of design for protecting this type of arrangement was developed during the design of the POD 5 facility at the Museum Support Center in Suitland, MD. See the Basis of Design document from SF Project 0230101 for additional details. This document may be obtained from the COTR.*

b. Provide sprinkler protection for fixed shelving appropriate for the arrangement and container type, per NFPA 13. *The Recommended Fire Protection Practices for Distilled Spirits Beverage Facilities* published by the Distilled Spirits Council of the United States, Inc. (DISCUS) may also be used as a reference in developing fire protection solutions when coordinated with OSHEM.

c. A Class I standpipe system will be provided.

d. Draft curtains will be considered in the design to sub-divide each compartment into smaller areas, aid in sprinkler response, and minimize the area of sprinkler activation.

e. Provide high temperature quick-response sprinklers.

9.8.3.3. Spill Containment:

a. Trench drains will be located to prevent potential alcohol spills from flowing into corridors, to limit pool size, and to provide a drainage system for fire protection water. They will be designed to prevent incidental alcohol spills from entering the drain. However, if the sprinkler system discharges, the trench will accumulate and discharge the water.

<u>COMMENTARY:</u> Additional information can be found in the IBC and NFPA 30.

b. Trench drains will discharge to the building exterior, either to the storm system, sanitary system, or to grade. The municipal water/sanitary authority will approve discharge locations.

9.8.3.4. Fire Alarm Systems:

a. Provide voice evacuation fire alarm systems.

b. Fire alarm notification appliances will consist of speakers and strobe lights.

c. Design detection appropriate to the space and hazard.

<u>COMMENTARY:</u> Wet collections storage areas are Class 1, Division 2, Zone 2 locations, and all equipment must be approved for use.

9.8.3.5. Special Detection and Control Systems:

a. Hydrocarbon gas detection systems will be provided. Design for the gas detectors will be based on the manufacturer's recommended spacing.

b. Hydrocarbon gas detection systems will be interlocked with the building fire alarm system and the HVAC system to initiate a supervisory alarm and a 100 percent purge sequence for the HVAC system serving the wet collections area.

c. All light fixtures and other electrical equipment in wet collections storage rooms will be Class I, Division 2.

d. Electrical receptacles will not be permitted in wet collections storage areas.

9.8.3.6. Means of Egress:

a. Wet collections storage areas will be provided with a minimum of two remote exits.

__COMMENTARY:__ NFPA 101, Life Safety Code, Chapter 7.11 requires two remote exits for high hazard areas over 200 sq ft.

b. Within wet collections storage rooms, provide two-hour separations between individual compartments and the center corridor to provide separated horizontal exits with a travel distance limit of 23 m (75 ft).

9.8.4. Collections and artifacts that may present an explosion or self-ignition hazard (e.g., munitions, cellulose nitrate film) will be stored in locations approved by OSHEM. Spaces to house these items will be designed with specific active and passive fire protection to address the unique hazards of the material. The design will be informed by both the collections staff and OSHEM to determine the nature of the materials and the appropriate fire protection features.

9.8.5. Every attempt should be made to “safe” collections or artifacts prior to storage to mitigate potential hazards. The collections or artifacts must be evaluated by OSHEM and the owner on a case-by-case basis through risk-assessment, to determine the stability and general condition of the items and any adverse ramifications if the collections or artifacts are exposed to fire or other unfavorable conditions. Collections storage areas may include, but are not limited, to:

9.8.5.1. Magazines (permanent, portable, and/or fire resistant)

9.8.5.2. Fire-rated rooms

9.8.5.3. Areas with special provisions, such as explosion venting

9.8.5.4. Remote buildings/facilities/areas that will not expose major facilities or other collections if the artifacts/collections become unstable.

<u>COMMENTARY:</u> Cellulose nitrate film is the most common hazardous collection material at SI in this category. This type of film decomposes at normal storage temperatures, generating toxic and flammable gases. If the film is stored improperly, it can spontaneously combust and will burn extremely rapidly. Therefore, cellulose nitrate is often kept in cold-storage rooms in listed ventilated cabinets. This slows decomposition and decreases the chance for spontaneous combustion. Storage and handling for this film is governed by NFPA 40: Storage and Handling of Cellulose Nitrate Film. This standard describes the requirements for the storage cabinets, vaults, and standalone buildings where film may be stored.

Most cellulose nitrate film production ceased in the mid-1950s, but film stocks were used until they were depleted (likely into the late 1950s or early 1960s). If the film was made before 1960, verify whether it is cellulose nitrate or cellulose acetate.

9.9. SPACE REQUIREMENTS LOADING DOCK/MAILROOM/STORAGE

9.9.1. All deliveries to museum facilities must be directed to the building service entrance. This includes deliveries by shipping, courier, and the U.S. Postal Service.

9.9.2. Locate a secure storage area for delivered items and an interior staging area adjacent to the loading dock in each facility. Provide a direct route from the loading dock to the freight elevator.

9.9.3. Locate a security booth on the loading dock.

9.9.4. Locate the mailroom on an exterior wall adjacent to the loading dock.

9.9.5. Provide an area for recycling (multiple collections) at the loading dock.

9.9.6. Provide a storage area in each facility for hazmat materials related to work performed in fabrication shops, laboratories, and wet collections.

9.9.7. Open loading docks must be covered a minimum of 1,219 mm (4 ft) beyond the edge of the loading dock platform and over the loading berth to protect materials during loading and unloading.

9.9.8. Provide a ramp from the loading dock to grade to facilitate deliveries from small trucks and vans. The maximum allowable ramp slope will be 1:12.

9.9.9. Provide at least one off-street loading berth adjacent to the loading dock at each facility.

9.9.9.1. The berth must be a minimum of 4,572 mm (15 ft) wide. The length will be based on the longest vehicle serving the building as identified by the COTR.

9.9.9.2. Provide an apron space in front of the loading berth for vehicle maneuvering equal to the berth length plus 609 mm (2 ft).

9.9.9.3. The minimum headroom in the loading berth and apron area will be 4,572 mm (15 ft).

9.9.9.4. Truck maneuvering space should occur within the site and will be designed to minimize impacts to traffic on adjacent streets and to pedestrian safety.

9.9.10. Wherever possible, provide a separate, dedicated loading dock for food service and a separate, dedicated loading dock for collections/exhibitions receiving.

9.9.10.1. Provide space for waste sorting, recycling, and composting functions adjacent to the food service loading dock. Coordinate with the waste-handling capacity of the facility.

9.9.11. In facilities that use trash containers that are picked up by a trash service contractor, provide at least one loading berth for the trash containers.

9.9.12. Provide an office for the materials handler, who oversees supplies, adjacent to the Operations and Maintenance supply room.

9.9.13. Loading Dock Architecture:

9.9.13.1. UL 752 Level 3 rated a security booth with HVAC will be situated on the loading dock to provide clear, simultaneous views of the loading dock and, to the greatest extent possible, doors in and out of the area and adjacent hallways.

Construction will maximize the use of lockable, sliding glass panels for both surveillance and verbal communications.

9.9.13.2. All pedestrian movement on and off the docks will bring individuals to an operable window and counter at the loading dock security booth. The counter must accommodate a writing shelf for sign-in logbooks.

9.9.13.3. Provide secure storage areas for delivered items waiting for uncrating and distribution within the facility.

9.9.13.4. See the Site Considerations for Loading Dock Vehicle control and set-up.

9.9.14. Not Used.

9.9.15. Trash and Recycling Dumpsters:

9.9.15.1. Trash dumpsters located inside of a building, will be placed within a two-hour fire-rated room and protected with automatic sprinklers.

9.9.15.2. Trash dumpsters located outside of a building will have metal covers that are kept closed when the dumpster is not in use. They will not be located under metal eaves of a facility, in proximity to combustible buildings, adjacent to window openings, or located fewer than 15 feet away from a building.

9.9.16. Mail Room:

9.9.16.1. Provide space within the receiving area for inspection and imaging of mail received; OPS will provide additional details regarding machine size and intended location. This may be space shared with the loading dock. When mailboxes are provided, they will be in a separate room from the mailroom and inspection area.

9.9.16.2. Locate mailrooms on an exterior wall adjacent to and sharing the main loading dock for general facility receiving and shipping.

9.9.16.3. Not Used.

9.9.16.4. Not Used.

9.9.17. Utility Rooms, Shop Areas, and Incidental-Use Spaces:

9.9.17.1. All non-sprinklered storage rooms and sprinklered storage rooms more than 9.3 sq m (100 sq ft) shall be enclosed with one-hour-rated fire barriers.

COMMENTARY: The IBC requires fire-rated separation for various incidental occupancies. While the above is not within the requirements of the IBC, SI deems the above type of space as an incidental occupancy of the same hazard level of those found in the code. Additionally, this approach aligns with NFPA 101 Section 8.7 for areas with a higher degree of hazard.

9.9.17.2. Incidental use areas will be enclosed with rated barriers as required by applicable codes and standards. In each case, the most restrictive requirement among the IBC, national fire codes, and this manual will be followed.

9.10. SPACE REQUIREMENTS FOOD SERVICE/RESTAURANTS

9.10.1. Food service kitchens will not be located above collections storage areas.

9.10.2. Carefully consider placement of food service operations (back-of-house and public components) within a building, being mindful of odors to adjacent spaces. Care will be given to the layout of utilities and the access required to properly maintain them, not only within the food service space, but also to adjacent spaces. Adjacent spaces, public or private, will not be interrupted for routine systems maintenance.

9.10.3. Food service kitchen locations must be planned to coordinate with kitchen exhaust duct routing to minimize horizontal lengths of ductwork and to permit routing as straight as possible to the exterior or shaft location. Careful consideration shall be given for access to exhaust duct to facilitate regular route maintenance.

9.10.4. Design built-in banquette seating on legs off the floor or with a stainless-steel base to prevent pests from nesting in the lower concealed cavity.

9.10.5. To the greatest extent possible minimize concealed cavities under all millwork in food service areas to minimize pest infiltration.

9.10.6. Provide sensor alarms on stainless steel drip pans under mechanical ductwork in areas of high humidity such as dishwashing rooms.

9.10.7. Provide a filtration system for the water supply to all food service equipment that requires water service.

9.10.8. Refer to Technical Section 23 - Heating, Ventilation and Air Conditioning (HVAC), in Volume 1 for redundancy requirements for water-cooled food service equipment.

9.10.9. Refer to Technical Section 22 - Plumbing in Volume 1 for requirements for grease interceptors in food preparation areas. Reference 221323 Sanitary Waste Interceptors portion of the Division for specific requirements.

9.10.9.1. Refer to local jurisdictions D.C. Water and D.C. Department of Health for all facilities located in Washington, DC.

9.10.10. Provide for on-site waste composting and recycling, including the collection of oils for biofuels, bottles, cans, paper, and plastic recycling. Provide signage in dining areas to encourage recycling.

9.10.10.1. Avoid storing waste near any collections storage or collection receiving/staging spaces.

9.10.10.2. Carefully plan composting and recycling areas to minimize the attraction of rodents and other pests.

9.10.10.3. Provide water and drainage at composting areas.

9.10.11. Provide 1,219 mm (4 ft) high, minimum 16-gauge stainless steel corner guards at all outside corners of food service back-of-house areas and associated corridors.

9.10.12. Provide stainless steel wall panels on walls behind the equipment line and cooking line. Provide stainless steel door guards on all doors in food service areas; coordinate the required size of the door protection.

9.10.13. Flooring:

9.10.13.1. Provide durable, non-slippery, easily cleanable quarry tile flooring at back-of-house and servery spaces.

9.10.13.2. Provide a durable, cleanable material in seating areas. Carpeting is prohibited in seating areas.

9.10.13.3. Provide water-tight, non-slip epoxy flooring in dishwashing areas.

9.10.13.4. Refer to Appendix J- Facilities Design Standards Smithsonian Enterprises Supplement in Volume 3 for additional SE requirements.

9.10.14. All doors in food service areas will be a minimum 1,067 mm (3 ft 6 in) in width to accommodate material handling and carts.

9.10.14.1. Provide stainless steel door guards on all doors in food service areas to prevent damage from material handling and carts.

9.10.14.2. Refer to Appendix J- Facilities Design Standards Smithsonian Enterprises Supplement in Volume 3 for additional SE requirements.

9.10.15. All restaurants operated by SE and other vendors will be on separate utility meters. Refer to Technical Section 22- Plumbing, and Technical Section 26- Electrical in Volume 1 for additional information for respective water and electric meter requirements.

9.10.15.1. Refer to Appendix J- Facilities Design Standards Smithsonian Enterprises Supplement in Volume 3 for additional SE requirements.

9.10.16. Provide a locker area for food service employees.

9.10.16.1. Where required by the local jurisdiction, provide dedicated rest rooms and a changing area.

9.10.17. Restaurant back-of-house, servery, and food display equipment in areas accessible by the public and/or staff outside of restaurant operating hours must be secured to prevent theft.

9.10.18. Food Service Staff Break Room:

9.10.18.1. Provide a room of sufficient size approximately 20.1 sq m (225 sq ft) to accommodate four tables with four chairs each, a sink, counter, disposal, lower and upper cabinets, and space for a full-size refrigerator and full-size soda machine. Provide one mail slot for each staff person. Provide a bulletin board.

9.10.18.2. Provide an Information Technology (IT) outlet for a PC and telephone. Staff share a PC to interface with the personnel office.

9.10.19. Refer to the Appendix J- Facilities Design Standards Smithsonian Enterprises Supplement in Volume 3 for additional SE requirements.

9.11. SPACE REQUIREMENTS MUSEUM SHOPS

9.11.1. The design of retail spaces, whether new or retrofit, must address all power and lighting requirements. Coordinate power, data, and voice drops wherever cash/wrap and sales counters are located.

9.11.1.1. All retail points of sale must be on dedicated, grounded circuits to maintain equipment warranties.

9.11.2. The main retail shop in each museum facility may be located close to the main entrance lobby. The location of the museum shop must be coordinated with the unit director.

9.11.3. The shop area must be secured after hours by security grilles or a similar measure approved by SE and OPS.

9.11.4. All museum shops shall be on separate utility meters. Refer to Technical Section 26- Electrical in Volume 1 for electric meter requirements.

9.11.5. Museum Shop Staff Break Room:

9.11.5.1. Provide a room approximately 20.1 sq. m (225 sq. ft.) of sufficient size to accommodate four tables with four chairs each, a sink, counter, disposal, lower and upper cabinets, and space for a full-size refrigerator and full-size soda machine. Provide one mail slot for each staff person. Provide a bulletin board.

9.11.5.2. Provide an IT outlet for a PC and telephone. Staff share a PC to interface with the personnel office.

Refer to Appendix J- Facilities Design Standards Smithsonian Enterprises Supplement in Volume 3 for additional SE requirements.

9.12. SPACE REQUIREMENTS AUDITORIA

9.12.1. Provide several wheelchair locations in assembly places with fixed seating. These locations will be dispersed throughout the seating area per the Smithsonian Guidelines for Accessible Design (SGAD).

9.12.2. Design of auditoria and large meeting spaces requires an acoustical design consultant/professional as an integral part of the design team. The Architect/Engineer (A/E) will discuss which spaces require a consultant with the SI early in the design process. The acoustical design professional’s responsibilities may include space programming requirements, development of design parameters, performance goals, consultation with the A/E design team, and preparation of documentation and specifications.

9.12.3. Design of auditoria and large meeting spaces requires a lighting design consultant/professional as an integral part of the design team. The A/E will discuss which spaces require a consultant with the SI early in the design process The lighting design professional’s responsibilities may include space programming requirements, development of design parameters, performance goals, consultation with the A/E design team, and preparation of documentation and specifications.

9.12.4. Neither water nor sanitary waste piping will run over auditoria. Fire sprinkler piping is the only exception.

9.12.5. Design of auditoria must address access to relamp light fixtures and adjust audio-visual equipment mounted above the stage and above the sloped floor seating area. These tasks need to be accomplished without the use of scaffolding and with the provision for necessary fall protection.

9.12.6. All auditorium fixed seating will have the seat row letter and number identified on the seats to allow for assigned seating at events.

9.12.7. Auditorium Staff Break Room:

9.12.7.1. Provide a room of sufficient size approximately 20.1 m2 (225 sq ft) to accommodate four tables with four chairs each, a sink, counter, disposal, lower and upper cabinets, and space for a full-size refrigerator and full-size soda machine. Provide one mail slot for each staff person. Provide a bulletin board.

9.12.7.2. Provide an IT outlet for a PC and telephone. Staff share a PC to interface with the personnel office.

9.12.8. Refer to the Appendix J- Facilities Design Standards Smithsonian Enterprises Supplement in Volume 3 for additional SE requirements.

9.13. SPACE REQUIREMENTS- RESTROOMS

9.13.1. Provide a plumbing fixture count in accordance with International Plumbing Code (IPC) requirements.

9.13.1.1. Women’s restroom fixture counts will exceed code required quantities by 40 percent.

9.13.2. Provide family restrooms and a collocation of men’s and women’s restrooms in new facilities and in major renovations.

9.13.2.1. For facilities that anticipate high visitation by children, and where there is enough space, consider including a child-size toilet, sink, and soap dispenser at appropriate mounting heights in the family restroom.

9.13.2.2. Provide separate staff-only restrooms in non-public areas of the building.

9.13.3. Consider providing bathrooms that are inaccessible to the public in staff-only areas.

9.13.4. The design of restrooms and fixtures shall comply with the Smithsonian Guidelines for Accessible Design (SGAD), which may be obtained from the COTR. The size of accessible toilet compartments and fixture/accessory mounting heights and clearances are among the requirements that must be addressed in the design.

9.13.5. Provide a separate, unisex, accessible, family toilet room in museum facilities, where possible, in addition to men's and women's restrooms.

9.13.5.1. If a family restroom is provided and if there is adequate space, provide one lavatory, one soap dispenser, and one hand dryer or paper towel holder mounted at a lower height for children.

9.13.5.2. Provide a thumb-lock at unisex restrooms.

9.13.6. Provide a baby-changing station with its own sink in all public family restrooms. If a family restroom is not present within a facility, locate baby changing stations in men and women's restrooms. Consider proximity to paper towel dispenser and trash receptacle as well as space for a stroller when laying out baby changing areas.

9.13.7. Sinks in restrooms will be integral or undermount.

9.13.8. All restroom floors will be sealed.

9.13.9. Provide ceiling-hung toilet partitions.

9.13.10. Provide at least one drinking fountain / bottle-filling station on every floor near restrooms and near auditoria. Refer to the SGAD for the required number of accessible drinking fountains.

Locate wall washing strip lighting over toilet stalls at a minimum 914 mm (3 ft) from the wall to allow maintenance staff to relamp the strip safely.

9.13.11. Provide a shelf/hook for personal belongings while people use the restroom.

9.13.12. Quality Assurance:

9.13.12.1. For products listed together, provide products of the same manufacturer unless otherwise approved by the COTR.

9.13.12.2. Electrical components, devices, and accessories will be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authority Having Jurisdiction (AHJ) and marked for intended use.

9.13.13. Provide baffled entrances without doors to support both public health and security.

9.14. SPACE REQUIREMENTS- CHILDCARE CENTERS

9.14.1. The design of childcare centers will be in accordance with the National Association for the Education of Young Children (NAEYC) Program Standards and Accreditation Criteria. Refer to Standard 9 – Physical Environment for design criteria related to indoor and outdoor childcare spaces.

9.14.2. The design of childcare centers will meet all applicable requirements of federal, state, and local jurisdiction code regulations. If there is a discrepancy between different criteria, the most stringent requirement will apply.

9.14.3. Design outdoor spaces and play equipment for childcare centers to meet the following requirements:

9.14.3.1. Locate and design outdoor spaces associated with childcare to maximize solar gain during the winter months to extend outdoor space use seasonally.

9.14.3.2. Incorporate natural elements such as water and planting in outdoor spaces to enhance shading and cooling during warmer months and to provide interactive educational opportunities.

9.14.3.3. Comply with the latest Consumer Protection Safety Commission (CPSC) requirements for equipment, fall zones, and safety surfacing if play equipment is utilized.

9.14.4. The designer will collaborate with the childcare center director to ensure that the design elements support and enhance the SI educational mission.

9.14.4.1. Design indoor and outdoor spaces to support and encourage socialization, including small and large group activities.

9.14.4.2. Design indoor and outdoor spaces to support and encourage physical activity and to promote the mastery of gross and fine motor skills.

9.14.4.3. Design spaces with elements that support and encourage educational activities and contact with natural elements.

9.14.4.4. Locate the childcare center in proximity to a building entrance for efficient drop-off and pick-up of children by adults.

9.14.4.5. Provide sufficient space for stroller parking outside of the childcare center entrance without interfering with required egress.

9.14.5. In laying out the egress route, consider that infants may be moved in cribs during an emergency evacuation.

9.15. SPACE REQUIREMENTS- LOBBIES

9.15.1. Types of signage that may be required in museum lobbies include building orientation and wayfinding, public programs and exhibitions, revenue-generating activities, visitor amenities and donor signage.

9.15.2. Provide a vestibule at each building entrance that meets accessibility requirements, includes an air lock to conserve energy, and has appropriate ventilation where the vestibule serves also as a queuing area for security screening. Refer to ISC requirements for CBR including air filtration and return.

9.15.2.1. The distance between inside and outside doors in the vestibule will comply with SGAD.

9.15.2.2. The depth of the vestibule will be a minimum of 2,134 mm (7 ft) to minimize air infiltration into the lobby.

9.15.2.3. An air lock is required for swing doors; revolving doors do not require an air lock.

9.15.3. Spatial requirements for museum entrances and lobbies will reflect program, security, and egress requirements, including the following:

9.15.3.1 Lobbies must accommodate security desks and screening equipment for visitor screening. OPS will provide screening requirements for each project.

a. Allow space for the visitor queue inside the lobby in front of inspection stations.

b. Not Used.

c. The location of screening equipment will not restrict emergency egress or reduce the available egress width.

9.15.3.2 Lobbies must accommodate Visitor Information and Associates Reception Center (VIARC) desks.

9.15.3.3 Lobbies will include provisions for wheelchair storage.

9.15.3.4 Space for the visitor queue outside the entrance doors will be considered during the planning and design of new museum facilities and major renovations. Consult with OPS for protective measures to protect pedestrians against exterior threats.

9.15.3.5 Where physically and aesthetically appropriate, consider security screening outside of the building.

9.16. SPACE REQUIREMENTS- ENTRANCES

COMMENTARY: This section provides general security requirements for primary and secondary pedestrian entrances, entrance lobbies, employee entrances, loading docks, and other service entrances.

9.16.1. All entrances require security monitoring. For museums and collections storage facilities, security guard posts will be located at primary and secondary building entrances that are open to the public and staff; this includes loading docks. Security guard posts will be located where all lobby entrances and pedestrian traffic can be monitored and controlled by security personnel. If guard stations are located outside, they will be protected from weather and capable of being secured when not in use.

9.16.1.1. All pedestrian entrances to museums and collections storage will be staffed by a security guard force.

9.16.1.2. Based on a risk assessment, pedestrian screening may be required. Public entrances and lobby space will be appropriately sized to match facility size and pedestrian volumes/visitation. OPS will provide screening requirements for each project through the COTR. In lobby areas, the queuing requirements must be incorporated in front of the inspection stations so that visitors are not forced to stand outside during inclement weather or in a congested line inside a small lobby while waiting to enter the secured areas.

9.16.1.3. Staff entrances will be located independent of main entrance lobbies and be convenient to staff parking. Staff entrances must be appropriately sized to accommodate guard force operations (i.e., guard desks, chairs). Landline communications will be provided to accommodate guard operations.

9.16.2. When the screening of visitors and packages is required, provide an area with the capacity for screening devices and equipment and for a queuing area for the anticipated crowd capacity required. At secondary public entrances, provide the means to restrict public access to those areas where screening is available when required. Where it is necessary to screen people entering a building, install screening equipment. Where it is necessary to screen people entering a building under specific conditions, provide the required connections for the temporary installation of metal detectors and package screening equipment and sufficient space for their installation.

9.16.2.1. Locate screening equipment in a manner that will prevent passage into the building or facility without passing through the devices.

9.16.2.2. When screening devices are not permanently installed, provide secure storage close to the installation location.

9.16.2.3. Locate screening equipment so as not to restrict emergency egress or reduce the available egress width.

9.16.2.4. Provide sufficient power, telecommunications, and data connections for the installation of screening equipment.

9.16.3. The Fire Command Center (FCC) and a secure house key box for emergency responders will be located near an entrance door at a location approved by the COTR. The door associated with the FCC will be controlled and monitored by security video.

9.17. SPACE REQUIREMENTS- INTERIOR LANDSCAPING

9.17.1. Smithsonian Gardens (SG) will be involved in the design of interior landscaping of SI museums (except at the National Zoo). Coordination with SG shall be through the COTR. For areas where interior landscaping is considered for visual enhancement or biophilic design, collaborate with SG through the COTR to determine performance criteria to support healthy plant functioning and survival. Coordinate across disciplines to provide adequate natural or supplemental lighting for required photo periods, including electrical requirements specific to plant needs and locations. Coordinate HVAC requirements to provide adequate humidity, temperature, and air exchanges, and locate supply ducts so that air does not blow directly on foliage or create hot spots. Coordinate with plumbing for water source (irrigation, quick connects, and/or points of connection) and drainage requirements. Coordinate waterproofing needs and consider leak detection systems, as appropriate. Consider inclusion of supplemental power sources for event lighting and seasonal displays. Provide access for maintenance and consider frequency of plant and soil rotations.

9.17.2. Interior landscaping within SI museums in the DC Metro area (except at the National Zoo) are highly maintained display gardens and garden exhibits, which contribute to SG, an American Alliance of Museums (AAM) accredited museum. Any trees proposed on the SG campus, including in interior garden spaces, are accessioned SI collections items within the SG Tree Collection.

9.17.3. SG provides guidance for plant selections for interior landscaping projects for SI museums (except at the National Zoo).

9.17.4. Interior landscaping proposed for food service areas will be reviewed with SG through the COTR for structural pest considerations.

9.18. SPACE REQUIREMENTS- ELEVATORS

9.18.1. Refer to the SI Specifications in Volume 2 for Division 14 Conveying System Specifications.

9.19. SPACE REQUIREMENTS- STAIRS

9.19.1. The SGAD specifies that areas of rescue assistance are required even in fully sprinklered buildings.

9.19.2. Provide access to the main roof from at least one enclosed stair.

9.19.3. The initial design effort will address the exit capacity needs of the facility throughout the life of the structure before the design of the enclosed rated stairs commences.

9.19.4. Design egress stairs to encourage vertical circulation by staff and visitors where possible.

9.19.4.1. Locate exit stairs relative to public and staff access points.

9.19.4.2. Stair design and materials will reflect the public circulation nature of the stair.

COMMENTARY: Stair use is intended to encourage healthy living practices by both staff and visitors.

9.20. SPACE REQUIREMENTS- CORRIDORS AND CIRCULATION PATHWAYS

9.20.1. The minimum clear height of ceilings in corridors shall be 2,438 mm (8 ft).

9.20.2. Egress corridors must be appropriately fire rated and will remain free of obstructions and protrusions.

9.20.3. Provide 1,219 mm (4 ft) high, minimum 16-gauge stainless steel corner guards at all outside corners in non-public corridors where carts, cases, equipment, and trash and recycle bins are moved.

9.20.4. Corridor walls will be made of durable, abuse-resistant materials including, but not limited to, concrete masonry units (CMU).

9.21. SPACE REQUIREMENTS- ATRIUMS AND OTHER VERTICAL OPENINGS

9.21.1. Atriums and other vertical openings will be in accordance with the requirements of NFPA 101.

9.22. SPACE REQUIREMENTS- MAINTENANCE/SERVICE

9.22.1. Provide access to all building service closets from common public corridors.

9.22.2. Provide at least one janitor closet per floor and one central maintenance room that is accessible to the loading dock in each building.

9.22.3. Consider first how to eliminate potential fall hazard situations for maintenance and service personnel. If this is not feasible, then parapets or standard guardrails that meet applicable OSHA and ANSI requirements will be installed.

9.22.4. During the design phase, consider requirements for using lift equipment (weight, access) to perform maintenance on exterior building façades.

9.23. SPACE REQUIREMENTS- PENTHOUSES

9.23.1. Keep roof-mounted equipment to a minimum. Any roof-mounted equipment must be enclosed in a penthouse or behind screen walls.

9.23.2. Penthouses and screen walls will be integrated into the exterior building design and constructed of similar materials.

9.23.3. Do not locate roof-mounted equipment directly over collections storage areas.

9.23.4. If existing mechanical equipment on rooftops is not screened or is located over collections storage, these existing conditions will be corrected whenever the equipment is repaired or replaced.

9.23.5. Historic Building Requirements:

9.23.5.1. Design roof penthouses, mechanical equipment enclosures and other roof features on historic buildings (and buildings in historic areas) to maintain the architectural massing and character as seen from grade or neighboring taller buildings.

COMMENTARY: This is particularly true of buildings on the National Mall in Washington, D.C.

9.24. SPACE REQUIREMENTS- BUILDING ROOF TREATMENTS

9.24.1. Consider the installation of roof treatments to encourage energy efficiency, water harvesting, or stormwater treatment where possible.

9.24.2. Consider the appearance and visual quality impact of roof areas from public and non-public areas, especially in terms of their ability to demonstrate sustainable practices.

9.25. SPACE REQUIREMENTS- TEMPORARY FACILITIES

9.25.1. Any structures (i.e., shed, building, trailer, or enclosure) that are intended for storage, office, or service uses and that are intended for a short-term period of use will be considered as SI temporary facilities. The IBC defines the short-term period as 180 days or fewer.

9.25.2. The design of SI temporary facilities will comply with all applicable provisions of fire, life safety, and building and electrical codes. Requirements related to structural safety, fire safety, means of egress, accessibility, light, ventilation, and sanitation must be met to ensure public health and safety.

9.26. SPACE REQUIREMENTS- SECURITY-RELATED SPACES

9.26.1. OPS Office Suite

9.26.1.1. Program a minimum of 140 sq m (1,500 sq ft) not including the Security Operations Center, Security Server Room, and Weapons Room. This may be larger based on the size of the Security staff at this location.

9.26.1.2. Separate offices with lockable doors are needed for the security and assistant security managers.

9.26.1.3. Provide a reception area with a counter equipped with a waist-high swinging door to separate the reception area from the rest of the security office space. Provide three lockable drawers and shelves behind the counter. Provide two chairs and one low table in the reception area.

9.26.1.4. Provide wall space to accommodate the Key Management System and radio chargers.

9.26.1.5. Provide a common work area with approximately 4.6 m (15 ft) of counter area for a fax machine and mail sorting.

9.26.1.6. Provide numerous under-counter storage cabinets, a minimum of 15 over-the-counter mail slots (may vary per site), and additional storage units.

9.26.1.7. Provide task lighting under the upper cabinets if appropriate and when possible.

9.26.1.8. Provide space for a printer and a stand-alone copier with side sorter.

9.26.1.9. Lost and Found Room needs to be a separate lockable room of sufficient size to accommodate the following furniture items: shelving unit 3.05 m wide x 2.44 m high (10 x 8 ft), a two-drawer safe, two 900-mm (35.43 in) wide locked storage cabinets, a legal-size file cabinet, and a desk and chair.

9.26.2. Weapons Room

9.26.2.1. Locate the Weapons Room within the OPS Suite.

9.26.2.2. The room must be no less than 7.43 sq m (80 sq ft). Coordinate with OPS and the Security Consultant to ascertain the minimum room size based on the storage system for the number of weapons required for the facility. The number of weapons should include 20% expansion for future changes. Allocate additional space for a clearing barrel.

9.26.2.3. Provide a complete envelope (walls, floor, ceiling, and door assembly) meeting UL 752 Level 3. If the Weapons Room will contain firearms other than pistols (e.g., Zoo Police Station) the envelope must meet the highest UL 752 level of those weapons.

9.26.3. Security Locker Rooms

9.26.3.1. Locate the Security Locker Rooms within the OPS Suite.

9.26.3.2. 9.26.3.2. Determine the number of lockers from the staffing requirements and provide separate male and female areas.

9.26.3.3. Lockers will be a minimum of 1.8 m (6 ft) in height, 46 cm (18 in) deep, and 46 cm (18 in) wide to accommodate winter outerwear.

a. Provide a full-height shirt-drop locker in each room.
b. Provide showers based on the number of staff.
c. Provide benches between the rows of lockers.

9.26.4. Security Break Room

9.26.4.1. Provide a room of sufficient size approximately 20.1 sq. m (225 sq ft) to accommodate four tables with four chairs each, a sink, counter, disposal, lower and upper cabinets, and space for a full-size refrigerator and full-size soda machine. This may be larger based on the size of the Security staff at this location. Provide one mail slot for each security officer. Provide a bulletin board.

9.26.5. Security Equipment Storage Room

9.26.5.1. Provide a locked room of a minimum of 9.3 sq m (100 sq ft) for security equipment storage. Provide floor-to-ceiling metal shelving around the four walls.

9.26.6. Security Operations Center / Unit Control Room

9.26.6.1. SOC / UCRs will not be located below grade for new construction/major modernizations. For existing facilities, UCRs will not be located below grade when in a flood zone.

9.26.6.2. Program a minimum of 37 sq m (400 sq ft) to accommodate the standard monitoring console and associated monitoring equipment. A minimum ceiling height of 2.4 m (8 ft) is required.

9.26.6.3. The Security Operations Center must be accessed through the OPS Suite. If this is not possible, provide a man-trap entrance from a Staff Only corridor.

9.26.6.4. Surrounding walls and partitions shall be two-hour fire-resistive construction and extend from slab to slab; a two-hour ceiling assembly may be substituted where slab-to-slab construction is not practical.

9.26.6.5. Provide a low-profile raised floor to support power and communications cabling between the racks in the Security Server Room and the consoles in the Security Operations Center.

9.26.6.6. Provide wall-mounted, sound-soak panels to minimize background noise; the panels must meet interior finish requirements for fire safety. Wall(s) behind the monitors shall be a dark color to minimize eye strain.

9.26.6.7. Coordinate non-Security related equipment and panels that must be monitored in the Security Operations Center including Fire Alarm workstation, elevator controls, generator status monitoring.

9.26.6.8. No wet piping is allowed through or above this space.

9.26.6.9. Provide a TV feed. Coordinate with OPS.

9.26.7. Security Server Room

9.26.7.1. The minimum size is 18.5 m2 (200 sq ft). Increase the size to accommodate the electronic security needs of the building or buildings that the server room will support. Consider building or campus expansion potential. Consult OPS during the space programming phase of the project.

9.26.7.2. The Security Server Room must be accessed through the Security Operations Center or the OPS Suite.

9.26.7.3. Locate the supporting UPS Room near support electrical distribution.

9.26.7.4. Surrounding walls and partitions shall be two-hour fire-resistive construction and extend from slab to slab; a one-hour ceiling assembly may be substituted where slab-to-slab construction is not practical.

9.26.7.5. Provide a low-profile raised floor to support power and communications cabling between the racks in the Security Server Room and the consoles in the Security Operations Center.

9.26.7.6. No wet piping is allowed through or above this space.

9.26.8. Security UPS Room

9.26.8.1. The physical size is dependent on the power requirements for the facility dictating the UPS requirements.

9.26.8.2. The Security UPS Room must not be from the SOC or SSR; it will have a separate entrance to allow for maintenance.

9.26.8.3. Locate the Security UPS Room in close proximity to the SSR to support electrical distribution.

9.26.8.4. Surrounding walls and partitions shall be two-hour fire-resistive construction and extend from slab to slab; a one-hour ceiling assembly may be substituted where slab-to-slab construction is not practical.

9.26.8.5. No wet piping is allowed through or above this space.

9.26.9. Security LAN Closet

9.26.9.1. This space will be dedicated for security. No other trades will have equipment or access without written approval from OPS. Utilities not serving the space will not transit the space, including plumbing, fire sprinkler, HVAC, and electrical.

9.26.9.2. Locate closets within 76.2 m (250 ft) of all security equipment and devices and on each level in a riser type configuration.

9.26.9.3. The minimum dimensions are 30 inches deep by 6 feet wide with a minimum ceiling height of 2.44 m (8 ft) and a 6' wide double door for access.

9.26.9.4. No wet piping is allowed through or above this space.

9.26.9.5. Provide lighting on generator power to illuminate security panels and provide enough lighting for a safe working environment.

9.26.10. Exterior Security Guard Booth

9.26.10.1. Provide Guard Booths for exterior guard posts at locations identified by OPS.

9.26.10.2. The minimum interior physical dimensions are 8'-2.5" wide and 9' deep. This also requires a minimum overhang on the front of 13" for mounting security cameras.

9.26.10.3. The guard booth must have UL 752 Level VII ballistic rating protection. The door should be hinged on the threat side and controlled via card reader.

9.26.10.4. Provide 2' deep counters on the front and back wall with 2 wall mounted racks for Security and Telecom under the rear counter.

9.26.10.5. Provide a mini-split HVAC system with a ceiling mounted cassette.

9.26.10.6. Provide two electrical feeds, one from generator and one from the Security UPS.

9.26.10.7. Provide dimmable lights.

9.27. SECTION NO LONGER USED.

9.28. SPECIAL OCCUPANCY REQUIREMENTS

9.28.1. Mission Critical Spaces:

9.28.1.1. Spaces housing mission critical IT equipment, research laboratories, and other operations vital to SI's mission will be protected by the following active and passive fire protection measures:

COMMENTARY: Mission Critical is defined as vital to the operation of the institution. Examples of mission critical rooms would be rooms housing equipment, systems, or utilities, the loss of which would interrupt operations in more than one facility or result in permanent loss of collections or mission data. (i.e., there is no off-site backup); and rooms containing the fiber entrance(s) for a critical facility.

9.28.1.2. Two-hour fire-rated enclosures

9.28.1.3. Very early warning smoke detection

9.28.1.4. IT Rooms will comply with the requirements of NFPA 75, *Fire Protection of Information Technology Equipment*, and the other requirements of this section.

COMMENTARY: Very early warning smoke detection is defined as aspirating smoke detection

(VESDA) and/or closely spaced spot smoke detection. Providing early warning allows for a quicker OPS or fire department response, minimizing fire impact.

9.28.1.5. A clean agent fire suppression system or other approved active system.

COMMENTARY: Clean agent systems are installed in addition to sprinkler systems. They are designed to operate prior to sprinklers to avoid collateral damage to sensitive electronic equipment.

9.28.1.6. Either one of the following:

a. One Type AC fire extinguisher (water mist, clean agent)

b. One Type BC carbon dioxide extinguisher, and one Type A water extinguisher.

COMMENTARY: Dry chemical extinguisher discharge could damage the equipment in the space due to the residue left behind, and therefore dry chemical extinguishers are not permitted.

9.28.1.7. A sign will be located adjacent to each fire extinguisher to plainly indicate the type of fire for which it is intended.

9.28.1.8. Combustible storage within the computer room, such as for paper stock, inks, and unused recording media, will be restricted to the minimum necessary for efficient operations and will be stored in closed metal cabinets.

COMMENTARY: Similar to collections storage areas, even a small fire in an IT space could cause widespread smoke damage to all equipment in the space.

9.28.1.9. Local Area Network (LAN) rooms and similar second-tier IT spaces will be enclosed with one-hour fire-rated construction, protected with sprinklers and smoke detection, and kept free of combustible storage.

9.28.1.10. Where trash receptacles are specified as part of the design, only non-combustible containers will be specified.

9.28.2. For large-assembly buildings with an occupant load of more than 6,000 people, provide the following:

9.28.2.1. Automatic smoke detection throughout

9.28.2.2. A Fire Command Center (FCC), as defined in IBC Section 911. Minimum size of existing command centers is 9.3 m (100 sq ft).

9.28.2.3. Automatic sprinkler system throughout

9.28.2.4. Emergency responder radio coverage

9.28.2.5. Remotely located risers in interior exit stairways

9.28.2.6. Emergency voice/alarm communication system

9.28.2.7. Stair pressurization systems

COMMENTARY: SI museums experience extremely heavy occupant loads during many times of the year. As such, additional measures are needed to ensure the safety of visitors, staff, and responding emergency personnel. Previously, this manual reduced the height at which a building was considered high-rise to ensure the features above were provided. This created confusion during design, and in response, the section was updated to require specific building features from the high-rise section. Items above will be designed based on the applicable section of the IBC.

9.28.3. Laboratories:

9.28.3.1. The design of laboratories will be in accordance with the requirements of NFPA 45, *Fire Protection for Laboratories Using Chemicals* and this design manual.

9.28.3.2. All designs for laboratory spaces will follow the lab unit approach as defined in NFPA 45. Limitations on allowable quantities of corrosives, toxic chemicals, and other hazardous materials not addressed by NFPA 45 shall comply with the requirements of the IBC.

9.28.3.3. Refer to Appendix O- Laboratory Design Standards in Volume 3 for comprehensive lab design requirements.

9.28.4. Flammable and Combustible Liquids:

9.28.4.1. The storage and handling of flammable and combustible liquids will comply with Chapter 19, “Chemical Handling and Storage,” of the SI Safety Manual, NFPA 30, and the following requirements:

a. Flammable liquid storage areas will be separated from other areas by barriers having a minimum two-hour fire rating.

b. Consider the volume of anticipated sprinkler system discharge in sprinklered flammable/combustible liquids storage areas in addition to the quantity of flammable/combustible liquids when designing containment measures such as diking, trenches, and remote impounding.

9.28.5. Marine Operations:

9.28.5.1. Marine craft will comply with United States Coast Guard regulations and NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

9.28.5.2. Marinas and boatyards will comply with NFPA 303, *Fire Protection Standard for Marinas and Boatyards*.

9.28.5.3. All boats and docking areas will be equipped with portable fire extinguishers. The number and type of extinguishers will be as specified in NFPA 302.

9.28.5.4. Smoke detectors will be provided on boats with sleeping quarters.

9.28.5.5. All inboard-powered boats with enclosed engine compartments will have a fixed automatic fire suppression system in the engine space or will have a portable clean agent or carbon dioxide fire extinguisher that can be used in conjunction with a discharge port into the machinery space.

9.28.5.6. Water supply for fire protection in marinas, piers, and boatyards will be provided in accordance with the latest editions of NFPA 13, NFPA 14, *Installation of Standpipes and Hose Systems*, and NFPA 24, *Installation of Private Fire Service Mains and Their Appurtenances*.

9.28.5.7. Standpipes will be provided for piers or marine docks where the hose lay from the responding fire apparatus is in excess of 150 feet per NFPA 303, or where deemed necessary by OSHEM.

9.28.6. Animal Housing Facilities:

9.28.6.1. All animal housing facilities will comply with this section and NFPA 150, Fire and Life Safety in Animal Housing Facilities.

9.28.6.2. A fire protection / life safety basis of design narrative will be prepared for each renovation and new construction project that affects animal housing facilities. This narrative will include a description of how the fire and life safety features and systems comply with NFPA 150.

<u>COMMENTARY:</u> The inability of most animals to leave their enclosures requires a shelter-in-place approach. Buildings may require special design features to safely house animals. Such design features need to be considered at the beginning of a project design to ensure constructability.

9.28.6.3. Means of egress will be designed to meet the special requirements of animals and equipment necessary for egress.

9.28.6.4. All fire protection designs will take into consideration the animals' ability to reach fire protection equipment, which could potentially harm the animal or damage the fire systems.

<u>COMMENTARY:</u> Animals can reach with enrichment tools such as bamboo sticks, balls, etc. All systems will consider the space arrangement and the animal. For instance, an orangutan may

be curious about a shiny new object (i.e., sprinkler) whereas a bird may not. Consulting with the animal keepers and OSHEM is critical to any design in such areas.

9.28.6.5. All fire alarm systems will address the need for a push-button that silences the fire alarm notification appliances in the animal areas only, but that activates a silent red beacon to indicate that the system is still in alarm.

COMMENTARY: The fire alarm tone and voice recording may be stressful to some animals. Providing a silence button allows keepers the option to silence the fire alarm only in the animal areas if they think it is necessary. An additional feature that should be considered is programming the fire alarm system to automatically silence the audible alarm in animal areas after one minute and to activate a red beacon if there is a fire alarm activation after staff hours.

9.28.6.6. Smoke exhaust systems will be performance-based and consider toxicity levels, temperature, and smoke layer height based on the breathing zone and the tenability risk for the species housed.

COMMENTARY: Smoke control systems are installed in animal housing facilities to protect animals using a shelter-in-place approach during a fire event. Properly designed smoke control systems can ensure that toxic gases do not reach the breathing zone of the animals being sheltered.

It should be noted that a smoke control system design requires computer-based fire modeling and significant analysis. During construction, coordination from multiple trades is necessary to ensure these systems are fully integrated.

10. BUILDING REQUIREMENTS

10.1. WALLS AND BARRIERS

10.1.1. Walls

10.1.1.1. The walls general criteria and minimum requirements presented here are not all-inclusive, additional technical information for implementation can be found in the referenced documents.

10.1.1.2. Perimeter or Exterior Walls – Design in accordance with the Structural Section of the ISC Security Design Criteria and the requirement in Appendix A – Security Design Criteria Matrix.

10.1.1.3. Interior Walls – Refer to Appendix A – Security Design Criteria Matrix in Volume 3 for design requirements.

10.1.2. Fire and Smoke Barriers:

10.1.2.1. The following are fire ratings for critical spaces.

Space	**1-Hour**	**2-Hour**
Security LAN Closet	X	
Security Operations Center (SOC) / Unit Control Room (UCR)		X
Security Server Room (SSR)		X
Security UPS Room (SUR)		X

10.1.2.2. Fire and smoke barrier locations will comply with the requirements of the International Building Code (IBC), the national fire codes, and this design manual. Fire barriers for incidental use areas will be as required by applicable codes and standards. In each case, the most restrictive requirement among the IBC, national fire codes, and this manual will be followed. Refer to Appendix J of this manual for a summary of requirements for some of the more common spaces.

10.1.2.3. Dampers will comply with the requirements of NFPA 90A, *Installation of Air-Conditioning and Ventilating Systems*, for treatment of HVAC duct penetrations, locations of smoke dampers, and smoke detector requirements. HVAC ducts that penetrate smoke barriers provided to isolate collections storage rooms will be equipped with listed combination fire/smoke dampers and operated by adjacent area smoke detection. Subject to the approval of the Office of Safety, Health, and Environmental Management (OSHEM), smoke dampers may be omitted in HVAC ducts that penetrate smoke barriers where the system is designed to perform any of the following functions:

a. Function as an engineered smoke-control system, including the provision of continuous air movement with the air-handling system.

b. Maintain pressure differentials during a fire emergency.

10.2. DOORS

10.2.1. Refer to Technical Section 8 – Openings in Volume 1 for additional requirements.

10.2.2. Door Assembly. Refer to Appendix A- Security Design Criteria Matrix in Volume 3 for design requirements.

10.2.3. Door Hardware. Refer to Appendix A- Security Design Criteria Matrix in Volume 3 for design requirements.

10.3. WINDOWS

10.3.1. Refer to Technical Section 08- Openings in Volume 1 for additional information.

10.3.2. For windows-specific criteria (minimum requirements) and to identify the specific security measures required, refer to Appendix A- Security Design Criteria Matrix in Volume 3.

10.3.3. Not Used.

10.4. INTERIOR FINISHES

10.4.1. Refer to Technical Section 09- Finishes in Volume 1 for additional information.

10.4.2. Interior Finishes and Decorative Materials:

10.4.2.1. Interior finishes, insulation, and decorative materials will comply with this manual, Exhibit Fabrication Guidelines in the Volume 3 Appendix F, and applicable Life Safety Code requirements.

10.4.2.2. Wall and ceiling materials, paneling, and acoustical tile will be Class A or B, unless otherwise noted, with a maximum flame spread index of 75, and maximum smoke developed index of 450, as tested in accordance with ASTM E-84.

a. Exits (interior exit stairways, interior exit ramps, and exit passageways) must be Class A (maximum flame spread index of 25, maximum smoke developed index of 450, per ASTM E84).

b. Interior finishes must be Class A in any space where automatic sprinkler protection is not provided.

c. Class B materials are allowed in areas others than exits where fire sprinklers are provided.

COMMENTARY on Plastics: For many plastic materials, ASTM E84 does NOT adequately measure fire performance. The use of such materials for interior finish should be avoided. The limited application of these materials as trim or backing for graphics may be allowed on a case-by-case basis.

10.4.2.3. Wood used for platforms, enclosures, cases over 100 cu ft, cases with heat-producing equipment, or for other purposes will be fire-retardant, pressure-impregnated lumber. Markings attesting to its fire-retardant characteristics will remain clearly visible.

10.4.2.4. Fire retardant coatings of intumescent paint or other fire-retardant chemicals will not be used in lieu of fire-retardant, pressure-impregnated treatment.

10.4.2.5. No more than 6 in of carpet will be installed on vertical surfaces unless it meets the above ASTM E84 criteria for wall and ceiling materials.

10.4.2.6. All fabrics (not applied to solid backing) or other materials used in curtains, draperies, or similar treatments, must be certified as flame resistant in accordance with the criteria contained in NFPA 701: *Fire Tests for Flame Propagation of Textiles and Films*.

10.4.2.7. Decorative surface covering materials including banners, bunting, streamers, fabric, paper, cotton batting, and artificial and real vegetation, as well as wall, ceiling, and floor coverings for acoustical or other effects will meet the requirements of NFPA 101.

10.4.2.8. Textiles or other materials treated with fire retardant will be re-treated as per the recommended frequency by the treatment manufacturer. The building manager will maintain a record of the date and type of treatment for as long as the material is in use.

10.4.2.9. Artificial rocks, faux environments, and similar construction for exhibit staging will be fabricated of noncombustible materials to the greatest extent possible. Gypsum, glass fiber, metal lath, and other noncombustible materials will be used in lieu of foamed plastics and other combustibles.

10.4.2.10. Cellular or foamed plastics, expanded plastics, and similar materials will not be used in Smithsonian Institution (SI) facilities unless they comply with the fire test criteria and limits on quantities of the IBC and the Life Safety Code. Data on all such materials will be submitted to OSHEM for review and approval.

10.4.2.11. Theater and bench seating materials will comply with California Technical Bulletin 133: *Flammability Test Procedure for Seating Furniture for Use in Public Occupancies*.

10.5. ROOF COVERINGS AND ROOF DECKS

10.5.1. Use roof coverings approved and listed by a Nationally Recognized Testing Laboratory (NRTL). The UL Roofing Materials and Systems Directory lists three Classes (A, B, and C) of acceptable roof coverings based on compliance with UL 790: *Tests for Fire Resistance of Roof Covering* Materials and NFPA 256: *Fire Tests of Roof Coverings*.

10.5.2. Roof deck assemblies must be FM Class I approved, or UL listed as Fire Classified or equal listing or classification by a NRTL.

Exceptions:

10.5.2.1. Fully sprinklered buildings

10.5.2.2. Buildings less 744m (8,000 ft)

10.6. INSULATION

10.6.1. Insulation:

10.6.1.1. Use thermal and acoustical insulation with a flame spread index not higher than 25 and a smoke developed index not higher than 450 when fire tested in accordance with ASTM E84 (NFPA 255): *Test of Surface Burning Characteristics of Building Materials*.

10.6.1.2. The use of foam plastic insulation will meet the requirements of IBC Chapter 2603: *Foam Plastic Insulation*, including the application of thermal barriers.

10.6.1.3. The use of cellular foam plastic insulation will be permitted only for exterior envelope, mechanical piping, and walk-in cool rooms/freezers, subject to the limitations identified in this section.

10.6.2. Insulation of Utility Systems:

10.6.2.1. Insulation of mechanical systems will meet the requirements of the International Mechanical Code. All insulating materials, linings, and coverings will have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

10.6.2.2. Cellular foam plastic insulation may be used only on mechanical piping, subject to the following additional requirements:

a. These insulation materials must be approved according to FM Approval Standard 4924: *Approval Standard for Pipe Insulation*.

b. Where the insulation thickness and diameter/sectional dimension are further limited according to the listing, these limitations will be followed.

11. SAFETY AND SECURITY ENGINEERING REQUIREMENTS

11.1 GENERAL ENGINEERING REQUIREMENTS

11.1.1 This section is intended to provide additional information specific to safety and security considerations for engineering building systems. Refer to the Technical Sections in Volume 1 for additional discipline-specific engineering guidelines and standards that are applicable to Smithsonian Institution (SI) projects. Additionally, Smithsonian specification sections are included in Volume 2 of these Smithsonian Design Standards (SDS). These detailed, complete specifications pertaining to specific systems are to be included in each project as applicable.

11.2 BLAST MITIGATION

11.2.1 Catastrophic collapse of buildings and facilities is a primary concern to minimize mass casualties in the event of a terrorist attack. The methods used to mitigate this can include increasing standoff distances and implementing structure systems designed to prevent progressive collapse and building hardening to resist blast effects and limit collapse for any extreme loading events.

11.2.2 Flying glass fragments and debris from walls, ceilings, and fixtures causes a substantial number of injuries in an explosive event. Minimize the potential for flying glass fragments through site layout, reducing window numbers and sizes, and through enhanced glazing and window frame construction. Minimize the potential for flying debris through building design and avoidance of certain building materials and construction techniques. Hazardous fragments may also include secondary debris from such sources as barriers and site furnishings.

11.2.3 Utilize the Interagency Security Committee (ISC) Security Design Criteria, PBS P100 Facilities Standards for The Public Building Services, GSA Alternative Path Analysis and Design Guidelines for Progressive Collapse Resistance, and ASCE 59 Blast Protection of Buildings to determine the requirements and appropriate mitigation measures for each project.

11.2.4 Work directly with OPS to identify project-specific threats, risk assessment, and required level of protection.

11.2.5 Design all SI facilities to a minimum FSL Level III – Medium for all structural, blast, building harden, windows, and flying debris related criteria.

11.3 MECHANICAL ENGINEERING

11.3.1 General Requirements

11.3.1.1 Mechanical system design standards address limiting damage to critical infrastructure and protecting building occupants against CBR threats. The primary goal of a mechanical system after a terrorist attack should be to continue to operate key life safety systems. This can be accomplished by locating components in less vulnerable areas, limiting access to mechanical systems, and providing a reasonable amount of redundancy. The Mechanical Engineer shall utilize the following references in their mechanical systems designs; ISC Security Design Criteria and Guidance for Filtration and Air-Cleaning Systems to Protect Building Environments from Airborne Chemical, Biological, or Radiological Attacks.

11.3.1.2 During an interior bombing event or fire, smoke removal and control are paramount. The designer should consider the fact that, if window glazing is hardened, a blast may not blow out windows, and smoke may be trapped in the building. The smoke removal system will be essential in the event of a blast, particularly in large open spaces. This equipment should be located away from high-risk areas (e.g., entrances, garages, and loading docks). The system controls and power wiring to the equipment should be protected and connected to emergency power. Smoke removal equipment should be provided with standalone local control panels which can continue to function independently in the event the control wiring is severed from the main control system.

11.3.1.3 SI adheres to the ISC standards so comply with ISC Countermeasures and requirements for the facility's Facility Security Level (FSL) and the following minimum requirements:

- Locate all fresh air intakes a minimum of 30.5 m (100 ft) from areas where vehicles may be stopped with their engines running.
- Locate all fresh air intakes a minimum of 12 m (40 ft) above finish grade.
- To prevent widespread dispersion of a contaminant released within lobbies, mailrooms, and loading docks, isolate their HVAC systems and maintain them at a negative pressure relative to the rest of the building but at positive pressure relative to the outdoors.
- HVAC is a critical system so physically separate major HVAC equipment and utility entrances from high-risk areas including loading docks and entrances by at least 50' horizontal feet and not directly above or below.
- Mount all overhead utilities and other fixtures weighing 14 kg (31 lbs.) or more to minimize the likelihood they will fall and injure building occupants. Design all equipment mountings to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction. This standard does not preclude the need to design equipment mountings for forces required by other criteria such as seismic standards.

11.3.2 Security Spaces

11.3.2.1 Locate the HVAC equipment outside of the Security Operations Center (SOC) / Unit Control Room (UCR), and Security Server Room (SSR) to keep unauthorized people out of these critical spaces and enable access and maintenance of the equipment without hindering security operations.

11.3.2.2 The Security Operations Center (SOC) / Unit Control Room (UCR) require HEPA filtration. Larger Security Operations

Centers with multiple operators may require Ultraviolet Germicidal Irradiation (UVGI). Request clarification from OPS for any Security Operations Centers with more than one operator.

11.3.3 Barrier Bars

11.3.3.1 For locations where wall protection is required (see Security Design Criteria Matrix, Volume 3 Appendix 1), design ducts penetrating a slab-to-slab wall to be smaller than 240 square cm (37 square in) with any dimension being greater than 15.25 cm (6 in), if possible. If not possible, incorporate burglar bars to preclude intrusion. Mount burglar bars in ducts within fifteen centimeters of the duct penetration through the boundary wall, preferably on the protected side of the boundary wall. Burglar bars will be #5 rebar (5/8 inch) forming a rectangular web welded 125 mm (5 in) on center both horizontally and vertically. Substantial exterior duct support plates and bolts which shall be removable with a special tool are to secure the burglar bars in the ducts. The bars need to be removed when the ducts need cleaning. A duct inspection door is required, on the secure side of the duct grill, to inspect the grill. The installation of burglar bars must not interfere with the installation or ability to inspect/test a fire damper when the two must be collocated.

11.3.4 Smoke-Control Systems:

11.3.4.1 Codes: Smoke-control systems will be installed where required by applicable National Fire Protection Association (NFPA) codes and applicable SI standards.

11.3.4.2 Design Requirements: All smoke-control systems will comply with the requirements of NFPA 92: *Smoke-Control Systems*.

COMMENTARY: Performance-based design of smoke-control systems can result in lower required volumes of air movement and smaller HVAC equipment. This may result in *considerable cost savings over prescriptive ventilation requirements and should be considered for larger projects.*

11.4 ELECTRICAL ENGINEERING

11.4.1 General

11.4.1.1 The major security functions of the electrical system are to maintain power to essential building services, particularly those required for life safety and security; provide lighting to aid surveillance which deters criminal activities; and provide emergency communications. Thus, the operability of electrical systems is an important element and is a critical component for life safety systems.

11.4.1.2 Design emergency and normal electric panels, conduits, and switchgear at different locations and as far apart as possible. Electric distribution should be run from separate locations.

11.4.2 Power

11.4.2.1 All Electronic Security Systems and associated monitoring equipment will be powered by a dedicated centralized UPS that is on generator power. Wall mounted power supplies will be on dedicated generator circuits. OPS and the Security Consultant will provide the loads for the UPS. All UPS for security equipment must have 20% extra capacity for future expansion.

11.4.2.2 Provide power distribution from the Security UPS to the racks in the Security Server Room, to the rack in each Security LAN Closet, console(s) and video wall in the Security Operations Center / Unit Control Room.

11.4.2.3 The dedicated Security UPS will have at least 30 minutes of run-time when supported by generator. When generator power is not available, the UPS shall have eight (8) hours of run-time.

11.4.2.4 Provide relay outputs to the security system for battery fail, low battery, and AC fail conditions.

11.4.3 Lighting

11.4.3.1 Provide protective lighting in accordance with guidance from the Illuminating Engineering Society (IES).

11.4.3.2 Coordinate lighting with video cameras to enhance surveillance and prevent interference. Avoid “blinding” video cameras in the placement and selection of fixtures and their “cutoff” angles. Site lighting shall be uniform with no area having a light to dark ratio of greater than 4:1.

11.4.3.3 Vehicle Access Control Points: Lighting shall be provided at all vehicle access control points at 10 horizontal foot-candles to assist security officers with visual identification into vehicles and occupants. Where practical, high-mast lighting is recommended, because it gives a broader, more natural light distribution, requires fewer poles (less hazardous to the driver), and is more aesthetically pleasing than standard lighting. Lighting of the entry control point should give drivers a clear view of the gatehouse and, for security personnel, it gives a clear view of the drivers and vehicles.

11.4.3.4 Break Room for Security - A minimum of 50% of the ceiling fixtures in the security break room shall be on emergency power as the room may serve as an Emergency Command Center.

11.4.3.5 Security Operations Center (SOC) / Unit Control Room (UCR) – Provide dimmable lighting for general console illumination. Coordinate fixture location with the security console layout to provide appropriate lighting at the front edge of the console writing surface. Provide a wall mounted battery powered emergency light unit with the light directed at the operator side of the security console.

11.4.3.6 Security LAN Closet – Provide sufficient level of illumination is required for close, detailed work on circuit board electronics.

11.5 FIRE PROTECTION & LIFE SAFETY

11.5.1 Pre-Action Systems

11.5.1.1 Provide pre-action systems in the Security Operations Center (SOC) / Unit Control Room, Security Server Room (SSR), and the Security UPS Room (SUR).

11.5.2 Area of Rescue Assistance (ARA) Stations

11.5.2.1 Work with OSHEM to identify ARA locations and coordinate these locations with the Architect for signage and the Security Designer for the ARA intercom station.

11.5.3 Mass Notification

11.5.3.1 NFPA defines emergency communications system (ECS) as “a system for the protection of life by indicating the existence of an emergency situation and communicating information necessary to facilitate an appropriate response and action.” One type of ECS is in-building Mass Notification System (MNS), which NFPA defines as “a system used to provide information and instructions to people in a building or other space using intelligible voice communications and including visible signals, text, graphics, tactile, or other communications methods.” Another type of ECS is wide-area MNS, which is generally provided for real-time information to outdoor areas and could have the capability to communicate with other notification systems provided for a campus.

11.5.3.2 The Fire Alarm System is to have 17 pre-recorded messages and be the primary trigger of a on-premises MNS. This trigger can be serial through the printer port or, if a UL864 listed solution, over Ethernet with the appropriate isolation as required by the OEM to be UL864 listed.

11.5.3.3 The on-premises MNS shall be Siemens Desigo CC MNS when connected to a Siemens XLS Fire Alarm or Alertus for all non-Siemens XLS Fire alarms.

11.5.3.4 The system must provide the following:

- Integration with OCIO's existing Four Winds Interactive (FWI) digital signage players.
- Integration with OCIO's existing Singlewire InformaCast system, which will provide Cisco VoIP phone and computer notifications.
- Integration with existing Smithsonian Enterprise (SE) displays, including displays in Cafes.
- Integration with existing Exhibit Audiovisual digital signage players using RSS.
- Integration with existing Exhibit Audiovisual computers, which is often done using a matrix switcher.
- Displays that cannot be integrated shall show a blank screen, or turn off, and will be reviewed on a case-by-case basis.
- The Office of Emergency Management's (OEM) LiveSafe mobile device and email notification system will remain a separate solution and will not be integrated with the Fire Alarm/ MNS system.

11.5.4 Fire Alarm Systems:

11.5.4.1 Purpose: Designs of new facilities, as well as modifications to existing SI-owned and leased buildings, will incorporate redundant fire protection concepts, employing active fire protection through automatic fire suppression and detection systems, passive fire barrier features, and limiting combustible fuel loads to minimize potential injury to SI staff and losses to collections, mission, and infrastructure.

COMMENTARY: Specific fire protection design criteria is located within the body of the SDS and in the attached SI master fire protection related specifications.

11.5.4.2 General Requirements:

a. Fire protection systems installed in facilities on SI-occupied sites will be compatible with, and connected to, (where available) the site-wide fire alarm monitoring system.

COMMENTARY: In accordance with OPS Policy Memo 27, OPS is responsible for responding to a fire alarm and notifying the fire department. The SI typically utilizes the Keltron life safety event monitoring system as it has the ability to remotely monitor numerous manufacturers' fire alarm panels. The Keltron often serves as a redundant fire alarm campus system.

b. Fire alarm installations will comply with the requirements and recommendations of NFPA 72, project specifications, and SI requirements.

c. All new fire alarm systems will be addressable unless otherwise permitted by OSHEM.

COMMENTARY: Addressable fire alarm systems provide the exact location of a fire incident in the building, which allows the OPS officers to respond faster to an alarm condition.

d. Complete smoke detection coverage will be provided throughout SI facilities where early detection of fire can improve life safety or limit damage to collections and property (leased or owned) or where required by IBC and/or applicable NFPA codes.

e. Refer to the SI Specification Section 28 31 11, Addressable Fire Alarm System, located in Volume 2 for fire alarm specification criteria. This specification should be included in all projects where applicable.

11.5.5 Fire Extinguishing Systems:

11.5.5.1 General:

a. Design of new facilities and modifications to existing SI-owned and leased buildings will incorporate redundant fire protection concepts, employing active fire protection through automatic fire suppression and detection systems, passive fire barrier features, and limiting combustible fuel loads to minimize potential injury to SI staff and losses to collections, mission, and infrastructure.

<u>COMMENTARY:</u> Specific fire protection design criteria is located within the body of the SDS, and in the attached SI master fire protection related specifications

b. Complete automatic fire suppression systems are to be provided and installed in accordance with the applicable International Building Code (IBC) and NFPA standards for all projects (regardless of funding sources) where the Maximum Credible Fire Loss (MCFL) without automatic fire suppression would result in the loss of use of a structure or equipment for a period longer than that considered acceptable by the program director.

c. In addition to the above requirement, fire extinguishing systems will be provided where required by the IBC and/or applicable NFPA standards.

<u>COMMENTARY:</u> Some of the requirements set forth in this document differ from the minimum NFPA and IBC requirements, which are focused on life safety and firefighter safety, not property protection or business continuity. These codes also do not specifically address system ease of maintenance, flexibility for future modifications, and durability. The SI fire suppression requirements ensure appropriate protection for the SI's valuable collections and mission-critical operations. They also ensure systems are designed and installed to provide long-term, lower maintenance service and to permit future modifications with the least amount of disruption to SI buildings.

d. When the criteria above do not apply, automatic fire suppression may still be warranted based on any one of the following factors:

i. Programmatic importance

ii. Effects on operations

iii. Cost vs. benefit

iv. Exposure (e.g., wildland, adjacent buildings or sheds, storage)

v. Future conditions

11.5.6 Sprinkler Systems:

11.5.6.1 Fire sprinkler system design criteria for SI facilities will comply with NFPA 13: *Installation of Sprinkler Systems*, but will be designed for no less than Ordinary Hazard Group 2 criteria (0.20 gpm/sf over 1500 sq ft (8.1 mm/min over 139 m^2)).

COMMENTARY: The SI has many types of occupancies ranging from business to assembly to storage. Facilities are constantly changing out spaces, which may impact occupancy classification. The Ordinary Hazard Group 2 criteria provides a sprinkler system with flexibility for future expansion/modification to protect spaces where the use changes (e.g., from an office to a storage occupancy).

11.5.6.2 The following minimum design criteria will be met:

a. Hydraulic calculations must be used for design. Pipe schedule design will not be accepted.

COMMENTARY: The sprinkler systems are constantly being modified within the SI due to construction. This expansion or modification may change the water pressure and flow rate a system can deliver. Baseline hydraulic calculations assist in determining if an existing system can *provide the required protection, and when necessary, the extent of the modifications when there is an occupancy change.*

11.5.6.3 Reductions in the hydraulically most remote area allowed in NFPA 13 with the use of quick response sprinklers are not permitted.

COMMENTARY: The SI has many types of occupancies ranging from business to assembly to storage. The facilities are constantly changing out spaces, which may impact the occupancy classification. By not permitting the reduction to the remote area, systems are designed with greater capacity to accommodate future expansion/modification.

11.5.6.4 Safety Margin: The total demand water flow and pressure must be at least 10 percent less than the available water flow and pressure.

COMMENTARY: Over time, the water supply pressure tends to decrease due to increased public water demands. Friction losses increase due to pipe corrosion. The safety margin allows for adequate water flow and pressure even though the available water supply and pressure may have decreased over time.

11.5.6.5 Pipe Schedule: Schedule 40 or greater must be used for all sprinkler piping less than 4 in (100 mm). Schedule 10, 40, or greater must be used for sprinkler piping 4 in (100 mm) and larger.

COMMENTARY: Sprinkler mains are typically routed in open areas whereas branch mains are routed above exhibits/collection areas. Utilizing thicker-walled piping (Schedule 40) for branch lines reduces the risk of leaks over collections and critical operations.

11.5.6.6 Wet pipe sprinkler systems will be designed as outlined in the Smithsonian Specification Section 21 11 13 Wet Pipe Sprinkler System included in Volume 2.

11.5.6.7 Drypipe sprinkler systems will be designed as outlined in the Smithsonian Specification Section 21 13 16 Dry Pipe Sprinkler System included in Volume 2.

11.5.6.8 Gate valves must be OS&Y style on systems with piping greater than 4 in diameter.

<u>COMMENTARY:</u> According to feedback provided by the SI Office of Facilities Management and Reliability (OFMR) life safety shop and the SI plumbing shop, OS&Y valves are more reliable and typically installed in large mains where there is room for the stem to move up and down.

11.5.6.9 Butterfly valves may be used only on piping 4 in (100 mm) and less.

11.5.6.10 Use of restrictive orifices, reducing flanges, unions, and plain-end fittings will not be permitted. Flanged fittings are permitted.

11.5.6.11 Branch outlet mechanical fittings and clamp-type fittings are not permitted unless approved by OSHEM.

<u>COMMENTARY:</u> Theses fittings are not as reliable and more prone to catastrophic failure compared to threaded fittings and grooved couplings and grooved fittings. Per the SI sprinkler specifications, all pipes less than 4 in are required to have threaded fittings, and pipes 4 in and larger are permitted to have grooved couplings and fittings since these larger mains are typically not routed over collections/exhibit spaces.

11.5.6.12 Automatic sprinkler systems used to protect special occupancies, such as compact storage units (mobile shelving) and wet collections, will meet the design requirements of Chapter 7 of these SDS.

11.5.7 Standpipe Systems:

11.5.7.1 When required, standpipe systems must be installed in accordance with NFPA 14: *Installation of Standpipe and Hose*

Systems.

11.5.7.2 Residual pressure requirements may be omitted for buildings under 150 ft (45 m) in height where fire department apparatus is expected to boost pressure in standpipe systems. Piping for standpipe systems must be designed by hydraulic calculation to show that the fire department pumper, connected to a fire department connection, can deliver the needed flow and pressure at the topmost hose connections.

11.5.7.3 All standpipe systems will be Class I. Adapters will be in accordance with the local fire department.

a. Class I standpipe systems must be provided in exit stairways of buildings four stories or more in height.

b. Class I standpipe systems must also be provided in non-sprinklered facilities where not all portions of the building can be reached with 150 ft of firefighting hose lines extended from the exterior of the building, regardless of building height. Locate fire hose connections such that all portions of the building can be reached with 100 ft (30.5 m) of hose plus 30 ft (9.14 m) of the hose stream.

COMMENTARY: Typically, the code requires high-rise buildings to have automatic standpipe systems that provide a residual pressure of 100 psi at the top. This section permits manual standpipes for high-rise buildings. Fire department pumper capabilities can change as years pass and accordingly, the hydraulic calculation associated with these standpipes should be reassessed every five years.

COMMENTARY: Class II and Class III standpipes are not permitted. A Class II or Class III standpipe permits attachment of occupant hoses to the standpipe riser. Due to the pressures associated with the water flow, an occupant must be trained to use the hose to decrease the risk of injury. The SI does not have trained fire brigades and therefore, does not install occupant hoses for safety reasons.

11.6 SECTION NO LONGER USED

11.7 SECTION NO LONGER USED

11.8 SECTION NO LONGER USED

1. DIVISION 01 SUPPLEMENTARY CONDITIONS FOR CONSTRUCTION

1.1. Reference Codes, Standards, and Guidelines

1.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards, (SDS) Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design.

1.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

1.2. Fire Safety During Construction and Renovation

1.2.1. Coordinate with the facility prior to and concurrent with design.

1.2.2. Separate all occupied areas from demolition, renovation, or construction activities with temporary smoke-tight construction partitions of gypsum wall board (GWB) or other approved non-combustible or limited-combustible material in accordance with the requirements of NFPA 241, *Safeguarding Construction, Alteration, and Demolition Operations*. Barrier design will be detailed in project documents.

1.2.3. Partitions will be full height, extending through suspended ceilings to the floor slab or roof deck above and will be one-hour fire rated, unless sprinklers are installed and are operational on both sides of the temporary partition whereupon the partition may be permitted to terminate at the ceiling in accordance with NFPA 241.

COMMENTARY: This requirement is due to the inherently greater potential for fire or hazardous materials incidents associated with the combustibles and operations of demolition/construction. This risk is heightened by the likelihood of compromised fire protection systems and fire/smoke-resistant barriers. This does not obviate the need to provide other protective measures to contain dust and debris as specified under other SI requirements.

1.2.4. Sprinklers are considered to be operational when they are installed and maintained in accordance with NFPA 13, *Installation of Sprinkler Systems* (including spacing, protection, distance from the ceiling, and adequate automatic water supply).

1.2.5. Phase construction as necessary to ensure that exits are not obstructed or reduced in width. If exits must be obstructed during construction, provide alternate exit routes during each phase of construction and identify the alternate routes on the construction drawings.

<u>COMMENTARY:</u> The impact of construction on nearby occupied areas must be evaluated to ensure adequate egress is maintained for occupants in these spaces. Temporary egress paths may need to be provided. Where adequate egress cannot be maintained, it may be necessary to temporarily close areas adjacent to the construction.

1.2.6. Minimize or avoid disruptions to fire alarm and sprinkler system service. Delineate construction phasing to ensure that installations of new systems are expedited, and where possible, maintain existing systems in service until the replacement system is operational. If fire protection systems are to be impaired, follow the SI Fire System Impairment Permit to ensure procedures are implemented. Maintain equivalent levels of fire protection and provide formal notification to the facility while systems are down via the fire protection system impairment process.

<u>COMMENTARY:</u> Impairment of fire systems during modifications and construction activities can subject SI facilities and occupants to greater risk. Application of these guidelines manages this risk to allow continued operations of the facilities concurrent with construction. Provision of adequate exits and sprinkler protection are especially effective in providing adequate fire protection and life safety.

1.2.7. Contractors will furnish their own fire extinguishers when an area is vacated for renovations. SI-owned fire extinguishers will be removed from the vacated area and returned (or replaced with new) prior to re-occupation by SI.

1.2.8. Hot work operations involving open flames or spark-producing processes will be minimized to the greatest extent possible through use of off-site fabrication or alternate work methods. When performing hot work, contractors will adhere to strict SI guidelines and coordinate all activities with the COTR.

<u>COMMENTARY:</u> Hot work has been a major cause of fires at the SI since its establishment in 1846. Constant attention to this source of ignition is a strict requirement for all SI work.

Modifying projects to avoid or reduce hot work is preferable to conducting such high hazard operations on site.

2. DIVISION 02 – EXISTING CONDITIONS

2.1. Reference Codes, Standards, and Guidelines

2.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional requirements specific to Division 2:

2.1.1.1. Refer to NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations,* for additional requirements.

2.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

2.2. Design Requirements

2.2.1. Construction Barriers:

2.2.1.1. All dust barriers will be constructed of non-combustible or fire-retardant materials.

2.2.1.2. Separate all occupied areas from demolition, renovation, or construction activities by temporary smoke-tight construction partitions of gypsum wall board (GWB) or other approved non-combustible or limited-combustible material in accordance with the requirements of NFPA 241, *Safeguarding Construction, Alteration, and Demolition Operations.* Barrier design will be detailed in project documents.

2.2.1.3. Partitions will be full height, extending through suspended ceilings to the floor slab or roof deck above and will be one-hour fire rated, unless sprinklers are installed and are operational on both sides of the temporary partition whereupon the partition may be permitted to terminate at the ceiling in accordance with NFPA 241.

COMMENTARY: This requirement is due to the inherently greater potential for fire or hazardous materials incidents associated with the combustibles and operations of demolition/construction. This risk is heightened by the likelihood of compromised fire protection systems and fire/smoke-resistant barriers. This does not obviate the need to provide other protective measures to contain dust and debris as specified under other SI requirements.

2.2.2. Temporary Tree, Vegetation, and Soil Protection:

2.2.2.1. An International Society of Arboriculture (ISA) certified arborist, who has a minimum of five years of experience in the field of urban forestry and remediation of construction damage, will identify trees to be protected with the limit of disturbance and determine the means and methods to be used.

2.2.2.2. All tree protection will be installed prior to the start of all work on site.

2.2.2.3. Equipment pathways will avoid critical root zones (CRZ). Vehicular traffic or materials storage inside the drip line of trees and shrubs requires approval of Smithsonian Gardens (SG) through the Contracting Officer's Technical Representative (COTR). If it is necessary for vehicles to cross planting beds, bed bridging is required. Parking is not permitted on the turf at any time.

2.2.2.4. Generator placement on site requires approval of SG.

2.2.2.5. When aerial work is being performed above plantings, a protective frame will be erected at least 300 mm (12 in) above the tops of the plant material. SG approval through the COTR is necessary to tie-back trees and shrubs. This must be performed by an ISA certified arborist approved by SG through the COTR.

2.2.3. Asbestos and Lead Abatement:

2.2.3.1. Refer to the SI specification sections listed below for project requirements for asbestos and lead abatement in SI facilities.

2.3. Specifications

2.3.1. Asbestos and Lead Abatement:

2.3.1.1. The SI Asbestos Abatement Specification 028200 is available on the Smithsonian Facilities (SF) A/E Center website (Architect-Engineer Information Center | Facilities (si.edu). A reference copy of the specification is available in Volume 2.

2.3.1.2. The SI Work Activities Impacting Lead-Containing Materials Specification 028300 is available on the SF A/E Center website (Architect-Engineer Information Center | Facilities (si.edu). A reference copy of the specification is available in Volume 2.

3. DIVISION 03 – CONCRETE

3.1. Reference Codes, Standards, and Guidelines

3.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design.

3.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

3.2. Design Requirements

3.2.1. Structural Loading – Roof Framing:

3.2.1.1. Deflections:

a. Framing supporting glass canopies will be limited to a typical live load deflection of L/480. Verify deflection requirements with skylight and/or window manufacturer.

3.2.1.2. Roof Drains and Ponding Load:

a. Ponding loads will not exceed one-half the design live load.

b. For roof framing, limit total deflection to 25.4 mm (1 in).

3.2.1.3. Member Depth:

a. Limit the depth of roof framing members to L/24.

3.2.2. Structural Loading – Floor Framing:

3.2.2.1. Member Depth:

a. Limit the depth of floor framing members to L/20.

3.2.2.2. Deflections and Cambers:

a. Floor framing supporting high density files will be limited to a typical live load deflection of L/480. Verify deflection requirements with unit manufacturer.

b. Interior framing supporting unreinforced concrete masonry unit (CMU) walls shall be limited to L/600 or 7.63 mm (0.30 in), maximum.

3.2.3. Structural Loading – Spandrel Framing:

3.2.3.1. Design Loads:

a. Design spandrels for point loads from any supported beams, uniform load of floor/roof beyond beam centerline (DL + LL), and wall loads, minimum.

b. All spandrel designs must include the effects of torsion where applicable.

3.2.3.2. Deflection and Camber:

a. Spandrels supporting masonry will be designed for a maximum deflection of L/600. Include superimposed DL, LL, and wall weight when calculating deflections, but omit concrete weight and slab DL.

b. Limit live load deflections of typical spandrels to 12.7 mm (0.5 in) maximum. This allows the spandrel to deflect without transferring load to the wall system below.

c. Do not specify cambers for spandrel members

3.2.4. Structural Loading – Expansion Joints:

3.2.4.1. The following are guidelines for maximum building length between building expansion joints. However, regional locations, geometries, materials, etc., can affect these lengths.

a. 83.8 m (275 ft) precast structures and parking garages

b. 76.2 m (250 ft) concrete structures (all façade types)

c. 68.6 m (225 ft) other materials, irregular shaped structures, etc.

3.2.5. Concrete Stairs:

3.2.5.1. Refer to the International Building Code (IBC) for all requirements for stairs, such as dimensions for stair width, headroom, riser height, tread depth, and landing.

3.2.5.2. Provide integral non-slip nosings on all stair treads. Surface-applied nosing type is not allowed.

3.2.5.3. Apply slip-resistive finish on concrete stair treads, ramps, and platforms.

3.2.6. Concrete admixtures are permitted, subject to SI approval.

3.3. Specifications

3.3.1. Concrete:

3.3.1.1. For structural concrete, post-installed anchors will be a minimum of 101.6 mm (4 in) from edge of centerline of anchor.

3.3.1.2. Architectural Concrete (Poured in Place):

a. The contractor will be required to fabricate and erect sample panels of exposed concrete elements prior to construction of the work showing all the required finishing techniques (i.e., finishes and textures).

b. Mockups/samples will be required for exposed concrete and precast.

3.3.2. Precast Architectural Concrete:

3.3.2.1. The contractor will be required to fabricate and erect sample panels of exposed concrete elements prior to construction of the work showing all the required finishing techniques (i.e., finishes and textures).

3.3.2.2. The concrete used in the sample panels will be provided from the project concrete supplier and will represent the approved mix for strength and texture. The designer will consider stipulating all elements exposed to view meet the Precast/Prestressed Concrete Institute (PCI) requirements for architectural concrete for finishes and tolerances.

3.3.3. Concrete Topping and Underlayment:

3.3.3.1. Concrete Topping:

a. Installation of cement-based, self-leveling topping over structural grade concrete must be performed by a qualified, factory-trained installer with previous experience.

b. Specify proper concrete design mix and final floor levelness required to accommodate end use of the topping slab (for example, installation of floor rail system for mobile storage shelving system).

c. Topping will be able to be installed from 6 mm (1/4 in) to 51 mm (2 in) in one pour and up to 127 mm (5 in) with the addition of an appropriate aggregate; topping must be tapered to match existing adjacent floor slab elevation.

d. Minimum thickness/coverage of concrete is required over conduit. Coverage must comply with ACI 318.

e. Topping must be coated with a wear finish coating suitable for the intended use of the floor. Finish may be high performance, water-borne acrylic concrete sealer if appropriate for use.

f. Substrates will be inspected and corrected for moisture and any other conditions that could affect the performance of the floor covering or the finish sealer.

3.3.3.2. Gypsum cement underlayment will not be used in exterior locations or where moisture migration may be an issue such as slabs on grade.

4. DIVISION 04 – MASONRY

4.1. Reference Codes, Standards, and Guidelines

4.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 04-specific requirements:

4.1.1.1. National Concrete Masonry Association (NCMA)

4.1.1.2. Brick Institute of America (BIA)

4.1.1.3. Indiana Limestone Institute of America, Inc. (ILIA)

4.1.1.4. Marble Institute of America (MIA)

4.1.1.5. The Masonry Society (TMS) 402/602: *Building Code Requirements and Specifications for Masonry Structures*

4.1.1.6. ASTM C90: *Standard Specification for Loadbearing Concrete Masonry Units*

4.1.1.7. ASTM E119: *Standard Test Methods for Fire Tests of Building Construction and Materials*

4.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

4.2. Design Requirements

4.2.1. General Requirement: Provide bracing at the top of all masonry walls.

4.2.2. Exterior Walls:

4.2.2.1. Perimeter or exterior walls will be designed in accordance with the Interagency Security Committee (ISC) Security Design Criteria – Structural Section.

4.2.2.2. The selection of exterior building façade materials for SI buildings on or near the National Mall in Washington is subject to external review by federal agencies including the National Capital Planning Commission (NCPC), Commission of Fine Arts (CFA), and the Advisory Council on Historic Preservation. Refer to the SI Special Conditions for A/E Services for more detail about the review process.

4.2.2.3. Masonry facades will be designed with primary and secondary waterproofing and air barrier systems.

4.2.2.4. Project specifications will require the contractor to assign a single point of responsibility for coordination and responsibility for exterior connection points (including, but not limited to: roofing, flashing, façade elements, and waterproofing).

4.2.2.5. At a minimum, on-site air and water infiltration testing will be required for all customized wall assemblies.

4.2.3. Interior Walls:

4.2.3.1. At a minimum, interior partitions will be designed in accordance with space classifications as listed in Appendix A–Security Design Criteria Matrix in Volume 3.

4.2.4. Masonry and Stone:

4.2.4.1. For renovations and additions, specify masonry and stone to match existing materials. New material will match the size, color, appearance, and texture of the original masonry and stone, including color and appearance of the mortar.

4.2.4.2. For new building design, specify masonry and stone that is readily available and in ample supply. Limited space is available for storage of "attic stock" materials for new buildings.

4.3. Specifications

4.3.1. Unit Masonry:

4.3.1.1. Install concrete masonry units in accordance with ACI 530.1.

4.3.1.2. Install loadbearing concrete masonry units in accordance with ASTM C90.

4.3.1.3. Provide concrete masonry units that comply with requirements for fire resistance ratings where needed and as determined by testing according to ASTM E119.

4.3.2. Brick Masonry:

4.3.2.1. Brick masonry will be designed and constructed according to BIA standards.

4.3.2.2. The contractor will be required to fabricate and erect one or more sample wall panels. The minimum size of the mock-up will equal 1.5m2 (16 sq ft). Sample panels will contain the proposed brick and mortar and include masonry backup, wall ties, insulation, and any limestone/precast stone trim applicable to the project.

5. DIVISION 05 – METALS

5.1. Reference Codes, Standards, and Guidelines

5.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 05-specific requirements:

5.1.1.1. Occupational Health and Safety Administration (OSHA) Standards 1910.24: *Fixed Industrial Stairs*, 1910.26: *Portable Ladders*, 1910.27: *Fixed Ladders*

5.1.1.2. American Institute of Steel Construction (AISC) 303: *Code of Standard Practice for Steel Buildings and Bridges*

5.1.1.3. ANSI/AISC 360: *Specification for Structural Steel Buildings*

5.1.1.4. ANSI/American Welding Society (AWS) D1.1: *Structural Welding Code – Steel*

5.1.1.5. National Association of Architectural Metal Manufacturers (NAAMM) Metal Finishes Manual for Architectural and Metal Products

5.1.1.6. ANSI/NAAMM 531: *Metal Bar Grating Manual*

5.1.1.7. ASTM A36: *Standard Specification for Carbon Structural Steel*

5.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

5.2. Design Requirements

5.2.1. General Requirements:

5.2.1.1. Consider the inclusion of decorative metal railings at the front of exhibitory. Coordinate with the Exhibit Design Team.

5.2.1.2. Include integral lighting guidelines for handrails and other metal fabrications where applicable.

5.2.1.3. Use of Cor-Ten steel is limited to certain facilities. Refer to National Zoological Park (NZP) standards for additional information and coordinate with the Contracting Officer's Technical Representative (COTR). A copy of this standard can be provided by the COTR.

5.2.2. Structural Loading – Roof Framing:

5.2.2.1. Framing supporting glass canopies will be limited to a live load deflection of L/480, typically. Verify deflection requirements with skylight and/or window manufacturer.

5.2.2.2. For roof drains, ponding loads should not exceed half the design live load. For roof framing, limit the total deflection to 25.4 mm (1 in).

5.2.2.3. Limit the depth of roof framing members to L/24.

5.2.3. Structural Loading – Floor Framing:

5.2.3.1. Limit the depth of floor framing members to L/20.

5.2.3.2. Deflections and Cambers:

a. Floor framing supporting high density files will be limited to a live load deflection of L/480, typically. Verify deflection requirements with unit manufacturer.

b. Interior framing supporting unreinforced concrete masonry unit (CMU) walls will be limited to L/600 or 0.30 inches, maximum.

5.2.4. Structural Loading – Spandrel Framing:

5.2.4.1. Design Loads:

a. Design spandrels for point loads from any supported beams, uniform load of floor/roof beyond beam centerline (DL + LL), and wall loads, minimum.

b. All spandrel designs must include the effects of torsion, where applicable.

5.2.4.2. Deflection and Cambers:

a. Spandrels supporting masonry will be designed for a maximum deflection of L/600. Include superimposed DL, LL, and wall weight when calculating deflections, but omit concrete weight, and slab DL.

b. Limit live load deflections of typical spandrels to 12.7 mm (0.5 in), maximum. This allows the spandrel to deflect without transferring load to the wall system below.

c. Do not specify cambers for spandrel members

5.2.5. Structural Loading – Expansion Joints:

5.2.5.1. The following are guidelines for maximum building length between building expansion joints. However, regional locations, geometries, materials, etc., can affect these lengths.

a. 91.4 m (300 ft) steel structures (e.g., curtain wall, metal panel, precast, or Exterior Insulation Finishing System (EIFS) surfaces)

b. 83.8 m (275 ft) steel structures (e.g., brick or masonry façades)

c. 68.6 m (225 ft) other material structures, irregular shaped structures, etc.

5.2.6. Metal Fabrications:

5.2.6.1. The design of metal ladders (fixed and portable) and fixed industrial stairs will meet the safety requirements identified in the SI Safety Manual and in the applicable OSHA standards.

The SI Safety Manual is located online at SI Safety Manual Oct 2010.

5.2.7. Metal Stairs:

5.2.7.1. Refer to the International Building Code (IBC) for all requirements for stairs, such as dimensions for stair width, headroom, riser height, tread depth, and landing.

5.2.8. Metal Railings:

5.2.8.1. Refer to the IBC for all requirements for handrails and guard rails.

5.2.8.2. Railings and guards must be approved by OSHEM representatives, with regard to height and construction.

5.2.8.3. The design of handrails will comply with the Smithsonian Guidelines for Accessible Design (SGAD), such as the requirements for allowable mounting height and for clearance between handrail and wall.

5.2.8.4. Railings and guards must have a maintenance-free finish.

5.2.8.5. Provide sufficient intermediate interior and exterior handrails.

5.2.8.6. All handrails must be of sturdy construction and durable material due to heavy and frequent use as places for people to lean and sit.

5.2.8.7. If fall hazards cannot be eliminated, OSHEM prefers passive fall prevention systems such as parapets and standard guardrails that meet the height and strength requirements outlined in OSHA and ANSI standards.

5.2.8.8. Match facility unique requirements as requested by the SI project manager. For example, at the NZP, railings and guards are most often Cor-ten to mitigate rust.

5.2.8.9. Consider integral lighting in the design of new handrails in public spaces and on the exterior at museum entrances.

5.2.9. Metal Finishes:

5.2.9.1. Comply with the NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.

5.3. Specifications

5.3.1. Metal Fabrications:

5.3.1.1. Metal fabrications are required to be galvanized. Paint may then be applied as applicable.

5.3.1.2. Metal Stairs:

a. Exterior metal service stairs will be hot-dipped galvanized at a minimum and will not be painted.

b. Exterior metal service stairs will be wide enough to accommodate equipment, especially on roofs.

c. Exterior metal service stairs will not be visible from the ground.

d. Metal stairs of four or more risers will be equipped with standard handrails based on configuration and exposure as outlined in OSHA and ANSI standards.

e. Non-slip nosing and tread grips are required.

5.3.1.3. Pipe and Tube Railings:

a. Exterior handrails will be maintenance-free (will not require painting, for example) and will be fabricated of bronze, aluminum, or stainless steel.

b. Consider materials most appropriate for their location (public/visible railings versus back-of-house/loading areas).

5.3.1.4. Metal Gratings:

a. Metal bar gratings shall comply with the ANSI/NAAMM 531: *Metal Bar Grating Manual*.

b. Steel components of steel gratings will comply with ASTM A36.

c. All gratings will comply with the SGAD accessibility requirements.

   i. Openings will allow passage of a sphere no greater than 13 mm (1/2 in) in diameter.

   ii. Elongated openings will be placed so that the long dimension is perpendicular to the dominant direction of travel.

d. Exterior gratings will satisfy both vehicular loading requirements and accessibility requirements for pedestrians and persons with disabilities.

   i. Provide close spacing of the bearing bars – 6 mm (1/4 in) to 13 mm (1/2 in) space between bars to accommodate wheelchairs, high heeled shoes, and bicycles.

   ii. The gratings will have a non-slip finish.

e. Gratings will be designed and fabricated to meet the loading requirements, clear span conditions, and maximum deflections specified.

   i. Provide anchorages for gratings, grating frames, and supports, where required, to secure gratings to in-place construction.
   ii. Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly.

5.3.2. Decorative Metal Railings:

5.3.2.1. It is recommended that the design of new decorative metal railings at SI museum buildings on the exterior and in the interior public areas (lobbies, monumental stairs) will match the profile and material of any existing historic railings.

5.3.2.2. Exterior handrails will be maintenance-free and will be fabricated of bronze, aluminum, or stainless steel.

5.3.2.3. Handrails with integral lighting will be provided by a manufacturer with a minimum of five years of experience producing handrails with integral lighting.

5.3.2.4. Glass-supported railings will include a continuous top rail anchoring adjacent glass panels.

6. DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

6.1. Reference Codes, Standards, and Guidelines

6.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information Volume 1 in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 06-specific requirements:

6.1.1.1. Architectural Woodwork Institute (AWI) Quality Standards

6.1.1.2. American Wood Protection Association (AWPA) Standards

6.1.1.3. ANSI A208.1: *Standard for Particleboard*

6.1.1.4. ANSI A208.2: *Medium Density Fiberboard (MDF) for Interior Applications*

6.1.1.5. Forest Stewardship Council (FSC) Principles and Criteria for Forest Stewardship

6.1.1.6. Ozone Transport Commission

6.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

6.2. Design Requirements

6.2.1. Carpentry:

6.2.1.1. All wood and wood products used for walls, platforms, blocking, furring, exhibit cases over 2.8 cu m (100 cu ft), light attics with electric lighting, and similar applications will be fire retardant, pressure impregnated (FRPI) per the SI Office of Safety, Health, and Environmental Management (OSHEM).

6.2.1.2. All wood and wood products used in spaces containing collections storage will meet International Standards for Phytosanitary Measures (ISPMs) to prevent against pest infestation.

6.2.1.3. Fire retardant coatings of intumescent paint or other fire-retardant chemicals are not acceptable in lieu of fire-retardant pressure treated wood per OSHEM.

6.2.1.4. All exterior wood will be rated for exterior use, will have longevity, and will be termite-proof, pest-resistant, and weather-resistant.

a. Marine-grade wood will be acceptable for exterior applications.

6.2.1.5. Specify borate-treated lumber for blocking where moisture may be encountered, such as below-grade locations, roof locations, and wet areas such as kitchens, warewashing, and food preparation rooms.

6.2.1.6. Specify environmentally sensitive treated lumber where the building material selections may impact the scientific or preservation work to be performed in the facility (for example, Smithsonian Environmental Research Center (SERC)).

6.2.1.7. Specify that lumber will be certified wood, obtained from forests certified by a FSC-accredited source to comply with FSC certification criteria.

a. Maintain FSC-accredited source as a requirement.

6.2.1.8. Composite wood and agrifiber products used on a building interior (defined as inside of the weatherproofing system) will contain no added urea-formaldehyde resins.

6.2.1.9. Wood Preservative:

a. Impregnate with Alkaline Copper Quaternary (ACQ) in accordance with AWPA Standards. Chromated Copper Arsenate (CCA) is NOT acceptable

b. Specify borate-treated lumber in wet areas such as kitchens, warewashing, and food preparation rooms.

6.2.2. All wood decking and sheathing will be designed to meet the requirements of OSHEM. Refer to Design Guideline Chapter 10- Building Requirements in Volume 1 for more information.

6.2.3. Woodwork:

6.2.3.1. All cabinetry will be fabricated to conform to the AWI Quality Standards, Section 400, for custom-grade material and workmanship.

6.2.3.2. Refer Exhibit Fabrication Guide, located in Appendix F of Volume 3, for requirements for wood products, such as plywood, MDF, and framing lumber, and for laminates to be used in exhibit case construction.

6.2.3.3. Refer to the SI Office of Protection Services (OPS) Exhibit Case Construction and Alarming Design document for security requirements for materials used in exhibit case construction. A copy of this document may be obtained from the COTR.

6.2.3.4. Refer Exhibit Fabrication Guide, located in Appendix F of Volume 3, for plastic laminate application requirements.

6.2.3.5. Provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001: *FSC Principles and Criteria for Forest Stewardship*.

6.2.4. Plastics:

6.2.4.1. Refer Exhibit Fabrication Guide, located in Appendix F of Volume 3, for standards prohibiting the use of plastics and foamed plastics in exhibit construction unless specific criteria have been met.

6.2.4.2. Refer Exhibit Fabrication Guide, located in Appendix F of Volume 3, for requirements for acrylic products to be used in exhibit case construction.

6.2.4.3. Use of plastics in building construction will conform to the requirements of the International Building Code (IBC) and the National Fire Protection Association (NFPA) 101: *Life Safety Code*.

6.3. Specifications

6.3.1. Carpentry:

6.3.1.1. Rough Carpentry:

a. FRPI plywood 19 mm (3/4 in) thick will cover three walls of any utility or security closet to be used for mounting equipment.

b. FRPI plywood 19 mm (3/4 in) thick will be used for mounting items such as equipment, AV/network racks, retail shelving and rails, etc.

6.3.1.2. Wood Decking and Sheathing:

a. Specify appropriate fasteners for use with treated lumber. Coordinate the compatibility of materials and fasteners to avoid corrosion and failure of the fasteners.

b. Bond breakers or backing materials will be used where treated lumber is adjacent to incompatible materials.

c. Roof sheathing will be tongue-and-groove type or will be fastened with clips.

6.3.2. Finish Carpentry:

6.3.2.1. Interior Finish Carpentry:

a. Finished carpentry and cabinet work will be manufactured and installed by a single firm specializing in the production and installation of work matching the specified industry standard.

b. Architectural millwork and finished cabinetry will conform to AWI custom grade as established by the AWI Quality Standard.

c. At a minimum, maintain AWI custom grade material and workmanship requirements.

d. The fabricator/installer will be a certified participant in the AWI Quality Certification Program.

e. The fabricator will prepare shop drawings showing locations of each item with dimensioned plans and elevations, large scale sections, and details showing attachment devices, components, and hardware with specifications; will indicate seaming of finish materials; and will submit the shop drawings to the architect for review prior to commencing fabrication.

f. The fabricator will fabricate all millwork from field measurements with provisions for scribing as required to meet built-in conditions.

g. In a millwork design where cabinet doors exceed 813 mm (32 in) in height, the architect will include the provision for 1 and a ½ pair of hinges per leaf. The fabricator will verify the adequacy of the proposed hinges to support each door/leaf.

h. The general contractor will refer to power and communication plans and elevations to coordinate millwork with scheduled electrical, telephone, and data outlets.

i. The fabricator will assemble units in the shop utilizing the largest components as practical to minimize field cutting and fabrication.

j. The general contractor will coordinate the delivery of millwork with all other applicable trades so that casework and finish carpentry are not delivered or installed until painting, wet work, and similar operations that could damage finished work have been completed and HVAC systems have been properly operating for ten (10) days.

k. The fabricator will install casework and finish carpentry plumb, level true, and straight with no disruptions.

l. Many wood products experience off-gassing of Volatile Organic Compounds (VOCs) that can affect artifacts and sensitive collections. Therefore, the architect/designer needs to carefully consider the selection of wood products (e.g., flooring and casework materials) for storage or display. Acceptable VOC levels and conservation requirements shall be coordinated through the Contracting Officer's Technical Representative (COTR).

m. Requirements for Clear Finish:

   i. The maximum moisture content will be 9 percent.

   ii. Finger jointing is not allowed.

6.3.3. Architectural Woodwork:

6.3.3.1. Wood-Veneer-Faced Cabinetry:

a. When specifying veneers for architectural woodwork and/or built-in or free-standing casework, the architect will identify specific information about the selected wood, such as:

   i. Wood species

   ii. Exact log number or flitch if amount of veneer required is less than a log

iii. Vendor's contact information

iv. Grain direction

b. To avoid noticeable color and grain variations in veneers, architect will strongly consider limiting selections to "select white" veneers.

c. The architect will obtain a finished submittal from the actual log or flitch, which will become the architect's control sample.

d. When matching veneers for public spaces, the architect will describe how the veneer leaves are to be matched, such as "all adjacent leaves are to be book matched" and will address the following characteristics of veneers:

i. Book matching will result in a mirror image between adjacent veneer leaves.

ii. Slip matching will result in an even progression of grain between adjacent veneer leaves.

iii. End matching is required when the elevation is taller than the veneer. Identify whether the fabricator will book or slip the veneer at the end match line. Both the end match and the choice of either book or slip at the match line will be indicated on the drawings.

iv. For veneer panels (applicable to all types of projects using veneer such as walls and free-standing millwork due to the limited width of all veneer species), include a statement about the panels, such as "all adjacent panels will have an equal number of veneer leaves and will be centered balanced."

v. Veneer numbering is required. On the elevation of the millwork and/or the architectural woodwork design, add a note requiring that "all panels across the elevation will be sequenced and numbered."

e. The architect will call out the desired finish system in the specifications, such as "The architectural woodwork/millwork finish will be catalyzed lacquer (conversion varnish, marine epoxy, etc.)." OR "The woodwork/millwork will be stained to match the architect's control sample."

f. The architect will call out the finish sheen with percentage indicated, such as "The sheen of finish shall be (40-60 percent)."

g. To ensure that the completed wood veneer product designed by the architect matches the control sample, the architect will consider the following:

i. Has the control sample been stained, or does it have a clear finish? If the sample has a stain, the staining process must occur prior to the clear finish application.

ii. What is the sheen level of the finish – matte, satin, or high polish?

iii. Is the design intent of the millwork/architectural woodwork to have an open pore or closed pore finish?

h. The fabricator will submit finished samples of each wood from the specified log(s)/flitch(s) and with the type and level of finish specified to match the control sample in the architect's record.

6.3.3.2. Plastic Laminate:

a. A gloss finish is recommended for vertical surfaces only. It is not recommended for horizontal applications.

b. Plastic laminate will not be adhered directly to plaster, gypsum board (drywall), or concrete.

c. Plastic laminate will not be used in areas exposed to temperatures exceeding 135° C (275°F) or for exterior applications.

d. Plastic laminate will be bonded to an appropriate substrate, such as #45 density particleboard (ANSI A208.1 – 2009) or MDF (ANSI A208.2 – 2009).

e. When specifying plastic laminate for any millwork that will be associated with excess heat, located near flames, or in large horizontal or vertical installations such as those associated with rolling, overhead fire doors, the architect/designer must specify fire-rated plastic laminate. To specify this type of plastic laminate, the architect/designer must designate either “fire-rated general-purpose grade” or “fire-rated vertical grade” and add the manufacturer’s designated number to the specification number. To achieve a Class A or 1 fire rating in plastic laminate panels, the specifier must also, in addition to specifying fire-rated laminate, specify two-part resorcinol adhesive and fire-rated particle board substrate.

f. Counter tops will be 31.75 mm (1-1/4) in phenolic resin MDF covered with plastic laminate (include backer sheet and seal all edges). Counter tops with sinks will be AB marine plywood with no joints occurring within 609.6 mm (2 ft) of the sink and the backsplash shall be integral. Adjacent counter tops in the same plane will also have integral splashes. Supports as detailed will occur at a minimum of 1.2 m (4 ft) on center.

g. Exposed edge banding will be plastic laminate. For counters, the top laminate will be applied after the edge. For all other conditions, the adjacent surfaces will be covered in the appropriate succession, so the laminate edge will not be visible in direct elevation.

6.3.3.3. Stile and Rail Wood Paneling:

a. The veneer within the insert panels will be center balance matched with an equal number of leaves per panel.

b. The stiles and rails with veneered construction will have either edges banded or hardwood moldings to conceal core and veneer joints.

c. The grain on the stiles will run vertically.

d. The grain on the rails will run horizontally.

e. The joint between any interior field rails to stiles will be simply end matched.

f. All veneer leaves for raised/recessed panels will be end matched or continually matched with the grain of the specified wood veneer, depending on architect/designer preference. In most cases, the specified wood veneer leaf should be wide enough to cover the entire raised or recessed panel. On the occasion where it does not entirely cover the panel, the architect/designer will call out for either a book or slip match, whichever is appropriate, on those pieces.

g. The outside corner of stile and rail paneling will be made with either lock-mitered or mitered-and-splined construction.

h. All adjacent raised/recessed panels will be sequenced and numbered for easier clarification from panel fabricator to installer.

i. All panels within the elevation will be matched – centered, balanced, or random – depending on architect/designer preference.

6.3.3.4. Flush Wood Paneling:

a. The veneer of the flush panels will be center balance matched with an equal number of leaves per panel.

b. Any exposed panel edges will be finished in a method specified by the architect/designer, such as solid wood, wood veneer matching the face, or metal channels forming reveals.

c. Adjacent leaves of veneer on each flush panel will be matched – centered, balanced, or random – depending on architect/designer preference.

d. The matched adjacent panels will be sequenced and numbered for easier clarification from the panel fabricator to the installer.

e. Where there is an elevation taller than what the veneer leaf will achieve, the veneer will need a vertical end match at some horizontal point on the elevation.

6.3.3.5. Architectural Woodwork:

a. All architectural woodwork will be designed to AWI custom grade standards.

b. Formaldehyde-free FR particleboard will be used for cores of cabinet carcasses and material for exhibit millwork.

   i. The use of formaldehyde is not permitted. Do not replace in kind if an existing material contains formaldehyde.

c. Refer to AWI custom grade guidelines for visible connections.

6.3.3.6. Wood Trim:

a. All wood trim will be designed to AWI custom grade standards.

b. Refer to AWI custom grade guidelines for joints and connections.

6.3.4. Solid Surfacing:

6.3.4.1. Solid Polymer (Solid Surfacing) Fabrications:

a. Solid surfacing is a solid homogeneous material that is a fully densified composite of modified resin and mineral filler.

b. Solid surfacing will not be used in applications that involve exposure to heat sources that may elevate the material temperature above 79°C (175°F).

c. Prior to fabrication, the solid surface material should be 18°C (65°F) or warmer.

d. When solid surface material is used for horizontal surfaces, such as countertops, there must be a support provided every 457 mm (18 in) for 12.7 mm (1/2 in) thickness.

e. Follow manufacturer recommendations for minimum spacing requirements of supports. The A/E will consider temperature restrictions relating to application for support spacing (e.g., adjacent food service/prep areas).

6.3.4.2. Top material will be solid and homogeneous filled methyl acrylate 100 percent acrylic based Meganite or Corian. Tops will be molded one-piece construction with flush inconspicuous seam construction. Provide integral apron and backsplash when so noted on the drawings.

6.3.4.3. Support solid surfacing on Unistrut frames as required with maximum spacing of 609.6 mm (2 ft) on center. Steel supports for Meganite or Corian tops will be fabricated from bolted metal framing system made of channel, fittings, and hardware as defined in the Metal Framing Manufacturers Association (MFMA) Standard Publication MFMA 1.

6.3.4.4. Solid surface material that is 6.4 mm (1/4 in) thick will not be used for horizontal applications.

6.3.4.5. Full wood underlayment will not be used as a support for horizontal solid surface.

6.3.4.6. Any unsupported overhang will be restricted to 152 mm (6 in) for 12.7 mm (1/2 in) thick solid surface material.

6.3.4.7. Particleboard will not be used as a substrate or support

7. DIVISION 07 – THERMAL AND MOISTURE PROTECTION

7.1. Reference Codes, Standards, and Guidelines

7.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 07-specific requirements:

7.1.1.1. ASTM C1193: *Standard Guide for Use of Joint Sealants*

7.1.1.2. ASTM C1472: *Standard Guide for Calculating Movement and Other Effects When Establishing Sealant Joint Width*

7.1.1.3. ASTM D312: *Standard Specification for Asphalt Used in Roofing*

7.1.1.4. ASTM E84: *Standard Test Method for Surface Burning Characteristics of Building Materials*

7.1.1.5. ASTM E 2178: *Standard Test Method for Air Permeance of Building Materials*

7.1.1.6. UL 790: *Standard for Safety Standard Test Methods for Fire Tests of Roof Coverings*

7.1.1.7. National Fire Protection Association (NFPA) 256: *Standard Methods of Fire Tests of Roof Coverings*

7.1.1.8. ASTM E1980: *Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces*

7.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

7.2. Design Requirements

7.2.1. Waterproofing:

7.2.1.1. Membrane waterproofing will follow the recommendations of the National Roofing Contractors Association (NRCA) Waterproofing Manual.

7.2.1.2. Membrane waterproofing will be fully bonded.

7.2.1.3. Below-grade waterproofing will be applied to the positive pressure side and must be covered by a protection mat to shield the waterproofing membrane from destructive effects of construction activities, ultraviolet radiation, or aggressive vegetation.

7.2.1.4. The use of redundant waterproofing systems is encouraged.

a. Evaluate the appropriate level of redundancy on a case-by-case basis.

b. To the greatest extent possible, extend existing systems so that the entire system is by one manufacturer. Avoid different types of waterproofing coming together, as in repairs or added assemblies/components.

c. Waterproofing will consist of more than one component.

d. Where possible, provide redundancy at weak points, such as at joints.

e. When possible, provide air barriers with waterproofing capability.

7.2.1.5. Where practical at entrances, provide membrane waterproofing that extends under the entire vestibule and sheds water toward the exterior (e.g., extensions of the plaza waterproofing) and can collect and discharge water that penetrates past the doors.

7.2.1.6. Foundation waterproofing will turn up a minimum of 203 mm (8 in) above grade.

7.2.1.7. Waterstops will be used at construction joints in below-grade walls, footings, and other elements where a water-proof system is required. Wherever possible, use level changes to create a redundancy with the substrate in the event the water barrier fails.

7.2.1.8. Metal panel façades will be designed with primary and secondary waterproofing and air barrier systems.

a. Any type of siding material will have waterproofing behind it.

b. Provide insect screens at weep holes to prevent insect infiltration & clogging.

7.2.1.9. The A/E will perform and submit dewpoint analysis for ALL building envelope components to demonstrate proper moisture prevention/removal and use of vapor retarders. At a minimum, the analysis will address the following:

a. Where the dew point will occur

b. Where the temperature profile will be located

c. Where the primary vapor retarder will be located

d. How far moisture will be allowed to penetrate

7.2.1.10. Construction documents will clearly indicate all drainage and air passages. Detailing will indicate critical corner terminations, interfaces of all differing systems, proper sealant methodologies, etc.

7.2.1.11. Quality Assurance:

a. The roofing/waterproofing contractor will demonstrate qualifications to perform the work of this section by submitting the following documentation:

i. Certification or license by the membrane manufacturer as a locally based, authorized applicator of the product the installer intends to use, for a minimum of five (5) years.

ii. List of at least (3) projects, satisfactorily completed within the past five (5) years, of similar scope and complexity to the project. The previous experience submittal will correspond to the specific membrane system proposed for use by the applicator.

b. Include a single source for all components from the manufacturer.

c. Membrane manufacturer will have available in-house technical staff to assist the contractor, when necessary, in application of the products and final inspection of the assembly.

7.2.2. Thermal Insulation:

7.2.2.1. All insulation materials will have a flame spread rating of 25 or less (75 for sprinklered spaces) and a smoke developed rating of 450 or less when tested in accordance with ASTM E84.

7.2.2.2. Provide insulation under concrete slabs on grade where a perma-frost condition exists.

7.2.2.3. An air/moisture barrier will be designed for all new construction and will be employed wherever possible during renovation of existing exterior envelopes.

7.2.2.4. An air barrier system will be continuous from roof to wall to foundation.

7.2.2.5. Foam plastic insulation will be protected in accordance with the International Building Code (IBC).

a. Use of foam plastic insulation will meet the requirements of IBC Chapter 2603, *Foam Plastic Insulation*, including application of thermal barriers.

b. Cellular foam plastic insulation will be permitted only for exterior envelopes, mechanical piping, and walk-in cool rooms/freezers, subject to the limitations identified in this section. The interior use of cellular foam plastic insulation is otherwise strictly prohibited.

c. When cellular foam plastic insulation is used on mechanical piping, it must be approved according to FM Approval Standard 4924, *Approval Standard for Pipe Insulation*. Where the insulation thickness and diameter/sectional dimension are further limited according to this listing, these limitations will be followed.

d. The insulation of mechanical systems will meet the requirements of the International Mechanical Code. All insulating materials, linings, and coverings will have a maximum flame spread index of 25 and maximum smoke developed index of 50 when tested in accordance with ASTM E84.

e. Spray-foam insulation requires a minimum 20-minute cover

7.2.2.6. Cellular plastics will not be used for interior insulation.

7.2.2.7. Thermal insulation materials will be asbestos free.

7.2.2.8. Where permitted by perimeter conditions, provide an R-30 insulation value or meet requirements of ASHRAE 90.1.

7.2.2.9. Provide glass-fiber insulation, where indicated, in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per the Erosion Test and Mold Growth and Humidity Test described in UL 181, or on comparable tests from another standard acceptable to Authorities Having Jurisdiction (AHJ).

a. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 13-m/s (2500 fpm) air velocity.

b. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosium on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

7.2.3. Roofing:

7.2.3.1. Roof Coverings and Roof Decks:

a. Use roof coverings approved and listed by a Nationally Recognized Testing Laboratory (NRTL). The UL Roofing Materials and Systems Directory lists three classes (A, B, and C) of acceptable roof coverings based on compliance with UL 790, *Tests for Fire Resistance of Roof Covering Materials* and NFPA 256, *Fire Tests of Roof Coverings*.

b. Roof deck assemblies must be FM Class I approved, or UL listed as fire classified or an equal listing or classification by a NRTL.

i. Exceptions:

a) Fully sprinklered buildings

b) Buildings less than 744 m2 (8,000 sq ft)

7.2.3.2. Roof designs will have a fire-resistance rating appropriate for the building construction type per the IBC.

7.2.3.3. All roofing materials (coverings and decks) will be UL-listed and in accordance with UL 790 and NFPA 256.

7.2.3.4. The Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Architectural Sheet Metal Manual will be used as a guide for detailing and specification of sheet metal flashing and trim.

7.2.3.5. Proper drainage, flashing, and allowance for expansion are imperative for successful roof design.

7.2.3.6. Flat roofs designed for access must include a parapet where feasible or a perimeter standard guardrail at least 1067 mm (42 in) in height.

7.2.3.7. Where parapets and guardrails are not feasible, a personal fall protection system must be provided meeting requirements in OSHA and ANSI standards. Equipment will be located at least 3048 mm (10 ft) away from roof edges and oriented with access panels inboard of the roof edge.

7.2.3.8. A roof system with limited maintenance demands will be selected. The selected system will be thermally efficient, with consideration given to R-value, reflectivity, and emissivity. For buildings that are intended to have a service life in excess of 20 years, a system with enhanced durability will be selected to reasonably maximize the life of the roof.

a. Where applicable, the renewal of existing systems is preferred. Clean the existing system and install new system per manufacturer recommendation. Provide a new warranty for the new coating/re-covering system.

7.2.3.9. For new buildings and major roof renovations, the incorporation of rainwater harvesting through water catchment systems will be considered to maximize the cost-effective use of water resources and to minimize the amount of water run-off from the building.

a. When rainwater harvesting is required, refer to state/local requirements/regulations for guidance.

b. Feasibility of rainwater harvesting will vary by facility. Consider rainwater harvesting during initial planning phases and coordinate with the Contracting Officer’s Technical Representative (COTR) and the individual facility.

7.2.3.10. Roof use should be considered during design. This includes access for HVAC maintenance, expected foot traffic and walkways, and the frequency of these uses.

a. The use of a single-ply roofing system where frequent foot traffic is anticipated will not be permitted.

b. Ballasted systems will require an additional membrane layer for increased durability.

c. Preference will be given to a more robust roofing system. The use of single ply is discouraged, even in locations with minimal foot traffic, due to vulnerability from seams, punctures, and potential failure points. The use of a single-ply roofing system should be reviewed with SI if deemed necessary.

7.2.3.11. Peer review of roofing drawings and specifications by a Registered Roof Consultant (RRC) will be considered for buildings with very valuable contents or operations, projects where the cost of the roofing work is very substantial, and complex or unusual projects.

a. Third-party inspections will be provided by the A/E on behalf of SI.

b. Requirements will be indicated in the AE scope of work document and coordinated with the COTR.

7.2.3.12. For large roofing projects or roofing repair projects, specify and budget for full-time, third-party observation and inspections of the roofing installation. The third-party observer will have a thorough understanding of the system being installed.

a. Third-party inspections will be provided by the contractor on behalf of SI.

b. When applicable, the use of an RRC is required. The use of a Roof Observer (RO) is not permitted.

7.2.3.13. Roofing specifications will require the roof covering materials manufacturer to inspect the roof application on the first or second day of application, and to perform an inspection upon completion of the application. Submittal of the inspection reports will be required.

7.2.3.14. Cut-out inspections for new and existing roofing work are required and will occur with selective inspection of systems to verify correct installation. Project specifications will require the roofing contractor to repair inadequate work at no cost to SI. When cut-out inspections are required, the following is required:

a. All roofing materials will be tested and analyzed for lead-based-paint and asbestos-containing materials prior to any cut-out inspections.

b. Roofing materials will be confirmed to be free of hazardous materials (asbestos, lead, etc.) prior to the commencement of any work or inspection.

c. Lead-coated copper is utilized on some existing historic roofs. Proper protocol will be strictly adhered to when cut-out inspections are required.

7.2.3.15. New work on an existing warranted roof system will require review of new roofing details by the existing roof manufacturer. The manufacturer must inspect the new installation before issuing a warranty. The installation will be performed by an installer licensed in both the existing and the new roofing systems.

7.2.3.16. When considering roof repairs, adjacent materials and systems will also be examined to determine if items such as mortar joints, parapets, curtain walls, flashing, or gutters have defects that are contributing to envelope failure and need to be replaced or repaired. Consider the remaining service life of these adjacent materials and systems relative to the expected life of the repairs being planned. Consider compatibility between repair materials and the original roof system material.

7.2.3.17. All roofing work will be required to be watertight at the end of each work day (including soldering, where applicable).

7.2.3.18. Project specifications will require a minimum five-year labor and material warranty by the roof installer on roof repairs and maintenance work and a 20-year manufacturer's material warranty and five-year labor warranty on new work by the roof installer. The warranty for metal and slate roofs shall be 30 to 50 years. Extended warranties may be considered on a case-by-case basis.

7.2.3.19. A 48-hour water test will be required for all low-slope roof installations and repairs.

a. SI recommends a below-grade 48-hour water test.

7.2.3.20. Roof slopes for drainage purposes will be achieved using a sloped roof structure rather than tapered insulation when possible.

7.2.3.21. The use of single-ply roofing will be reviewed on a case-by-case basis. When used, single-ply roofing will be reinforced and will be a minimum 60 mil thickness.

a. When single-ply roofing is utilized, a water/vapor barrier will be included as a moisture backup.

7.2.3.22. Photovoltaic (PV) roofs must include a primary roofing system under the PV system.

7.2.3.23. Where solar panels are installed, access will be provided to the roof below for maintenance and repair. Existing roofing that is to receive a solar panel installation will be examined for remaining lifespan prior to installation of panels. Roof replacement should be considered if the existing roof has fewer than five years of useful life remaining.

a. Slip-sheet/bond-break barrier will be required.

7.2.3.24. Chemicals used for roofing applications must meet VOC requirements established by the local jurisdiction and should be evaluated for compatibility with the building occupants (i.e., laboratories or animal enclosures).

7.2.3.25. Limit the use of ductwork on roofs. Where required, ensure adequate insulation and weatherproofing to maximize lifespan and energy efficiency.

7.2.3.26. Ensure that minimum clearances are established for distance between rooftop mechanical equipment and roof surface for roof maintenance and future repairs.

a. Fall protection is not required if rooftop mechanical equipment is a distance greater than 15 ft from edge.

b. When fall protection is not required, the SI preference is to have a line on the roof 15 ft offset from the roof edge indicating distance to the fall edge.

7.2.3.27. The use of isolation curbs for rooftop equipment will be required.

7.2.3.28. Consider the compatibility of roofing materials to rooftop equipment (i.e., the effect of oil leaks from equipment onto roofing materials, the proximity of high-temperature steam to roofing materials or grease/ kitchen fans).

7.2.3.29. The A/E will perform and submit dewpoint analysis for ALL building envelope components to demonstrate proper moisture prevention/removal and use of vapor retarders.

7.2.3.30. Provide a Solar Reflective Index (SRI) to meet all code and project sustainability requirements.

a. For low slope roofs, provide an SRI of 78 min.

b. For roofs over a 2:12 slope, provide an SRI of 29 min.

7.2.3.31. Roofing materials will not be comprised of lead-coated copper or have lead seam sealant/solder unless these are the only suitable materials and/or there is historic precedent to do so. Documentation must be provided attesting to this requirement. SI approval will be required for the use of lead-coated copper and will only be considered where used on existing historic roofs. Roofing materials containing hazardous materials, including but not limited to asbestos felts, transite shingles, and adhesives containing asbestos are strictly prohibited.

a. When the use of lead-coated copper for roofing is approved, the detailing of these systems will be robust. These systems are expected to have a 50+ year life expectancy.

7.2.3.32. Quality Assurance:

a. Installer Qualifications: A qualified installer firm will be approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product and eligible to receive the manufacturer's warranty.

b. Manufacturer Qualifications: A qualified manufacturer will have UL listing FMG approval for membrane roofing system identical to that used for the project.

7.2.4. Fireproofing and Firestopping:

7.2.4.1. Refer to Smithsonian Specification Section 078100, *Sprayed Fire-Resistant Materials* in Volume 2 for requirements for sprayed-on fireproofing.

7.2.4.2. Provide firestopping at all wall and floor penetrations by pipes, conduits, ducts, etc., in fire-rated assemblies. Refer to Smithsonian Specification Section 078413, *Penetration Firestopping* in Volume 2 for identification of required firestopping locations, which include penetrations through floor slabs, fire-rated partitions, fire walls, fire-rated ceiling assemblies, and vertical shafts.

7.2.4.3. All fire-rated construction and smoke barriers will be labeled above the ceiling with a plaque or stenciled sign to notify contractors that firestopping of penetrations through these walls is required.

a. Provide stenciled identification on all fire walls, fire partitions, smoke barriers, and smoke partitions, or on any other wall required to have protected openings or penetrations.

b. Stencil will be located in accessible concealed floor, floor-ceiling, or attic spaces, generally above the finished ceiling.

c. Stencil will be repeated at intervals not exceeding 30 ft (914 mm) measured horizontally along the wall or partition.

d. Stencil will include lettering not less than 6 in high, will be visible from the floor, and will incorporate the suggested wording, "FIRE AND/OR SMOKE BARRIER—PROTECT ALL OPENINGS," or other lettering height or wording approved by the AHJ.

7.2.4.4. Refer to Smithsonian Specification Section 078413, *Penetration Firestopping* in Volume 2 for specific signage requirements for labeling all firestopped penetrations of fire-rated assemblies.

7.2.4.5. All fireproofing and firestopping materials will be asbestos-free.

7.2.5. Joint Sealants and Expansion Control:

7.2.5.1. Exterior building envelope design will include expansion control systems for all exterior construction. Historically, new construction and repair work have required extensive patching due to the lack of expansion systems in the roofing, facades, gutters, and joints.

7.2.5.2. Quality Assurance:

a. Installer Qualifications: A qualified installer firm will be approved, authorized, or licensed by the roofing system manufacturer to install the manufacturer's product and eligible to receive the manufacturer's warranty.

b. Manufacturer Qualifications: A qualified manufacturer will have UL listing FMG approval for the roofing system identical to that used for the project.

7.2.6. Fall Protection:

7.2.6.1. Fall protection systems will be designed by a qualified person to meet OSHA standards and ANSI fall protection codes.

a. Wherever feasible, provide parapets/guardrails as part of all fall protection systems.

b. All roof access points are (or will be) controlled from the Office of Protection Services (OPS) control room. Note: this upgrade is currently in progress institution wide.

7.2.6.2. The following preferred order of control will be used to eliminate, or control fall hazards as outlined in OSHA and ANSI standards:

a. Elimination or substitution by removing the hazard or hazardous work practice

b. Passive fall protection such as guarding or covering

c. Installing a fall restraint system

d. Installing a fall arrest system.

7.3. Specifications

7.3.1. Preparation for Re-Roofing:

7.3.1.1. Where the existing roofing is to be replaced, it will be completely removed, and the substrate prepared for new roofing in accordance with the roof manufacturer's written requirements. Typically, a complete removal and replacement will be required when the roof is leaking. The portion of the roof to be removed will be reviewed on a case-by-case basis. SI may consider a coating option for a leaky roof, but this requires approval.

7.3.1.2. The new roofing system will not be of greater weight than the old roofing system, unless a structural analysis is performed and shows that the framing system can carry the additional weight.

7.3.1.3. Do not overlay new roofing membrane systems over existing roof membranes.

7.3.1.4. Prior to repair or replacement, roofing materials will be tested and analyzed for both lead-based-paint and asbestos-containing materials.

7.3.2. Waterproofing:

7.3.2.1. Bentonite Waterproofing:

a. Bentonite waterproofing will only be used for below-grade applications.

b. Do not expose to standing or moving water.

c. Provide performance-based requirements in lieu of product-specific requirements (bentonite).

d. Investigate current products that perform similarly to bentonite and include in specification where feasible.

7.3.2.2. Traffic Coatings:

a. Exposed-to-exterior concrete slabs formed from steel-reinforced concrete will be finished with a highly durable traffic coating to prevent corrosion of the steel reinforcing.

b. Provide slip-resistance at traffic coatings.

7.3.3. Thermal Insulation:

7.3.3.1. Exterior Insulation and Finish System (EIFS):

a. New EIFS is not permitted.

b. Do not use EIFS on a building exterior unless it is being used to repair or match an existing material. An insulated metal panel system will be a preferred alternative for new construction.

7.3.3.2. Air Barriers:

a. An air/moisture barrier is required of all new construction and will be employed wherever possible during remediation of existing exterior envelopes.

i. The air barrier material of each assembly must be joined and sealed to the air barrier material of adjacent assemblies with sufficient flexibility to allow for the relative differential movement and with sufficient strength to resist expected peak air pressure differences.

ii. Penetrations of the air barrier system must be sealed to the air barrier system in an airtight manner.

iii. The air permeance of materials comprising part of the air barrier system must not exceed 0.02 L/sm2 at 75 Pa (0.004 cfm/sq ft at 0.3 in wg) when tested in accordance with ASTM E 2178, *Standard Test Method for Air Permeance of Building Materials*.

iv. The air barrier system, and all materials and components comprising it, must last the anticipated service life of the enclosure or allow for easy maintenance, repair, and/or replacement.

v. For new construction, demonstrate performance of the air barrier system for the building enclosure by testing the completed building and demonstrating that the air leakage rate of the building enclosure does not exceed 2.0 L /sm2 (0.4 cfm/sq ft) at a pressure differential of 75 Pa (0.3 in wg). Tests can be conducted using either pressurization or depressurization. The building must not be tested until verifying that the continuous air barrier system has been installed as per the design in accordance with installation instructions.

b. Quality Assurance:

i. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

ii. Installer will be licensed by Air Barrier Association of America (ABAA) according to ABAA's Quality Assurance Program and will employ ABAA-certified installers and supervisors on the project.

iii. Installer will demonstrate a minimum 10 years of experience installing the air barriers.

iv. Single-Source Responsibility: Obtain products and accessories from a single manufacturer.

v. ABAA Quality Assurance Program: The materials and systems included in this section will be installed by ABAA-certified contractors in full compliance with the ABAA Quality Assurance Program, which will be administered by ABAA selected third party facilitators.

vi. Build mockups to set quality standards for materials and execution.

vii. Build integrated mockups of exterior wall assemblies, incorporating backup wall construction, external cladding, windows, storefront, door frames and sills, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air and vapor barriers, and sealing of gaps, terminations, and penetrations of air and vapor-barrier assembly.

viii. Coordinate construction of mockups to permit inspection of air and vapor barrier by a testing agency before external insulation and cladding are installed.

ix. Include junction with roofing membrane.

7.3.4. Steep Slope Roofing:

7.3.4.1. Roofing shingles and shakes will be Class A fire rated and will match existing where applicable.

7.3.4.2. Roofing tiles will be Class A fire rated and will match existing where applicable.

7.3.4.3. Natural Roof Coverings:

a. Green roofs will be considered where appropriate with approval from SI.

b. Design of green roof systems must protect the primary roofing membrane.

c. A green roofing tray system is preferred.

d. A drainage course will be provided with all green roof systems.

e. Provide roof access, walkways, and fall protection for maintenance and watering. Provide hose bib connection on roof for watering.

f. Smithsonian Gardens (SG) will be involved in the design of all green roofs. In addition, the occupants located below a green roof will be involved in the design. Coordinate with the COTR.

g. Structural analysis will be required for all new and existing green roofs.

7.3.5. Metal Panels:

7.3.5.1. Metal Roof Panels:

a. To avoid leakage problems at panel end-joint splices, it is preferable for the panels to be continuous from eave to ridge.

b. Standing seam roofing will be double-lock type.

7.3.5.2. Metal Wall Panels: refer to Division 8- Openings in Volume 1 for more information.

7.3.6. Membrane Roofing:

7.3.6.1. Built-Up Roofing:

a. Follow ASTM D312 for asphalt roofing.

b. When installed over polyisocyanurate, NRCA recommends a suitable cover board be installed over the polyisocyanurate. Four plies of Type IV felt is recommended.

7.3.6.2. Atactic-Polypropylene (APP) Modified Bituminous Membrane Roofing:

a. To avoid surface cracking, a field-applied coating (such as aluminum-pigmented asphalt, asphalt emulsion, or acrylic), factory-applied surfacing (granules or metal foil), or a sheet with protective reinforcement near the top should be specified.

7.3.6.3. Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing:

a. Factory-surfacing of SBS sheets is recommended.

7.3.6.4. Chlorosulfonate-Polyethylene (CSPE) Roofing:

a. The use of CSPE roofing is not permitted.

7.3.6.5. Ethylene-Propylene-Diene-Monomer (EPDM) Roofing:

a. The use of EPDM roofing is not recommended for areas where there will be the potential for liquid fuel spills or where there will be high foot traffic.

b. EPDM is susceptible to swelling when exposed to aromatic, halogenated, and aliphatic solvents and animal and vegetable oils such as those exhausted from kitchens.

c. Reinforced sheets are recommended for mechanically attached and loose-laid air-pressure equalized applications as well as for fully adhered and ballasted applications.

7.3.6.6. Polyvinyl-Chloride (PVC) Roofing:

a. Use of 90 mil PVC is preferred over EPDM roofing, especially in locations where corrosion protection is required (i.e., fuel storage or laboratory exhaust) and for white roofs.

b. PVC roofing will not be used for ballasted roofs.

c. Polystyrene boards will not be in direct contact with PVC membranes; otherwise the polystyrene will leach plasticizers out of the PVC. A suitable separator will be specified between polystyrene and PVC.

7.3.6.7. Metal Roofing:

a. Architectural panels may be specified if a solid deck is provided. If a solid deck is not provided, specify structural panels.

7.3.7. Sheet Metal Flashing and Trim:

7.3.7.1. Sheet Metal Flashing and Trim:

a. The SMACNA Architectural Sheet Metal Manual will be used as a guide for detailing and specification of sheet metal flashing and trim.

b. Gutters and downspouts will be adequately sized and transitioned.

c. When roof alterations or additions are performed, sizes of gutters, downspouts, and rain leaders will be confirmed as adequate for new conditions using engineering calculations.

d. Use durable metal flashings (e.g., zinc-tin coated-copper or stainless steel) where windowsill flashings will be exposed. Slope sill flashings to the exterior; provide an out-turned drip edge over face of wall cladding. Provide an upturned leg (25.4 mm (1 in) minimum, greater for high wind exposures) at the interior, and end dams soldered watertight. Do not penetrate the horizontal portion of flashing with fasteners. To fasten the sill frame, provide an attachment angle inboard of the window sill and fasten through the upturned leg of the sill flashing into the inboard leg of the sill frame.

e. Use durable metal flashings (zinc-tin coated-copper or stainless steel) for window heads. Slope window head flashings to the exterior; provide an out-turned drip edge over top of window frame. Extend head flashings several inches beyond the window frame. Provide end dams soldered watertight. Seal head flashings to the inner face of the windows and to the jamb flashings. Provide minimum 101.6 mm (4 in) upturned leg and counter flash with wall waterproofing membrane adhered to the vertical leg of the metal flashing. For punched window openings that do not allow extension of the head flashing beyond the opening (e.g., concrete openings) use dual sealant joints in lieu of head flashing to capture water and direct it to the jamb flashings.

f. Design lintels to allow for proper drainage of moisture. Issues have been observed at lintels; water cannot escape the assembly because lintels are caulked.

7.3.7.2. Performance Requirements:

a. General: Sheet metal flashing and trim assemblies as indicated will withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim will not rattle, leak, or loosen, and will remain watertight.

b. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements from ambient and surface temperature changes.

i. Temperature Change (Range): 67° C (120° F), ambient; 100° C (180° F), material surfaces

7.3.7.3. Quality Assurance:

a. Fabricator Qualifications: A qualified fabrication shop that employs skilled workers who custom fabricate sheet metal flashing and trim like that required for the project and whose products have a record of successful in-service performance.

7.3.8. Roof Accessories:

7.3.8.1. Provide stone parapet caps with adequate pins/dowels and waterproofing to prevent water infiltration into wall cavities.

7.3.8.2. Provide walk pads around and to all roof-mounted equipment that will require servicing and maintenance.

7.3.8.3. Installation of the following roof accessories should be considered on a building-by-building basis: lightning protection (A copy of the existing SI Lightning Protection Survey of Mall Buildings can be provided by the COTR), cell tower antennae, snow melt systems, and bird control. Snow melt systems, although not preferred, may be considered on a case-by-case basis.

7.3.8.4. Design must include elimination or guarding of fall hazards for safe access by maintenance and service personnel when conducting inspections, testing, and repair

7.3.8.5. Snow guards for sloped roofs will be high strength and designed for the appropriate roofing material.

7.3.9. Fireproofing:

Smithsonian Specification Section 078100 *Sprayed Fire-Resistant Materials* is located in Volume 2. This section will be used for all applicable projects.

7.3.9.1. Ensure that the proper mil thickness of intumescent mastic fireproofing is specified in relation to the structural members receiving the coating.

Smithsonian Specification Section 078413 *Penetration Firestopping* is located in Volume 2. This section will be used for all applicable projects.

7.3.10. Joint Sealants:

7.3.10.1. Sealant joints will be designed and installed per ASTM C1193 and ASTM C1472.

7.3.10.2. The use of urethane-based sealants with appropriate primer is preferred at exterior stone construction.

7.3.10.3. Compatibility and adhesion testing will be required.

7.3.10.4. Expansion control of exterior building elements will be fully coordinated, especially where materials overlap or are adjacent.

8. OPENINGS

8.1. Reference Codes, Standards, and Guidelines

8.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 08-specific requirements:

8.1.1.1. Glass Association of North America (GANA) Glazing Manual

8.1.1.2. American Association of Automatic Door Manufacturers (AAADM) Guidelines

8.1.1.3. ASTM A666: *Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar*

8.1.1.4. ASTM E330: *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*

8.1.1.5. ASTM E283: *Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen*

8.1.1.6. ASTM E331: *Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference*

8.1.1.7. ASTM E1300: *Standard Load Practice for Determining Load Resistance of Glass in Buildings*

8.1.1.8. The Aluminum Association's Specifications for Aluminum Structures

8.1.1.9. American Architectural Manufacturers Association (AAMA) 1503: *Standard for Thermal Testing and Condensation Resistance Factor (CRF)*

8.1.1.10. AAMA 505: *Dry Shrinkage and Composite Performance Thermal Cycling Test Procedure*

8.1.1.11. AAMA 611, 2603, 2604: *Standards for Finishing Aluminum*

8.1.1.12. AAMA 1600: *Voluntary Specification for Skylights*

8.1.1.13. AAMA 101/I.S.2/A440-05: *Standard/Specification for Windows, Doors and Unit Skylights*

8.1.1.14. AAMA Glass Design for Sloped Glazing

8.1.1.15. AAMA Structural Design Guidelines for Aluminum Framed Skylights

8.1.1.16. AAMA Aluminum Curtain Wall Design Guide Manual

8.1.1.17. AAMA 1502.7: *Voluntary Test Method for Condensation Resistance of Windows, Doors, and Glazed Wall Sections*

8.1.1.18. American Institute of Steel Construction (AISC) Specification for the Design of Cold-Formed Steel Structural Members

8.1.1.19. ANSI/AAMA Standard 101-85: *Specifications for Architectural Windows*

8.1.1.20. ANSI A250.8: *Recommended Specifications for Standard Steel Doors and Frames*

8.1.1.21. ANSI/Steel Deck Institute (SDI) A250.11: *Recommended Erection Instructions for Steel Frames*

8.1.1.22. ANSI/Builders Hardware Manufacturers Association (BHMA) A156.10: *American National Standard for Power Operated Pedestrian Doors*

8.1.1.23. ANSI/BHMA A156.19: *American National Standard for Power Assist and Low Energy Power Operated Doors*

8.1.1.24. ANSI Z97.1: *American National Standard for Safety Glazing Materials Used in Buildings*

8.1.1.25. ANSI/National Association of Architectural Metal Manufacturers (AAMM)/Hollow Metal Manufacturers Association (HMMA) 865: *Guide Specifications for Swinging Sound Control Hollow Metal Doors and Frames*

8.1.1.26. General Services Administration (GSA)-TS01-2003: *U.S. General Services Administration Standard Test Method for Glazing and Window Systems Subject to Dynamic Overpressure Loadings*

8.1.1.27. National Fire Protection Association (NFPA) 252: *Standard Methods of Fire Tests of Door Assemblies*

8.1.1.28. NFPA 288: *Standard Methods of Fire Tests of Floor Fire Door Assemblies Installed Horizontally in Fire Resistance-Rated Floor Systems*

8.1.1.29. NFPA 80: *Standard for Fire Doors and Other Opening Protectives*

8.1.1.30. Window & Door Manufacturers Association (WDMA) 1.S 1-A: *Specification for Architectural Wood Flush Doors*

8.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

8.2. <u>Design Requirements</u>

8.2.1. Historic Wood Windows:

8.2.1.1. Windows could, through prior agreement, receive locks without the addition of security alarm contacts. Under this circumstance, window locks must employ a mechanism which requires an unlocking tool not commonly available through hardware distributors. For wooden windows, the SI approved and preferred method is to insert a 6.35 mm (0.25 in) diameter stainless steel pin through the sash(s), concealed behind a glued-in hardwood dowel sanded flat and painted. Should the window need to be opened later, the dowel can be drilled out, the pin removed, and the wood restored.

8.2.1.2. Refer Appendix A- Security Design Criteria Matrix in Volume 3 for standard locking method for historic wood windows in existing facilities.

8.2.1.3. Replacement of windows in historic structures will exactly match original frame and muntin profiles. Consideration should be given to rehabilitating the existing windows. Retrofitting existing monolithic glass in a non-weeped, wood sash with insulating glass units is prohibited.

8.2.1.4. Historic wood windows that are to remain in SI facilities will be finished on the exterior with a three-step fluoropolymer coating.

8.2.1.5. If it is necessary to replace historic window hardware, historic replicas made from the same materials as the original hardware will be used to the greatest extent possible. If original hardware can be re-used, it will be cleaned to remove any paint or varnish build-up and restored to match its original finish.

8.2.1.6. When blast performance is required at historic wood windows, provide a separate blast window system in front of or behind the historic window system as appropriate. This item will be reviewed by SI on a case-by-case basis to determine the most appropriate design solution.

8.2.2. Doors and Frames:

8.2.2.1. All security locking arrangements on doors used for egress must comply with the requirements of the NFPA 101: *Life Safety Code.*

8.2.2.2. At a minimum, doors will be designed in accordance with space classifications as listed in Appendix A – Security Design Criteria Matrix in Volume 3.

8.2.2.3. The design of doors will comply with the Smithsonian Guidelines for Accessible Design (SAGD), such as the requirements for clear opening width and for maneuvering clearances.

8.2.2.4. Glass in doors will be safety glazing. Fire-rated glazing is required in all fire-protection-rated doors.

8.2.2.5. Quality Assurance:

a. Source Limitations: Obtain hollow metal doors and frames from a single source from a single manufacturer.

b. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

8.2.2.6. Not Used.

8.2.2.7. Not Used.

8.2.3. Entrances and Storefronts:

8.2.3.1. The design of entrances and storefronts will comply with the SGAD.

8.2.3.2. The use of vestibules and air curtains will be considered to control air and particulate infiltration.

8.2.3.3. The exterior grade at all entrances will slope away from the building.

8.2.3.4. Entrance floor mats and grilles will be designed for all public building entrances.

8.2.3.5. Heavy doors will be supported on pins.

8.2.3.6. Glass doors will only be permitted in areas with lighter foot traffic.

8.2.3.7. When selecting an entrance system, the A/E will select an appropriate system based on the volume of people using the system with careful consideration for the weight of the doors.

8.2.3.8. Door hardware will be selected for durability and ease of use.

8.2.3.9. Whenever feasible, doors will be factory installed into the frames.

8.2.3.10. In instances where vestibules utilize floor mats, the mats will be able to be lifted out of place by one person for ease of cleaning underneath.

8.2.4. Curtain Walls:

8.2.4.1. Curtain walls will be designed in accordance with the Interagency Security Committee (ISC) Security Design Criteria – Structural Section.

8.2.4.2. Curtain walls will terminate at least 203 mm (8 in) above grade; 305 mm (12 in) is preferred.

8.2.4.3. Curtain wall design will be carefully integrated with adjacent elements such as other wall claddings, roofs, and base of wall details.

8.2.4.4. Performance Requirements:

a. Provide glazed aluminum curtain wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:

i. Structural loads, including for wind, seismic, and blast

ii. Thermal movements

iii. Movements of supporting structure indicated on drawings, including but not limited to, story drift, twist, column shortening, long-term creep, and structural deflection from uniformly distributed and concentrated live loads

iv. Dimensional tolerances of building frame and other adjacent construction

v. Failure includes the following:

a) Deflection exceeding specified limits

b) Thermal stresses transferred to building structure

c) Framing members transferring stresses to glazing, including those caused by thermal and structural movements

d) Noise or vibration created by wind and thermal and structural movements

e) Loosening or weakening of fasteners, attachments, and other components

f) Sealant failure

b. Delegated Design: Manufacturer responsibilities include using a qualified professional engineer to prepare comprehensive structural calculations for glazed aluminum curtain wall members and connections, using performance requirements and design criteria indicated.

c. As scope and performance documents, the drawings and specifications do not necessarily indicate or describe all the work required for the performance and completion of the work. Trade contractors will clearly state size limitations (e.g., panel dimensions, insulating glass dimensions, sunshade projections, etc.) during the bid process and prior to the time their bids are submitted.

8.2.4.5. Quality Assurance:

a. Installer Qualifications: Acceptable to the manufacturer and capable of assuming engineering responsibility and performing work of this section.

   i. Engineering Responsibility: Preparation of data for glazed aluminum curtain-wall systems including the following:

      1. Shop drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for the project and submission of reports of tests performed on manufacturer's standard assemblies.

      2. Shop drawings, project-specific preconstruction-testing program development, and comprehensive engineering analysis by a qualified professional engineer

b. Qualifications:

   i. The fabricator will have a minimum of ten (10) years of experience in the fabrication of successfully glazed aluminum curtain walls and will have successfully fabricated a minimum of five (5) projects similar to this project.

   ii. The erector will have a minimum of ten (10) years of experience in the erection of glazed aluminum curtain walls and will have erected a minimum of five (5) projects similar to this project.

c. Testing Agency Qualifications: An independent agency qualified according to ASTM E699 for testing

d. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.

i. Build mockup of typical wall area as directed by the Contracting Officer's Technical Representative (COTR).

8.2.5. Windows:

8.2.5.1. All perimeter windows, skylights, and glazing will be designed in accordance with the ISC Security Design Criteria for blast resistance as appropriate.

8.2.5.2. The design of blast-resistant windows must take into consideration the structural capacity of the materials to which the window will be connected.

8.2.5.3. Connections to the structure will be engineered for the direct and rebound maximum capacity of the window framing members. The maximum capacity of each framing member will be calculated to account for the actual provided member section and material properties.

8.2.5.4. Design anchorage and connections to fully develop the calculated reaction forces with a safety factor of 1.5 when using the ultimate strength of the anchor.

8.2.5.5. Steel to concrete connections utilizing embeds or expansion anchors will be designed so that failure mode is yielding of the steel and not concrete splitting, spalling, or pulling out.

8.2.5.6. Steel to steel connections will be designed so that the weld is never the weak link in the connection.

8.2.5.7. Window system connections will be designed, fabricated, and installed to resist the blast loads specified for the project within limits and under conditions indicated.

8.2.5.8. At a minimum, the following submittals will be required for blast-resistant windows:

a. Submit shop drawings, including location floor plans or exterior wall elevations showing all window openings, typical unit elevations at 1/4 inch scale, and full-size detail sections of every typical composite member.

Show anchors, hardware, expansion provisions, flashing and drainage details, and other components. Show all attachments to adjacent materials, including structural support elements. Include glazing details and standards for factory-glazed units.

b. Submit certified test laboratory reports by independent laboratory substantiating performance of system as specified. Include other supportive data as required or as necessary including AAMA certification.

c. Submit certified explosive test reports for window system installed. Tests should be conducted in accordance with GSA test standard GSA-TS01-2003 or equivalent and by a recognized independent testing laboratory.

d. A single representative blast-resistant exterior window unit will be individually tested for the required explosive loads. These tests should be conducted consistent with the requirements specified for the project and should replicate the installed conditions as closely as possible. If the test specimen has a smaller surface area than the unit to be installed, supplemental calculations must be submitted verifying that the test results are valid for the larger pane. Submit shock tube or arena blast resistance test reports signed by a qualified independent laboratory.

e. Submit blast calculations by a qualified blast consultant, with a minimum of five (5) years of relevant experience, verifying that the window glazing, frame, sub-frame/embed, and anchorages meet the specified performance requirements. Each type and size of blast-resistant exterior window unit will be verified through analysis to meet the performance requirements. Calculations performed by the blast consultant will show that exterior window system (including frames, mullions, anchorages, and all required connections) will meet or exceed the minimum required blast load levels specified for the project. WINGARD, the approved government software, may be used to determine the appropriate glazing edge reaction loads for the design of the frames, mullions, and anchorage system. The analysis will show a performance condition that meets or exceeds the project's design loads.

8.2.5.9. At a minimum, exterior and interior windows will be designed in accordance with space classifications as listed in Appendix A – Security Design Criteria Matrix in Volume 3.

8.2.5.10. Replacement of windows in historic structures will exactly match original frame and muntin profiles. Consideration should be given to rehabilitating the existing windows.

8.2.5.11. The design of the fenestration, size, glazing properties, and shading will be closely coordinated with the design of the mechanical systems to maximize performance.

8.2.5.12. Windows will have a CRF appropriate to prevent condensation from forming on the interior surfaces of the windows. The CRF can be determined by testing in accordance with AAMA 1502.7: *Voluntary Test Method for Condensation Resistance of Windows, Doors, and Glazed Wall Sections*. Aluminum windows must meet the requirements of AAMA 101/I.S.2/A440-05.

8.2.5.13. Window design will be integrated with adjacent wall components to create a functioning wall system. Provide careful detailing to integrate water/air/vapor barriers with the window frames and to maintain their continuity at the window perimeters.

8.2.5.14. The interface between old and new construction will be carefully considered. Whenever possible, existing systems will be extended to avoid the interface of different systems.

8.2.5.15. Coordinate placement of setting blocks with weep holes to avoid blocking drainage paths.

8.2.5.16. Coordinate attachment details with flashing details to avoid penetrating the flashings.

8.2.5.17. All glazing and caulking materials will be polychlorinated biphenyl (PCB), lead, and asbestos free.

8.2.5.18. Window frame assemblies will not come into direct contact with building masonry. Use shims and sealants as required.

8.2.5.19. Window mullions, as much as possible, will be located on the floor-planning grid to permit the abutment of interior partitions.

8.2.5.20. Window design will provide for cleaning the interior and exterior surfaces of all windows, skylights, and other glazed openings. The A/E must demonstrate that cleaning and maintenance of interior glazing surfaces and equipment (e.g., lighting, smoke detectors, and other systems that are mounted within atrium spaces) can be achieved without extraordinary means and methods. This information will be included in the construction documents.

8.2.5.21. Select a window with a demonstrated track record in similar applications and exposures.

8.2.5.22. All windows, stock or custom, require construction and testing of a field mock-up representative of the wall/window for air infiltration and water leakage. Do not allow any reduction in pressure from the laboratory test.

a. Air Infiltration Test: Not exceed 0.30 cu ft per minute per ft of crack length when tested at a pressure of 6.24 psf. Adjust sash to operate in either direction with a force not exceeding 20 pounds after the sash is in motion. Perform tests in accordance with ASTM E283 with the sash in a closed and locked position.

b. Water Resistance Test: Subject window unit to a water resistance test in accordance with ASTM E331 with no water passing the interior face of the window frame and no leakage as defined in the test method. Mount the glazed unit in its vertical position continuously supported around the perimeter and the sash placed in the fully closed and locked position. When a static pressure of 10.00 pounds per sq ft has been stabilized, apply five gallons of water per sq ft of window area to the exterior face of the unit for a period of 15 minutes.

8.2.5.23. Require testing of production windows for quality assurance of window fabrication and installation. Require multiple tests early in the construction phase to catch problems early. Require additional testing if initial tests fail. Do not allow any reduction in pressure from the laboratory test.

a. Uniform Load Deflection Test: ASTM E330 at 50 pounds per sq ft: No member deflection more than 1/175 of its span. Maintain test load for a period of 10 seconds resulting in no glass breakage, permanent damage of fasteners, hardware parts, support arms, actuating mechanisms, or any other damage causing the window to be inoperable.

b. Uniform Load Structural Test: Apply a minimum exterior and interior uniform load of 75 pounds per sq ft to the entire outside surface of the test unit. Maintain this test load for a period of 10 seconds. Results: No glass breakage, permanent damage of fasteners, hardware parts, support arms, actuating mechanisms, or any other damage causing the window to be inoperable, and no permanent deformation of any frame or vent member in excess of 0.2 percent of its span.

c. Thermal Movements: Provide aluminum windows, including anchorages, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

i. Temperature Change (Range): 67° C (153° F), ambient; 100° C (212° F) material surfaces.

d. Life Cycle Test: Per AAMA 101 and AAMA 910, provide proof that the product meets the criteria including passing air and water tests at the conclusion of the cycle tests.

e. "U" Value Tests: (co-efficient of heat transfer): Test in accordance with AAMA 1503: *Thermal Transmittance of Conduction* with a 24.1 km/h (15 mph) perpendicular dynamic wind.

8.2.5.24. Require window installation shop drawings showing all adjacent construction and related work, including flashings, window attachments, interior finishes, and indicating sequencing of the work.

8.2.6. Skylights:

8.2.6.1. Retain blast consultant as required by ISC and the Office of Protection Services (OPS).

8.2.6.2. The use of low-emissivity glass is preferred.

8.2.6.3. Consideration must be given for UV filtration. Confirm UV levels are compatible with the contents of the space.

8.2.6.4. Placement of skylights will be considered to prevent glare or overheating in the building interior.

8.2.6.5. Coordinate the skylight configuration and proportions with the MEP design. The mechanical design must include provisions to accommodate the thermal loads imposed by the skylight.

8.2.6.6. Condensation gutters and a path for the condensation away from the framing will be integral to the skylight or sloped glazing design.

8.2.6.7. Consideration will be given to cleaning of all sloped glazing and skylights, including access and equipment required for both exterior and interior faces.

8.2.6.8. Skylights will be guarded for fall protection or meet OSHA structural requirements. The A/E will engage a qualified fall protection expert to design fall protection systems.

8.2.6.9. When a permanent fall protection system is not available, contractors are required to provide temporary fall protection when rendering services. Fall protection plans require COTR approval.

8.2.6.10. Skylight design will provide for cleaning the interior and exterior surfaces of all skylights and other glazed openings. The A/E must demonstrate that cleaning and maintenance of both interior and exterior glazing surfaces can be achieved without extraordinary means and methods. This information will be included in the construction documents.

8.2.7. Door Hardware:

8.2.7.1. Refer to Appendix A- Security Design Criteria Matrix in Volume 3 for security requirements for door hardware.

a. Yale cylinder locks are the SI standard.

b. Hinge pins on perimeter doors will be non-removable.

c. Door coordinators will be provided on double doors to ensure the doors close in the proper sequence and latch properly.

d. Refer to the criteria for locking requirements for roll-up doors, card-access controlled doors, perimeter doors, and construction doors.

e. Specify heavy-duty, continuous hinges for high-use doors.

f. Specify sound gasketing on mechanical room doors that open on to public corridors.

g. Provide kick plates on all doors subject to abuse by service carts and other similar equipment.

i. Confirm door protection height and type requirements based on location and usage on a case-by-case basis.

h. Provide full mortise type continuous-geared hinges for all museum entrance doors. The use of offset hinges for entrance doors is not recommended because of the heavy weight of the doors.

i. Provide heavy-duty surface-mounted overhead closers at museum entrances because of high door use.

j. Delayed egress hardware will be specified with the activation switch incorporated into the door panic hardware. The type of delayed egress hardware that integrates the activation switch within the magnetic locking mechanism will not be used.

8.2.7.2. Automatic Door Operators:

a. Specify automatic door operators as appropriate for the weight of the doors and the frequency of use.

b. Coordinate doors that have an automatic door operator with other building systems, such as power, smoke evacuation fans, alarms, and hydraulic lines.

c. Specify the type of door actuator for accessibility (infrared versus wireless manual push button). SI prefers the push-button actuator.

i. The location of the push button (on the wall or on a pylon) is critical so that the push button does not wear out with overuse.

d. Consider the use of electro-hydraulic openers where the sound of constant door usage may be disturbing to the building occupants (i.e., interior research or office spaces).

e. Refer to Appendix A- Security Design Criteria Matrix in Volume 3 for locking requirements for non-emergency exit doors equipped with automatic operators.

8.2.7.3. Perimeter entry doors will have hardware that can be repaired, replaced, or adjusted with the door left in place.

8.2.7.4. The design of door hardware will comply with the SGAD, such as the maximum threshold height, the mounting heights for operable hardware, and the allowable door opening force.

8.2.7.5. In existing facilities, specify that new hardware finish will match the building standard.

8.2.7.6. The contractor will properly coordinate exit devices with all door hardware components and adjacent assemblies.

8.2.7.7. Hinges

- Hinges will be mounted so hinge pins are within the protected area; if this is not feasible, security hinges will be provided.
- Security hinges will prevent the removal of the door by removing the hinge pin.
- Hinge pins on perimeter doors will be non-removable.

a. Electrified lockset with integrated REX is Smithsonian's preferred door hardware followed by electric strikes. Mag Locks are only to be used in extreme circumstances as a last resort.

b. In instances where perimeter (non-emergency) doors are constructed of glass, install a bottom rail of sufficient height to accommodate a dead bolt lock that can be removed without having to dismantle the door to service the lock cylinder and hardware.

c. Provide a card reader and door controls on the secure side of perimeter roll-up doors. The card reader will enable the open button on the electrical switch. The close button shall remain functional, not controlled by the card reader. Locks shall be capable of receiving Schlage or Medeco full size cylinders.

d. Provide card access-controlled doors with key cylinders on the unprotected side to permit bypass of inoperative card readers for emergency purposes. Use of key bypass will cause a forced open alarm. Equipped with mechanical or electric door closers.

e. During construction the Contractor shall provide construction cores. The project will fund and provide the proprietary cores to the OPS locksmith for keying and installation.

f. Provide at least one perimeter door with an exterior key lock for emer-gency entrance purposes.

g. All locks controlled by the electronic security system must be powered from the centralized power supplies in the Security LAN Closet. No local power supplies are allowed. Coordinate electric locks with the architect, door hardware and electronic security consultants to ensure appropriate lock specification.

8.2.7.8. Quality Assurance:

a. Contractor: Assign hardware installation to tradespeople experienced in the installation of commercial door hardware.

b. Installer Qualifications: An employer of workers trained and approved by the lock, door closer, and exit device manufacturers.

i. Installer's responsibilities include supplying and installing door hardware and providing a qualified architectural hardware consultant available during the course of the work to consult with the contractor, COTR, and government about door hardware and keying.

ii. Installer will have warehousing facilities in the project vicinity.

iii. Scheduling Responsibility: Preparation of door hardware and keying schedules

iv. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute (DHI) as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to those indicated for the project.

c. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

8.2.8. Not Used.

8.2.9. Mechanical Locks:

8.2.9.1. All locking arrangements must meet IBC and Life Safety Code (LSC) requirements. Notify OPS and the Office of Safety, Health, and Environmental Management (OSHEM) immediately of any conflicts or failure to meet both requirements.

8.2.9.2. Not Used.

8.2.9.3. Not Used.

8.2.10. Glazing:

8.2.10.1. Refer to Appendix F- Exhibit Fabrication Guide in Volume 3 for requirements for glass used in exhibit case construction.

8.2.10.2. Refer to Appendix F- Exhibit Fabrication Guide in Volume 3 for requirements for glazing products, such as laminated safety glass, to be used in exhibit case construction.

8.2.10.3. Refer to Appendix F- Exhibit Fabrication Guide in Volume 3 for OPS security requirements for glass used in exhibit case construction.

8.2.10.4. Refer to Appendix A- Security Design Criteria Matrix for requirements for the use of laminated glass in perimeter windows and in security guard booths.

8.2.10.5. Refer to the IBC for code requirements for safety glazing (tempered, laminated tempered, laminated heat-strengthened) for glass used in entrances/storefronts and in railings (handrails, guard rails).

8.2.10.6. The choice of single-, double-, or triple-glazed windows and the use of low-E coatings should be based on climate and energy conservation and security requirements.

8.2.10.7. Provide safety strips at glazing.

8.2.10.8. Quality Assurance:

a. Design Requirements:

i. Provide glazing systems capable of withstanding normal thermal movements, wind loads, and impact loads, without failure, including loss due to ineffective manufacture, fabrication and installation; deterioration of glazing materials; and other defects in construction.

ii. Provide glass thickness and strengths (annealed, heat-strengthened, tempered, or heat soaked) required to meet or exceed the following criteria based on project loads and in-service conditions per ASTM E1300.

iii. Minimum thickness of annealed or heat-treated glass products is selected so that worst-case probability of failure does not exceed the following:

a) 8 breaks per 1000 for glass installed vertically or not over 15 degrees from the vertical pane and under wind action.

b) 1 break per 1000 for glass installed 15 degrees from the vertical plane and under action of snow and/or wind.

iv. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by the coated-glass manufacturer.

v. Installer Qualifications: A qualified glazing contractor for this project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and who employs glazing technicians and/or glass installers who are certified under the Architectural Glass & Metal Technician (AGMT) certification program OR a glazing contractor that can provide the following:

a) Five (5) years of glazing co. ownership and experience

b) Written references to demonstrate evidence of successfully completed similar projects

c) A formal Safety Program documented in writing

d) A formal Quality Manual documented in writing

e) Resume and qualifications for a Quality Manager

f) Evidence of a fully implemented Quality Management System, including installation quality verification metrics to be utilized on the project

vi. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass, laminated glass, and insulating glass.

vii. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control Low-E coatings of a primary glass manufacturer that has established a certified fabricator program are specified, obtain sputter-coated solar-control Low-E-coated glass in fabricated units from a manufacturer that is certified by the coated-glass manufacturer.

viii. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

8.3. <u>Specifications</u>

8.3.1. Historic Wood Windows:

8.3.1.1. Historic Treatment of Wood Windows:

a. A historic treatment specialist will be required on site. The treatment specialist will be a firm or individual experienced in historic treatment of windows similar in material, design, and extent to that indicated for the project, whose work has resulted in construction with a record of successful in-service performance.

b. An experienced full-time field supervisor will be required at the project site when historic treatment of wood windows is in progress.

c. The contractor will provide a historic treatment program for each phase of the historic treatment process, including protection of surrounding materials on the building and project site during operations. Describe in detail the materials, methods, equipment, and sequence of operations to be used for each phase of historic treatment work.

d. Prepare existing windows to serve as mockups to demonstrate historic treatment methods and procedures for aesthetic effects and qualities of materials and execution. Use materials and methods proposed for completed work and prepare mockups under same weather conditions to be expected during remainder of work.

e. Comply with applicable requirements in the Architectural Woodwork Institute (AWI) Architectural Woodwork Quality Standards for construction, finishes, grades of wood windows, and other requirements.

8.3.2. Doors and Frames:

8.3.2.1. Hollow Metal Doors and Frames:

a. All new doors will have a minimum size of 914 mm (3 ft) wide by 2134 mm (7 ft) high by 45 mm (1-3/4 in) thick.

b. In existing facilities, new doors will match building standard.

c. Hollow metal doors and frames will be constructed of steel sheet in accordance with ANSI A250.8. Metal frames will be erected in accordance with ANSI/SDI A250.11.

d. Hollow metal frames will be welded. Do not use knocked-down frames without prior approval of the facility manger and the SI COTR.

e. Provide rated fire doors constructed in accordance with NFPA 80. Provide fire door core construction as required to provide the fire protection ratings required by the project.

f. Provide thermal-resistance-rated door core construction for exterior doors.

8.3.2.2. Wood Doors:

a. Do not use hollow-core wood doors or plastic-laminated doors.

b. Wood doors will have an overall thickness of 45 mm (1-3/4 in).

c. Wood doors will have a center interior field and core, preferably of strawboard/wheatboard.

d. Interior stiles of wood doors will be a minimum of 57 mm (2-1/4 in) wide Laminated Strand Lumber (LSL).

e. Interior top and bottom rails will be a minimum of 76 mm (3 in) wide LSL.

f. All doors will have a solid lumber edge of 12.7 mm (1/2 in) thick as the visible stiles, and they will be the same wood species as the face and back veneer if possible. If the same species is not possible, then a stained substitute must be presented for approval prior to fabrication.

g. Wood doors will have 6.4 mm (1/4 in) Medium Density Fiberboard (MDF) overlay front and back and will be calibrated perfectly flat prior to veneering the front and back of the door.

h. For doors receiving a transparent finish, the face and back veneer will be center balance matched with an equal number of leaves per face and an equal number of leaves per back.

8.3.2.3. Stile and Rail Wood Doors:

a. Wood doors will have an overall thickness of 45 mm (1-3/4 in), measured at either the stile or the rail.

b. Recessed panels will be a minimum of 12.7 mm (1/2 in) thick.

c. Raised panels will not exceed overall door thickness.

d. Solid lumber will be used to frame either recessed or raised panels and will be the same species as the wood veneer on the face and back of the door. If that is not possible, then a suitable alternative will be stained and presented for approval prior to fabrication.

e. Raised or recessed panels will preferably be of strawboard/wheatboard or No Added Urea Formaldehyde (NAUF) MDF.

f. Stiles will be a minimum of 57 mm (2-1/4 in) wide LSL or stave core.

g. Top and bottom rails will be a minimum of 76 mm (3 in) wide LSL or stave core.

h. All doors will have a solid lumber edge of 12.7 mm (1/2 in) thick as the visible stiles, and they will be the same wood species as the face and back veneer if possible. If the same species is not possible, then a stained substitute must be presented for approval prior to fabrication.

i. All stiles, rails, and recessed or raised panels will have 6.4 mm (1/4 in) MDF overlay front and back and will be calibrated perfectly flat prior to veneering the front and back of the door.

j. Stiles will always have the grain of the veneer running vertically, whereas the rails will have the grain running horizontally. Recessed or raised panels will always have an equal number of leaves of veneer and will be center balanced matched.

8.3.3. Specialty Doors:

8.3.3.1. Access Doors and Frames:

a. Provide a continuous piano hinge and a key-operated cam latch for access panels.

   i. Provide fire-rated access doors and frames in fire-rated wall, floor, and ceiling assemblies.

   ii. Fire-rated access doors and frames will be UL-listed.

b. Fire-rated access doors and frames must be in accordance with NFPA 252 if installed vertically and NFPA 288 if installed horizontally.

c. Specify concealed frame access panels for interior walls and ceilings in public spaces in museum facilities.

8.3.3.2. Sliding Aluminum-Framed Glass Doors:

a. Interior sliding glass doors may be used at the entrance to exhibition space. Location of the sensor is critical so that the doors do not open more than necessary.

b. Aluminum finish will comply with the requirements of AAMA technical standards 611, 2603 or 2604.

8.3.3.3. Overhead Coiling Doors:

a. Perimeter coiling door locations in new facilities will include vestibules or air locks.

b. Provide foamed-in-place insulation between the exterior and interior metal skins at loading dock doors. Insulated doors will have internal stiffeners to stiffen the face skins and provide adequate structural performance.

c. At all exterior coiling doors, provide heavy duty weatherstripping along the jambs, a neoprene bulb wiper strip at the front of the curtain, and a neoprene baffle at the top of the coil.

d. Replacement doors will consider an improvement in insulation value (R-value) and should not just be a replacement-in-kind.

e. Control devices will be suited for high-frequency operation, open and close quickly, and have a sensor edge to detect an object beneath to reverse operation.

f. The overhead coiling door controller will be located in an accessible location. A location at standing height is preferred, but at a location at the top of the door is acceptable when the ceiling is open.

g. Battery backups will be provided for all overhead coiling door operators.

8.3.3.4. Overhead Coiling Grilles:

a. Control devices will be suited for high-frequency operation, open and close quickly, and have a sensor edge to detect an object beneath to reverse operation.

8.3.3.5. Sound-Control Door Assemblies:

a. Provide sound-control doors with manufacturer’s standard sound-retardant core to achieve the Sound Transmission Class (STC) rating required by the project.

b. Fabricate steel sound-control doors according to ANSI/NAAMM-HMMA 865.

c. Fabricate wood sound-control doors according to WDMA 1.S.1-A.

8.3.4. Entrances and Storefronts:

8.3.4.1. Entrances and Storefronts:

a. Low energy and power-assisted doors will comply with the requirements of ANSI/BHMA A156.19.

b. Full-powered automatic doors will comply with the requirements of ANSI/BHMA A156.10.

c. All power-assisted doors must comply with the current edition of NFPA 101 and the LSC and will be properly coordinated.

d. It is recommended that at least one door at a museum entrance will have an automatic operator. If there is an interior vestibule at the entrance, then at least one vestibule door will have an automatic operator. Motion detectors and push plates are preferred over mats as actuating devices.

e. Entrance doors and frames will be of heavy-duty construction.

f. Doors will be designed as part of a curtain wall system or will have a subframe capable of supporting specified doors and hardware.

g. Provide weatherstripping at all perimeter doors.

h. At entrances and storefronts, provide sill flashings with a panned up interior leg and end dams to prevent water migration into the building or the interior of the frame. Shingle jamb flashing into the sill flashing.

i. Provide adequate sealing and flashing at any door or frame device penetrations to protect devices and prevent water migration.

j. It is recommended to use a wide stile door type because of heavy pedestrian traffic at museum entrances. Stiles will be evaluated on a case-by-case basis. Frameless, all-glass entrance doors are not recommended for museum entrances.

k. Provide full mortise type continuous geared hinges for all museum entrance doors. The use of offset hinges for entrance doors is not recommended because of the heavy weight of the doors.

    i. Coordinate with all accessibility requirements.

l. Provide heavy-duty surface-mounted overhead closers at museum entrances because of high door use.

m. Doors will be designed for a 20-year system life. The door assembly will have a 10-year warranty; the finish will have a 20-year warranty.

n. Entrance doors will be minimum 50.8 mm (2 in) in overall thickness with minimum 12.7 mm (1/2 in) thick laminated glass in exterior doors and minimum 6 mm (1/4 in) thick tempered or laminated glass in interior doors. Refer to the glazing section of these design standards.

o. Door construction will comply with the following:

    i. Doors will have welded corner construction.

    ii. Reinforce doors as required for hardware installation.

    iii. Aluminum doors will be fabricated from aluminum that is minimum 4.8 mm (3/16 in) thick.

    iv. Bronze doors will be fabricated from bronze that is minimum 1.5 mm (1/16 in) thick. The bronze door frame material will be minimum 2.3mm (3/32 in) thick.

p. Door hardware on entrance doors will include push/pull bars. Signage identifying “push/pull” is recommended.

q. In delegated design projects, the manufacturer will retain an independent licensed structural engineer to prepare structural calculations and to certify that the doors meet all criteria. The stamped and sealed structural calculations will be submitted by the contractor for SI review.

r. Entrance door system design will meet all performance requirements and design criteria listed below:

  i. Provide entrance door system to meet structural loads – wind, seismic, blast – as identified in each project.

  ii. Provide entrance door system to meet deflection of framing member criteria.

    a) Deflection Normal to Wall Plane is limited to the edge of the glass in a direction perpendicular to the glass plane and will not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 19 mm (3/4 in), whichever is less.

    b) Deflection Parallel to Glazing Plane is limited to L/360 of clear span, or 3.2 mm (1/8 in), whichever is less.

  iii. Provide entrance door system tested according to ASTM E330 as follows:

    a) When tested at positive and negative wind-load design pressures, system does not show evidence of deflection exceeding specified limits.

b) When tested at 150 percent of positive and negative wind-load design pressures, system including anchorage does not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.

c) Test durations will be as required by design wind velocity but not less than 10 seconds.

iv. Provide entrance door system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

a) Temperature Change (Range): 67° C (153°F), ambient; 100° C (212°F), material surfaces.

v. Provide entrance door system with maximum air leakage through fixed glazing and framing areas of 0.03 L/sec/m2 (0.064 cu ft/min/sq ft) of fixed wall area when tested according to ASTM E283 at a minimum static-air-pressure difference of 300 Pa (0.0435 psi).

vi. Provide entrance door system that does not show evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 300 Pa (0.0435 psi).

vii. Provide entrance door system with fixed glazing and framing areas having CRF of not less than 53 when tested according to AAMA 1503.

viii. Provide door frames that incorporate adequate thermal isolation from thermal bridges.

s. Means of egress doors will comply with NFPA 101 and with accessibility requirements. Doors will require a force not greater than 133 N (30 lbf) to set the door in motion and not greater than 67 N (15 lbf) to open the door to the minimum required width.

t. Provide an access panel in the bottom rail of glass doors that have the lock in the bottom rail so that the lock can be removed for service without having to dismantle the door.

8.3.4.2. All-Glass Entrances and Storefronts:

a. Frameless, all-glass entrance doors are not recommended for museum entrances.

b. Interior all-glass entrance doors will utilize stainless steel rails at the top and bottom of the glass doors. Stainless steel will be Type 304 and will comply with ASTM A666.

8.3.4.3. Sliding Automatic Entrances:

a. Full-powered automatic doors will comply with the requirements of ANSI/BHMA A156.10.

b. All power-assisted doors must comply with the current edition of NFPA 101 and the LSC.

c. The contractor will submit the qualifications of the sliding automatic entrance door manufacturer and installer.

i. The manufacturer will have a minimum of ten (10) years of documented experience in manufacturing doors and equipment for sliding automatic entrances. The manufacturer will be certified by AAADM.

ii. The installer will have a minimum of three (3) years of documented experience installing and maintaining sliding automatic entrances. The installer will be certified by AAADM.

8.3.4.4. Curtain Walls:

a. Aluminum curtain walls will be designed using the AAMA Aluminum Curtain Wall Design Guide Manual.

b. Provide thermal breaks to improve thermal performance and condensation resistance of the system.

c. Establish the required CRF based on anticipated interior humidity and local climate data and select a curtain wall with an appropriate CRF.

d. If a gasketed system is used, ensure continuity of the gaskets at horizontal and vertical transitions. To mitigate shrinkage of gaskets back from the corners, the use of vulcanized corners and diagonally cut splices is recommended.

e. Detailing of curtain wall systems will be integral to the building envelope design including roof, parapet, waterproofing, and air barrier design. See Division 07 Sections for additional requirements.

f. Aluminum curtain wall finishes will be either Class I anodic coatings (AAMA 611, supersedes AAMA 606, 607, and 608) or high-performance factory-applied fluoropolymer thermoset coatings (AAMA 2605).

g. Select a curtain wall with a demonstrated track record in similar applications and exposures.

h. The design of the curtain wall and perimeter construction will permit curtain wall removal and replacement without removing adjacent wall components that will remain.

i. Specify field mock-ups for all curtain wall systems.

j. Specify that laboratory tests are to be conducted at an AAMA-accredited laboratory facility.

k. Require the field testing of curtain walls for air infiltration and water penetration resistance, for quality assurance of curtain wall fabrication and installation. Require multiple tests with the first test on initial installation and later tests at approximately 35 percent, 70 percent, and at final completion to identify problems early and to verify continued workmanship quality. Require additional testing to be performed if initial tests fail.

l. Require curtain wall installation shop drawings showing all adjacent construction and related work, including flashings, attachments, interior finishes, and indicating sequencing of the work.

8.3.4.5. Panel Assemblies:

a. The A/E will perform and submit dewpoint analysis for ALL building envelope components to demonstrate proper moisture prevention/removal and use of vapor barriers.

b. Joints between panels will be wide enough to accommodate thermal expansion and differential movements between panels.

c. Clearly detail air and water barrier requirements for panel assemblies on the contract documents.

d. The following performance criteria will be included in the specifications:

i. Wind loading

ii. Seismic design criteria

iii. Deflection criteria

iv. Air Infiltration criteria

v. Water test performance criteria

vi. Panel flatness criteria

vii. Panel tolerance criteria

viii. Thermal movement criteria

ix. Performance testing criteria

x. Fire resistance ratings, if required

xi. Sound transmission criteria

xii. Insulation criteria

xiii. Performance criteria for air and moisture barrier or rainscreen

e. Steel panels will be designed using AISC's Specification for the Design of Cold-Formed Steel Structural Members.

f. Aluminum panels will be designed according to The Aluminum Association's Specifications for Aluminum Structures.

8.3.5. Windows:

8.3.5.1. Aluminum Windows:

a. Aluminum windows will meet the requirements of AAMA 101/I.S.2/A440-05.

b. Aluminum windows will meet the requirements of ANS I/AAMA Standard 101- 85.

c. Aluminum frames will incorporate thermal breaks. Thermal breaks will provide a continuous uninterrupted thermal barrier around the entire perimeter of the frame and all sash and will not be bridged by any metal conductors at any point. Provide the manufacturer's standard construction that has been in use on similar window units for a period of not less than three years, has been tested to demonstrate resistance to thermal conductance and condensation, and has been tested to show adequate strength per AAMA 505.

d. Slope the glazing pocket to promote drainage.

8.3.5.2. Steel Windows:

a. Steel windows will meet the requirements of the Steel Window Institute (SWI) Specifier’s Guide to Steel Windows for the performance class required.

b. Steel windows will meet the requirements of the NAAMM Standard SW-1 for the performance class required.

c. Fully weld all frame corners for watertight construction.

d. Existing steel frames, if not substantially weakened by corrosion, can be removed, refinished, and reinstalled.

8.3.5.3. Wood Windows:

a. Wood windows will meet the requirements of AAMA/WDMA 101/I.S.2/ NAFS. AW Architectural Class.

b. Wood windows will meet the requirements of ANSI/National Woodwork Manufacturers Association (NWMA) Standard I.S. 2-87, Grade 60.

8.3.6. Skylights and Sloped Glazing Assemblies:

8.3.6.1. Skylight design will follow the guidelines of AAMA Standard 1600.

8.3.6.2. Unit skylights will follow AAMA 101/I.S.2/A440-05: *Standard/Specification for Windows, Doors, and Unit Skylights*.

8.3.6.3. Design of sloped glazing will follow the guidelines of AAMA Glass Design for Sloped Glazing and Structural Design Guidelines for Aluminum Framed Skylights.

8.3.6.4. Provide a minimum skylight slope of 3:12.

8.3.6.5. Provide a continuous system of gutters, integral with the skylight rafters and cross members, to collect leakage and condensation. The cross-member gutters must be notched at their ends to assure drainage into the rafter gutters. Water must be drained from gutter to gutter and never onto units below.

8.3.6.6. Provide an exterior wet seal in lieu of a dry gasket seal.

8.3.6.7. Select a system with continuous rafters if possible.

8.3.6.8. Provide a continuous metal sill flashing to collect leakage and condensation. The flashing will be sloped and drain to the exterior. Fully integrate the sill flashing with the exterior envelope of the building.

8.3.6.9. Select a system with snap-on rafter caps, rather than exposed pressure bars.

8.3.6.10. Provide flush-glazed horizontal mullions without exterior applied pressure bars to avoid bucking water run-off.

8.3.6.11. Coordinate the waterproofing with the attachment details.

8.3.6.12. Establish the required CRF based on anticipated interior humidity and local climate data and select a system that meets this CRF.

8.3.6.13. Design for adequate differential movement between skylight systems and structural support members.

8.3.6.14. Skylight design will include a review of the potential for damage by adjacent structures or materials, including the possibility of gravel ballast being blown off adjacent roofs. Providing roof parapets or avoiding gravel roof ballast altogether limit the risk of breakage. All lites in the skylight glazing will be heat-strengthened to limit the risk of fracture. Monolithic fully tempered glass will not be used as the inboard lite of a skylight to avoid fall-out associated with spontaneous fracture.

8.3.6.15. Design the skylight and perimeter construction to allow component replacement and include provisions for safe access and fall protection for maintenance and service personnel. Match the life expectancy of components that are mated together into an assembly.

8.3.6.16. Verify skylight performance requirements are met using mockups and appropriate measurements and tests to confirm compliance of all design criteria. The mockups will include all representative perimeter construction details (sill, hip, head, rake), and will be tested for air and water penetration resistance.

8.3.6.17. Once skylight installation is complete, verify light and UV levels meet design requirements by measuring the levels in the space.

8.3.7. Glazing:

8.3.7.1. Follow GANA glazing guidelines.

8.3.7.2. Use ASTM Standard E1300: *Standard Load Practice for Determining Load Resistance of Glass in Buildings* to select appropriate glass thickness to resist service loads.

8.3.7.3. Single glazing has poor thermal performance and is suitable only for applications where thermal performance is irrelevant, such as interior applications or installations where interior and exterior temperatures do not vary substantially.

8.3.7.4. Provide continuous dual seals on all insulated glazing units.

8.3.7.5. Insulated glazing unit spacers will be filled with desiccant and constructed with bent, welded, or soldered corners in lieu of corner keys.

8.3.7.6. Provide setting blocks that are properly sized and spaced to promote moisture drainage away from glazing toward weep holes. Ensure that setting blocks are chemically compatible with secondary insulated glazing unit seals.

8.3.7.7. Ensure that sealants that come into contact with laminated glass interlayers are compatible to avoid delamination.

8.3.7.8. Protect the edges of laminated glazing from exposure to water to limit the risk of delamination.

8.3.7.9. Avoid glass-to-frame contact by using setting blocks.

8.3.7.10. Use heat-strengthened glass for high temperature applications, such as spandrel glass, and where greater resistance to bending and thermal stresses compared to annealed glass is required.

8.3.7.11. Use Fully Tempered (FT) glass where required by code but avoid use in areas where breakage poses a risk to safety due to the potential for spontaneous breakage. Where the use of FT glass is unavoidable, and where its breakage poses a threat to people or property, heat-soak the FT glass to reduce the risk of spontaneous breakage.

8.3.7.12. The use of laminated glass with appropriate polyvinyl butyral (PVB) interlayers is preferred over the use of applied films for UV protection.

8.3.7.13. Confirm specified glazing meets space requirements for light transmission and UV. Confirm design requirements are met upon completion of installation by taking measurements in the space. Coordinate this measurement effort with the COTR.

8.3.8. Louvers and Vents:

8.3.8.1. Louvers and vents will be constructed of aluminum unless heavier, more historic materials are required to match existing materials.

8.3.8.2. Louvers and vents will be designed to adequately prevent water and/or driving rain from penetrating the building envelope and will drain water away from the building.

8.3.8.3. Bird screens will be provided at all exterior louvers and vents. Bird screens will be coordinated with HVAC airflow requirements.

8.3.8.4. Louvers and vents will not be field modified during installation.

9. FINISHES

9.1. Reference Codes, Standards, and Guidelines

9.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 09-specific requirements:

9.1.1.1. National Fire Protection Association (NFPA) 701: *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*

9.1.1.2. American Society for Testing and Materials (ASTM) E84: *Standard Test Method for Surface Burning Characteristics of Building Materials*

9.1.1.3. ASTM C373: *Water Absorption*

9.1.1.4. ASTM C1028: *Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Substances*

9.1.1.5. ASTM C650: *Chemical Resistance*

9.1.1.6. ASTM C1027: *Abrasion Resistance*

9.1.1.7. Mohs Scale of Hardness (MOH)

9.1.1.8. ASTM E648: *Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source*

9.1.1.9. Carpet and Rug Institute (CRI) Green Label Plus Program and Texture Appearance Retention Rating (TARR) System

9.1.1.10. South Coast Air Quality Management District (SCAQMD) Rule #1168

9.1.1.11. Master Painters Institute (MPI) Architectural Painting Specification Manual

9.1.1.12. Ozone Transport Commission (OTC)

9.1.1.13. International Accreditation Service (IAS)

9.1.1.14. ASTM E2573: *Standard Practice for Specimen Preparation and Mounting of Site-Fabricated Stretch Systems to Assess Surface Burning Characteristics*

9.1.1.15. ASTM F710: *Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring*

9.1.1.16. ASTM F2034: *Standard Specification for Sheet Linoleum Floor Covering*

9.1.1.17. ASTM F970: *Standard Test Method for Static Load Limit*

9.1.1.18. ASTM D3359: *Standard Test Methods for Measuring Adhesion by Tape Test*

9.1.1.19. ASTM D4060: *Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser*

9.1.1.20. ASTM D2794: Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)

9.1.1.21. ASTM D3363: *Standard Test Method for Film Hardness by Pencil Test*

9.1.1.22. ASTM D2486: *Standard Test Methods for Scrub Resistance of Wall Paints*

9.1.1.23. ASTM D3023: *Standard Practice for Determination of Resistance of Factory-Applied Coatings on Wood Products to Stains and Reagents*

9.1.1.24. ASTM D1308: *Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes*

9.1.1.25. ASTM C423: *Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method*

9.1.1.26. ASTM E1414: *Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum*

9.1.1.27. ASTM E1264: *Standard Classification for Acoustical Ceiling Products*

9.1.1.28. ASTM E1477: *Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers*

9.1.1.29. ASTM A653: *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

9.1.1.30. ASTM C635: *Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings*

9.1.1.31. ASTM A641: *Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire*

9.1.1.32. ASTM F1861: *Standard Specification for Resilient Wall Base*

9.1.1.33. ASTM D2240: *Standard Test Method for Rubber Property—Durometer Hardness*

9.1.1.34. ANSI A108.11: *Specifications for the Installation of Interior Cementitious Backer Units*

9.1.1.35. ANSI A118.9: *Specifications for Cementitious Backer Units*

9.1.1.36. ASTM C1288: *Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets*

9.1.1.37. NFPA 286: *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*

9.1.1.38. ASTM C241/C1353: *Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic*

9.1.1.39. ANSI A108/A118: *American National Standard Specifications for the Installation of Ceramic Tile*

9.1.1.40. ASTM C587: *Standard Specification for Gypsum Veneer Plaster*

9.1.1.41. ASTM C754: *Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products*

9.1.1.42. ASTM C840: *Standard Specification for Application and Finishing of Gypsum Board*

9.1.1.43. ASTM C842: *Standard Specification for Application of Interior Gypsum Plaster*

9.1.1.44. ASTM C1396: *Standard Specification for Gypsum Board*

9.1.1.45. NFPA 255: *Standard Method of Test of Surface Burning Characteristics of Building Materials*

9.1.1.46. NFPA 265: *Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls*

9.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

9.2. Design Requirements

9.2.1. Interior Walls and Ceilings:

9.2.1.1. At a minimum, interior partitions will be designed in accordance with the Office of Safety, Health, and Environmental Management (OSHEM) requirements outlined in the Walls section of SDS Design Guidelines Chapter 10- Building Requirements in Volume 1. Partitions shall also be designed in accordance with the with the space classifications as listed in Appendix A – Security Design Criteria Matrix in Volume 3.

a. Enclose all mechanical and electrical rooms with minimum one-hour fire-rated construction (or higher as required by the International Building Code (IBC) building code).

9.2.1.2. Interior finishes will comply with the OSHEM requirements highlighted in the Interior Finishes Section of SDS Design Guideline Chapter 10- Building Requirements in Volume 1, all applicable NFPA code requirements, and OTC air quality regulations.

9.2.1.3. Ratings for Interior Finishes and Decorative Materials for maximum flame spread rating, maximum smoke developed rating, and flame resistance requirement for finish materials, will be in accordance with NFPA 101 and NFPA 701 standards and testing in accordance with ASTM E84. Refer to the Interior Finishes Section of SDS Design Guidelines Chapter 10- Building Requirements in Volume 1 for additional information.

9.2.1.4. Consideration will be given to using high performance coatings on walls in high traffic areas. Wall coatings and surfaces will be durable and easily cleaned.

9.2.1.5. Provide corner protection in specific zones, including but not limited to, loading docks, high-traffic back-of-house spaces, retail stock rooms, retail storage rooms, restaurant kitchens, dishwashing and public servery areas, etc.

9.2.1.6. Corner/edge protection in public spaces should be integrated into the overall design.

9.2.1.7. The use of stainless-steel corner guards is preferred.

9.2.1.8. Protection requirements will be determined on a building-by-building basis.

9.2.1.9. Performance Requirements:

a. Metal studs are to be minimum 362S137-33 (92 mm (3-5/8 in) web depth stud with minimum base metal thickness of 0.83 mm (0.033 in), minimum flange width of 34.9 mm (1.375 in), and minimum stiffening lip length of 9.5 mm (0.375 in)). More stringent stud requirements may be required for taller members.

b. SI will consider the use of dimpled studs on a project-by-project basis and approval is required. If this option is rejected in design, under no circumstance will dimpled studs be approved for use during construction.

9.2.2. Acoustic Design:

9.2.2.1. Carpet and acoustical ceiling systems will be specified in large public areas, where they will not conflict with existing and/or historic design, and in open office areas in order to minimize ambient noise levels. In addition, a white noise system should be considered in open office areas to assist in minimizing ambient noise levels. The use of acoustical plaster should strongly be considered to reduce ambient noise levels in public spaces.

a. The use of carpet in restaurant dining areas is prohibited.

b. The use of carpet and acoustic ceiling tiles in gallery or exhibit spaces is strongly discouraged. Use of these materials in exbibits or galleries must be reviewed and approved by relevant SI stakeholders.

c. Where acoustic tiles are used in wet and/or humid locations, the use of moisture- and mold-resistant tiles is required.

9.2.3. Ceiling Heights:

9.2.3.1. Ceiling heights in open office areas will promote flexibility for future floor plan changes. Office areas greater than 14 sq m (150 sq ft) will have a minimum ceiling height of 2700 mm (9 ft). Areas smaller than 14 sq m (150 sq ft) will have a minimum ceiling height of 2300 mm (8 ft).

9.2.3.2. Existing historical ceiling heights in historic buildings should be maintained to the greatest extent possible. Where appropriate, exposed ceiling solutions that provide for full ceiling clearances and exposure of ornamental finishes should be implemented. Careful consideration should be given to the layout of new systems that may detract from the historical character of the space.

9.2.4. Ceiling, Lighting, and Security Design:

9.2.4.1. The architect/designer will submit a thorough luminaire schedule with every lighting and/or ceiling design as part of the design/construction document submission. Refer to Division 26- Electrical in Volume 1 for additional lighting requirements.

9.2.4.2. The A/E will coordinate the locations of all ceiling-mounted fixtures and devices on the reflected ceiling plans. Fixtures and devices include, but are not limited to:

a. Lighting fixtures

b. Smoke detectors

c. Sprinkler heads

d. Fire alarm devices

e. Security devices (e.g., cameras, motion detectors)

f. Wireless access points

g. AV equipment

9.2.4.3. The design will include provision for access to maintain ceiling-mounted lighting fixtures, security devices, and other devices. The contractor will provide any specialized equipment required to access lighting and devices mounted on the ceiling.

9.2.4.4. Coordinate access to devices with fixed elements. Any required access door in a public space will be flangeless and well-integrated into the surrounding finishes.

9.2.5. Historic Finishes:

9.2.5.1. New work in historic buildings should maintain as much of the historic finishes as possible. Finishes should be restored using historically appropriate materials and methods. When historic finishes are uncovered in a project after having been hidden for some time, they should be repaired and restored to the greatest extent the project allows, even if these finishes will be covered up again as part of the new work.

9.2.5.2. All projects in historically significant structures will be mindful of <u>all</u> historic fabric. <u>No</u> historic fabric will be demolished or altered without knowledge and written permission from the SI. Any alteration to historic fabric will be done in a manner that is completely reversable. When a reversable solution is not possible, written approval of the proposed non-reversable alteration is required from SI.

9.2.5.3. If during demolition and construction, the contractor comes across a historic material or finish that is not anticipated, the contractor will notify the Contracting Officer's Technical Representative (COTR) immediately for direction on how to proceed. This requirement must be clearly stated in the design documents.

9.2.6. Resilient Flooring:

9.2.6.1. Quality Assurance:

a. A qualified installer will employ workers for the project who are competent in techniques required by the manufacturers for floor covering installation and seaming methods indicated.

   i. Engage an installer who employs workers for the project who are trained or certified by floor covering manufacturers for installation techniques required.

b. Build mockups to verify selections made from sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

c. Whenever specified, resilient flooring will be of an appropriate quality for the foot traffic of the area in which it will be utilized.

9.2.7. Carpeting:

9.2.7.1. Quality Assurance:

a. An experienced installer will have a minimum of five years of documented experience and be certified by the Floor Covering Installation Board or will demonstrate compliance with its certification program requirements.

b. The contractor will provide shop drawings identifying the carpet installation pattern, cut carpet tile dimensions, and all flooring transitions.

c. Before installing carpet tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

9.2.8. Painting:

9.2.8.1. Quality Assurance:

a. Apply benchmark mockup samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

i. The COTR will select one surface to represent surfaces and conditions for application of each paint system.

a) Wall and Ceiling Surfaces: Provide samples of at least 9.3 sq m (100 sq ft).

b) Other Items: The COTR will designate items or areas required.

ii. Apply benchmark samples after permanent lighting and other environmental services have been activated.

iii. The number of coats will be based on the application type and color selection with a minimum of two coats. Darker colors may require a minimum of three coats.

iv. Final approval of color selections will be based on benchmark samples.

1. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by the COTR.

9.3. Specifications

9.3.1. Gypsum Plaster:

9.3.1.1. Gypsum Plastering:

a. Install gypsum plaster in accordance with ASTM C842.

b. The installer will have a minimum of five (5) years of documented experience installing plaster.

9.3.1.2. Gypsum Veneer Plastering:

a. Specify USG Imperial Plaster, or a SI-approved equal, for high-traffic areas receiving veneer plaster finish.

b. Install gypsum veneer plaster in accordance with ASTM C587.

9.3.1.3. Cementitious Backer Board:

a. A qualified Installer must have a minimum of two (2) years of experience installing similar products.

b. The contractor will provide the following warranties:

i. Product Warranty: Limited product warranty against manufacturing defects:

a) 13 mm (1/2 in) nominal cement board for 20 years

b) 6 mm (1/4 in) nominal cement board for 20 years

ii. Workmanship Warranty: Application limited warranty for two (2) years.

c. Material will meet the following building code compliance:

i. Non-asbestos fiber-cement board will comply with ASTM C1288 and ANSI A118.9.

ii. Board will meet the building code compliance National Evaluation Report No. NER 405.

iii. U.S. Department of Housing and Urban Development Materials Release 1268C.

iv. California Division of the State Architect (DSA) PA-019.

v. City of Los Angeles Research Report No. 24862.

d. Fasteners for Cementitious Backer Board:

i. Wood Framing Fasteners:

a) Wood framing: 32 mm (1-1/2 in) corrosion-resistant (galvanized or stainless steel) roofing nails

b) Wood framing: 32 mm (1-1/2 in) No. 8 by 9.5 mm (0.375 in) HD self-drilling, corrosion-resistant ribbed wafer head screws

ii. Metal Framing:

a) Metal framing: 32 mm (1-1/2 in) No. 8 by 9.5 mm (0.375 in) HD self-drilling, corrosion-resistant ribbed wafer head screws.

9.3.1.4. Gypsum Board:

a. Gypsum board must meet the requirements of ASTM C1396. Metal stud systems must meet the requirements of ASTM C754. The application and finishing of gypsum board will be in accordance with ASTM C840.

b. Specify abuse-resistant gypsum board in all public areas where there is no plaster or stone finish.

c. Provide Level 5 finish for gypsum board used in all public areas, including permanent exhibition galleries, and any surface to which graphics will be applied. Provide Level 4 finish for gypsum board used in temporary exhibitions and in administrative areas. Any wall that is to receive a gloss finish, wall covering, or graphic will have a Level 5 finish. Provide finish levels in accordance with ASTM C840.

d. The use of impact-resistant gypsum board is preferred in all public spaces.

e. Specify mold-resistant gypsum board in the following areas:

   i. Washrooms

   ii. Utility closets

   iii. Humid areas (including vestibules)

   iv. Showers

   v. Locker rooms

   vi. Janitor closets

   vii. Sink areas/kitchenettes

   viii. Kitchen and food preparation spaces

   ix. Areas with plumbing fixtures

f. Identify fire rating (UL design number) and sound rating (Sound Transmission Class (STC) number) where applicable for all new partitions.

g. At a minimum, typical interior partition construction consists of 16 mm (5/8 in) gypsum board each side of 92 mm (3-5/8 in) 20-gauge metal studs at 610 mm (2 ft) on center.

i. Identify Type X gypsum board for fire-rated partitions.

h. Extend room partitions through ceiling and anchor to structure above. Do not terminate partitions at the ceiling grid without prior approval of the facility manager and SI Design Manager.

i. Extend all corridor partitions to the structure.

j. Provide sound insulation batts within partitions for sound control around offices, conference rooms, restrooms, and other spaces identified in project scope requirements.

9.3.2. Tiling:

9.3.2.1. Porcelain tile, with a low rate of absorption of less than half of 1 percent per ASTM C373, is the preferred ceramic tile material for use as a floor tile. A low rate of absorption is a measurement of durability in that it has a higher breaking strength than other ceramic tile types. The various porcelain types are through body, color body, double loaded, or glazed.

9.3.2.2. A minimum static coefficient of slip resistance of .60 for a floor tile per ASTM C1028 must be met, when wet, and when the tile is dry, a coefficient rate higher than .60 must be met.

9.3.2.3. Floor tile will have a minimum MOH of 7.0. In very high traffic facilities, the MOH should be 7.5 to 8.0 for scratch hardness.

9.3.2.4. Chemical resistance is measured on a pass/fail basis using ASTM C650-04 and must be used.

9.3.2.5. The classifications of tile that has been subject to ASTM C107-99 range from Class Zero – not recommended for use on a floor – to Class Five – heavy commercial. A minimum of Class Four will be applied to all SI floor tile installations with Class Five used for buildings or sections of buildings having the highest traffic.

9.3.2.6. When selecting grout, the A/E will confirm the material can withstand chemicals present in the environment as well as cleaning products utilized. Additional sealers and additives will be provided as necessary.

9.3.3. Ceilings:

9.3.3.1. Acoustical Tile Ceilings:

a. The acoustical ceiling tile information outlined below is for standard applications. Actual Acoustic Ceiling Tile (ACT) selection will be dependent on application.

b. The use of formaldehyde in ceiling tile products is prohibited.

c. The acoustical tile ceiling surface texture will be fine unless otherwise required for project-specific criteria.

d. The composition of the acoustical tile ceiling will be mineral fiber.

e. The color of the acoustical tile ceiling will be white unless otherwise required for project-specific criteria.

f. Preference will be given for through-body ceiling tiles when possible, to minimize the appearance of damaged or chipped tiles over time.

g. The acoustical tile ceiling will have the following Noise Reduction Coefficient (NRC): ASTM C423, classified with UL label on product carton, 0.70.

h. The acoustical tile ceiling will have the following Ceiling Attenuation Class (CAC): ASTM E1414, classified with UL label on product carton, 35.

i. The acoustical tile ceiling will pass the following emissions testing: Section 01350 Protocol, < 13.5 ppb of formaldehyde when used under typical conditions required by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 62.1-2004: *Ventilation for Acceptable Indoor Air Quality*.

j. The acoustical tile ceiling will pass the following tests for flame spread: ASTM E 1264 and E84; UL Class A.

k. The acoustical tile ceiling will pass the following test for Light Reflectance (LR): ASTM E 1477; white panel: minimum light reflectance: 0.90.

l. The acoustical tile ceiling will have antimicrobial protection: resistance against the growth of mold/mildew and gram-positive and gram-negative odor- and stain-causing bacteria.

m. The acoustical tile ceiling will have a one (1) year warranty from date of substantial completion.

n. Acoustical tile ceilings in kitchen or wet areas will be of the vinyl-faced, gypsum-backed type, cleanable as required by local jurisdiction requirements.

    i. Fiber-backed acoustical tile ceilings are prohibited in kitchen or food-preparation applications.

9.3.3.2. Suspended Grid Systems:

a. The suspended grid system will consist of the following components: all main beams and cross tees will be commercial quality hot-dipped galvanized (galvanized steel, aluminum, or stainless steel) as per ASTM A653; main beams and cross tees will be double-web steel construction with 9/16 in type exposed flange design; exposed surfaces chemically cleansed, capping pre-finished galvanized steel (aluminum or stainless steel) in baked polyester paint; main beams and cross tees will have rotary stitching (exception: extruded aluminum or stainless steel).

i. Structural Classification: ASTM C 635 HD

ii. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise

b. The suspended grid system will have the following attachment devices: sized for five times design load indicated in ASTM C635, Table 1; direct hung unless otherwise indicated.

c. The suspended grid system will have the following characteristics for the wire for hangers and ties: ASTM A641 Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three times design load, but not less than 12 gauge.

d. The suspended grid system will have the following edge moldings and trim: metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated. Provide moldings with exposed flange of the same width as exposed runner.

e. The suspended grid system will have a ten (10) year warranty from date of substantial completion.

9.3.3.3. Stretched-Membrane Ceiling Systems:

a. The use of stretched-membrane systems is strongly discouraged. Use of these systems will be evaluated on a case-by-case basis and require approval from SI.

b. The stretched-membrane ceiling system must be UL-approved.

c. The fabricator/installer must specialize in stretched-membrane ceiling systems and must have a minimum of five years of documented successful experience with such ceilings. The installation will be performed by skilled tradespeople thoroughly trained in this type of work.

d. The size and characteristics of the membrane will be as follows:

   i. The membrane will be minimum 0.17 mm (0.01 in) thick.

   ii. The width of sheeting between two factory welds will be minimum 1676 mm (5 ft 6 in).

   iii. The membrane will be washable.

e. Coordinate the layout and installation of the ceiling system with other building elements that penetrate the ceiling, such as light fixtures, HVAC, fire suppression, and partitions.

f. The membrane will be stretched over the subsurface and hooked into the supporting rails without glue or clips.

g. The stretched-membrane ceiling will be removable by hand and approved tools for visible inspection, to provide access above the stretched membrane, and to provide for subsequent reinstallation.

h. The following conditions must be met on site before the membrane can be installed:

   i. The space to receive the stretched-membrane ceiling will be enclosed.

   ii. Sufficient heat is provided. Maintain uniform temperature and humidity during installation.

   iii. All wet work is completed and dry.

   iv. Dust-generating activities have terminated.

v. Overhead mechanical, plumbing (sprinkler), and electrical work is completed, tested, and approved.

9.3.4. Flooring and Base:

9.3.4.1. Specialty Flooring:

a. The use of glass floors and glass stair treads is strongly discouraged. Use requires SI approval. When use is approved, the design of glass floors and glass stair treads requires load calculations performed by a structural engineer. The design will meet the load requirements of the IBC building code. Careful consideration will be given to applying point and impact loads to glass.

   i. Surface damage of the glass can occur by impact from hard objects. Therefore, redundancy and safety factors must be used in the design of glass flooring.

   ii. Identify the edge support conditions (four-, three-, or two-sided) in order to determine the load-carrying capabilities of the glass.

b. Types of glass products used in floors and stair treads include:

   i. Laminated glass: two or more pieces of glass bonded together with an interlayer. The glass may be heat-strengthened or fully tempered. The interlayer can contribute to reduction of sound transmission.

   ii. Glass block: a decorative glass building block that is set in a frame and sealed.

c. Since pedestrian safety is a critical objective, the glass must provide an acceptable level of slip resistance.

i. Glass floors must have a minimum static coefficient of friction of 0.60 per ASTM C1028.

ii. To create the slip-resistant top surface of glass floor treads, specify textured glass ceramic enamel that is permanently fused to the glass surface during the glass strengthening process at temperatures in excess of 649°C (1200°F).

d. Some type of marking, such as dots on the stair treads, is recommended on glass stairs in public areas of museums with high visitation in order to assist people to distinguish between the last stair tread and the landing.

e. The proper sealant that is compatible with the glass flooring will be selected.

f. Since glass floors are not typically fire resistant, the design of adequate fire barriers between floors must be developed.

9.3.4.2. Stone Flooring:

a. Water testing will be specified. Electronic testing may be available but should not take the place of water testing. Maintain drains and expansion joints and coordinate as required.

b. In SI museum facilities, the architect/designer will only specify stone flooring that passes the ASTM C241/C1353 test for abrasion resistance for heavy traffic measured by abrasive hardness (Ha).

i. The minimum value of abrasive hardness is 10.0 Ha for general areas.

ii. The abrasive hardness value increases to 12.0 Ha for stairways, elevator halls, and other concentration areas.

iii. Exterior paving will always have a minimum Ha of 12.0.

iv. Polished finish on stones with abrasion indices ≤ 20.0 are not suitable for most moderate and any heavy-traffic areas.

v. Thermal finish is recommended for exterior paving.

vi. Slip resistance for stone flooring is required for both interior and exterior applications.

c. If several varieties of stone are used together, care will be taken to ensure that the Ha of the stones is similar. Proper testing (ASTM C241 or ASTM C1353) will be performed on each stone variety.

d. Joints between stones will be of sufficient width to ensure that the grout being used can be placed at the bottom face of the stone and properly compacted within the joint. In no case will natural stone be installed with tight joints.

i. Exterior stone pavement has a typical stone joint width of a minimum 6.4 mm (1/4 in), preferably 9.5 mm (3/8 in). Joints of 13 mm (1/2 in) or larger are frequently required for a large unit size installation.

ii. Interior stone flooring has a typical stone joint width of a minimum 1.6 mm (1/16 in), preferably 3.2 mm (1/8 in). Joints of 6.4 mm (1/4 in) or larger are frequently required for a large unit size installation.

iii. Movement joints are also required in fields of paving. Refer to ANSI A108.01 Section 3.7 and ANSI A108.02 Section 4.4 for guidance on movement joint location.

e. The architect/designer will specify stone flooring with the following minimum thicknesses:

   i. Exterior Stone Pavers, Pedestrian Traffic: 32 mm (1-1/4 in)

   ii. Exterior Stone Pavers, Vehicular Traffic: best determined by engineering analysis but is generally 76 mm (3 in) or thicker.

   iii. Interior Stone Flooring, Heavy Duty/High Traffic: 19 mm (3/4 in), or 32 mm (1-1/4 in) pending stone variety selection. Stone tile that is 9.5 mm (3/8 in) thick is only acceptable for areas with light traffic.

f. The architect/designer will specify membranes to be used in the design of stone walking surface installations.

   i. Cleavage membranes are used in thick-bed installations below a reinforced mortar bed to intentionally prevent the bond between the stone setting system and the substrate slab to allow independent movement (free floating) of the stone and setting system. Cleavage membranes can be either sheet applied or liquid applied.

   ii. Crack isolation membranes are used to isolate the stone from minor cracking of the substrate surface in thin-set applications. Crack isolation membranes can be sheet applied, trowel applied, or liquid applied and must meet ANSI A118.12.

   iii. Uncoupling membranes are sheet applied and geometrically configured to provide a small airspace that accommodates lateral flexibility between the tile and the substrate, reducing the transfer of stresses to the thin-set stone installation system.

iv. Waterproof membranes are used to prevent the migration of liquid water. These membranes can be sheet applied, sheet metal, or liquid applied. In many cases, these membranes are installed by other trades and must meet ANSI A118.10.

9.3.4.3. Wood Flooring:

a. The wood for the flooring will be planks, which are milled from tree trunks and larger tree branches.

b. The planks will be kiln dried in order to avoid shrinkage, warping, cupping, bowing, and splitting.

c. The flooring will be Premium Select Grade.

d. The finished wood plank standard thicknesses are 19 mm (3/4 in), 16 mm (5/8 in) and 12.7 mm (1/2 in).

e. The floor planks will be from a hard wood species such as ash, walnut, cherry, oak, maple, and sycamore.

f. Many wood finishes and adhesives experience off-gassing of Volatile Organic Compounds (VOCs), which can affect artifacts and sensitive collections. Therefore, an architect/designer needs to carefully consider the selection of wood products (e.g., flooring and casework materials) for storage or display.

9.3.4.4. Resilient Base and Accessories:

a. Provide a cove base with resinous flooring. Provide a straight base with carpet flooring.

b. A sanitary butt-to-wall base is manufactured from a proprietary thermoplastic rubber formulation designed specifically to meet the performance and dimensional requirements of ASTM F-1861, Type TP, Group 1 (solid) Standard Specification for Resilient Wall Base.

c. The physical characteristics of the butt-to-wall base are as follows:

   i. Size: 102 mm (4 in) high with 51 mm (2 in) toe

   ii. Thickness: 2.8 mm (1/8 in) thick

   iii. Length: 30.48 m (100 ft) coils

   iv. Packaging: one coil per carton 30.48 m (100 ft), 21 kgs (46 lbs).

d. The performance characteristics of the butt-to-wall base are as follows:

   i. Hardness: ASTM D2240: 85 Shore A

   ii. Flexibility: will not crack, break, or show any signs of fatigue when bent around a 6.4 mm (1/4 in) diameter cylinder

   iii. Meets or exceeds the performance requirements for resistance to heat/light aging, chemicals, and dimensional stability when tested to the methods described in ASTM F-1861.

   iv. Fire Resistance:

      a) ASTM E84/NFPA 255 (Steiner Tunnel Test) Class B

      b) ASTM E648/NFPA 253 (Critical Radiant Heat Flux) Class 1

      c) No fire-resistance test for base

e. The manufacturer must provide a one (1) year warranty for the resilient base.

f. The resilient base will extend behind equipment located in the space.

9.3.4.5. Linoleum Flooring:

a. The specified linoleum must be Class I, not less than 0.45 watts per square centimeter for the Critical Radiant Flux Classification as determined by ASTM E648 or NFPA 253.

b. The floorcovering contractor will maintain ambient temperatures not less than 18°C (64°F) or more than 29°C (84°F) in spaces to receive resilient products during the 48 hours prior to installation, installation, and 48 hours after installation.

c. The floorcovering contractor will maintain the ambient relative humidity between 40 and 60 percent during installation.

d. The floorcovering contractor will prepare the substrate according to ASTM F710.

e. The specified linoleum must meet or exceed ASTM F2034 for linoleum sheet flooring, static load limit 3103 kPa (450 psi) per ASTM F970, ASTM E-682/NFPA 258 – 3103 kPa (450 psi) or less; ASTM E-648/NFPA 253, Class 1.

f. A currently certified manufacturer's associate or master mechanic who will provide proof of certification, as well as proof of demonstrated expertise in using all aspects of the product prior to the start of the job, must be used to install linoleum with appropriately installed heat-welded seams. Multi-colored heat welds will be used to hide the appearance of the seams.

g. The linoleum manufacturer will provide a manufacturer's warranty with a warranty period minimum of five (5) years.

h. Do not locate seams in high-traffic areas.

9.3.4.6. Epoxy Terrazzo Flooring:

a. The terrazzo contractor must be a current and active member of the National Terrazzo and Mosaic Association (NTMA).

b. The terrazzo contractor must have a minimum of seven (7) years of experience providing and installing epoxy terrazzo.

c. All thin-set epoxy terrazzo shall be 10 mm (3/8 in) thick.

d. Divider strips will be made of zinc and will be set no farther apart than 6096 mm (20 ft) on center.

e. The preparation of the floor will be vacuum blasted to meet CSP3-5 which is based on the International Concrete Repair Industry (ICRI) surface profile for bonded flooring materials.

f. The finish of the terrazzo will be 220-grit sealed with an acrylic sealer.

g. The epoxy terrazzo supplier must have a crack isolation membrane and barrier primer to meet requirements of slab detailing cracks and high vapor emission rates.

h. Match existing terrazzo where applicable.

i. The A/E will carefully consider the application for the use of terrazzo floor and will review locations for use with SI for approval.

9.3.4.7. Tile Carpeting:

a. Carpeting materials will have a minimum critical radiant flux of 0.45 watts/ cm2, when tested in accordance with ASTM E648.

b. For high-traffic areas, all carpet tile will be specified with solution-dyed fiber, nylon Type 6 or 6, 6.

c. The carpet tile will have 100 percent loop construction.

d. The loop construction of the carpet tile will be dense and have a low pile height, no greater than 12.7 mm (0.5 in), for use in high traffic areas.

e. The minimum face weight of the carpet tile will be 794 g/m2 (28 oz/yd2).

f. The specified carpet tile must be Green Label Plus. The adhesive must meet low emitting materials standards per the SCAQMD Rule #1168.

g. The carpet tile will have a TARR for severe traffic of 3.5 to 4.0.

h. The floor surface receiving the carpet tile will be free of defects and indentations. The substrate will not exceed the manufacturer's maximum moisture content requirements prior to placement of carpet tile.

i. The backing system for the carpet tile will be non-vinyl with a minimum 50 percent recycled content and will have a manufacturer's lifetime warranty against edge ravel, delamination, and dimensional stability against cupping/curling.

j. Provide five percent attic stock from the same lot as the original carpet tile.

    i. Attic stock quantity will be coordinated with individual museums and buildings. Consider available space for attic stock storage. Coordinate with the COTR.

k. Provide recyclable materials to meet current Leadership in Energy and Environmental Design (LEED) standards regardless of whether the project is pursuing LEED certification or not.

9.3.4.8. Broadloom Carpeting:

a. For high-traffic areas, all broadloom carpet will be specified with solution-dyed fiber.

b. The broadloom carpet will have 100 percent loop construction.

c. The loop construction of the broadloom carpet will be dense and have a low pile height, no greater than 12.7 mm (0.5 in), for use in high traffic areas.

d. The minimum face weight of the broadloom will be 907 g/sq m (32 oz/sq y).

e. The specified broadloom carpet must be Green Label Plus. The adhesive must meet low emitting materials standards per the SCAQMD Rule #1168.

f. The floor surface receiving the broadloom carpet will be free of defects and indentations.

g. The backing system for the broadloom carpet will be a unitary backing or equivalent and must have a 15-year warranty against edge ravel and delamination.

9.3.4.9. Access Flooring:

a. Access flooring may be used in changing gallery exhibition spaces. The potential problems of moisture and pests under the access floor will need to be addressed at each facility.

b. Access flooring must be accessible for cleaning.

c. Specify a clear concrete sealer on concrete floor under access flooring.

9.3.5. Wall Coverings:

9.3.5.1. Wall Coverings:

a. All wall coverings will be specified as minimum Type II, commercial grade.

b. Specify high performance, woven, direct- glue installed wall coverings with either a paper-backing or an acrylic-backing. The high performance, woven wallcovering that is most desirable can be cleaned with a solution of diluted household bleach. Wall coverings in spaces housing collections will not use paper backing.

c. The high performance, woven wallcovering must pass and/or comply with the following tests:

   i. NFPA 255

   ii. NFPA 265

   iii. ASTM E84 Adhered

   iv. Tensile Strength: Fed Spec. CCC-T-191b 5100

   v. Tear Strength: Fed. Spec. CCC-T-191 5132

9.3.5.2. Fabric-Wrapped Panels:

a. Panels are (fire) tested as assemblies; the requirement should be listed in the specification.

b. Consider protective coating in restaurant locations.

c. Fabric-wrapped panels are defined as a site-fabricated stretched fabric panel system with a continuous perimeter track profile mounted directly to a sheetrock substrate. The system will provide for face fabric to be perfectly tensioned over core materials, leaving fabric floating over the core surface.

d. The system will allow for the removal and replacement of fabric facing from individual panels. Removal of fabric will provide access to the surface behind the fabric without dismantling, removal, or replacement of track members or core.

e. The architect/designer will determine what acoustical properties are required for the system and select from the following core materials:

    i. Acoustical: Fiberglass rigid 12.7 mm (1/2 in) fiberglass - 96 kg/m3 (6 pcf) density or 25 mm (1 in) fiberglass - 96 kg/m3 (6 pcf) density

    ii. Acoustical/Tackable: HD fiberglass 25 mm (1 in) or 19 mm (3/4 in) - 96 kg/m3 (6 pcf) density with 6.3 mm (1/4 in) - 160 kg/m3 (10 pcf) density face

    iii. Tackable/High Impact: 12.7 mm (1/2 in) Micore by USG; 19 mm (3/4 in) Micore by USG; 12.7 mm (1/2 in) Armstrong Privacy Guard Max; or 19 mm (3/4 in) Armstrong Privacy Guard Max

f. The architect/designer must ensure that the selected fabric has been tested and approved for the intended use in a vertical application as a fabric-wrapped panel by the fabric manufacturer.

g. The installer will fabricate the fabric-wrapped panel system on the jobsite to conform precisely to existing conditions in areas indicated for their application. The space will be enclosed and weathertight.

h. The installer will apply framing materials to the sheetrock surfaces scheduled to receive the fabric-wrapped panel system. Framing will be plumb and straight, flush, and in proper alignment. Mounting channel details and core coloration will not be visible through the facing fabric.

i. Core materials will be installed in a continuous manner, flush and level with framing materials. Core materials shall not “telegraph” through the face fabric.

j. The installer will cut fabric from each roll maintaining a regular sequence of drops and matching weave direction for sequential and uniform installation.

k. Fabric will be tensioned securely to the track system using appropriate tools. Spray adhesives or stapling of fabric to core or frame members will not be permitted.

l. The installer will submit complete, unedited test reports for stretched fabric panel system prepared by an independent IAS-certified testing laboratory indicating full compliance with fire resistance performance requirements under ASTM E84, and specifically:

   i. Fire ratings will be for a complete assembly, including perimeter and longitudinal butt joint framing extrusions, core material, and fabric covering as required by ASTM E2573-07: *Specimen Preparation and Mounting of Site Fabricated Stretch Systems to Assess Surface Burning Characteristics*.

   ii. Systems must be certified under ASTM E84 and class must be compliant with placement in the building:

      a) Class A with a Flame Spread Index (0-25) Smoke Developed Index (0-450) – Required in exhibit spaces and means of egress

      b) Class B with a Flame Spread Index (26 - 75) Smoke Developed Index (0-450) – Required in exhibit spaces protected by automatic sprinkler system

      c) Class C with a Flame Spread Index (76 – 200) Smoke Developed Index (0-450)

m. Stretched fabric panel system installation will be warranted by the authorized distributor or certified installer for the period defined in contract documents.

9.3.6. Paintings and Coatings:

9.3.6.1. Painting:

a. The general contractor will only engage a painting contractor that has a minimum of five (5) years of proven satisfactory experience and will maintain a qualified crew of painters throughout the duration of the work.

b. The general contractor will ensure that only qualified journeypersons, as defined by local jurisdiction, be engaged in painting and decorating work.

c. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson in accordance with trade regulations.

d. The architect/designer will only select paint from manufacturers and products that are listed under the Approved Products List section of the MPI Painting Manual.

e. Use only materials complying with the OTC air quality regulations rating based on VOC (EPA Method 24) content levels. Where indoor air quality (odor) is an issue, use only MPI-listed materials having a minimum E3 rating.

f. The painting contractor will conform to workplace safety regulations and requirements of those Authorities Having Jurisdiction (AHJ) for storage, mixing, application, and disposal of all paint and related hazardous materials.

g. The painting contractor may apply paint only to dry, clean, properly cured, and adequately prepared surfaces in areas where dust is no longer generated by construction activities, such that airborne particles will not affect finished surface quality.

h. Ensure adequate continuous ventilation and sufficient heating and lighting are in place.

i. Paint, stain, and wood preservative finishes and related materials (e.g., thinners, solvents, caulking, empty paint cans, cleaning rags, etc.) will be regarded as hazardous products. Recycle and dispose of these materials according to regulations of applicable AHJ.

j. In order to meet LEED program requirements, the architect/designer will specify only MPI-listed materials having an L rating.

k. The condition and preparation requirements for all surfaces will be in accordance with MPI Painting Manual requirements:

   i. Unless specifically pre-approved by the specifying body, paint inspection agency, and the applied product manufacturer, perform no painting or decorating work when the ambient air and substrate temperatures are below 50° F (10° C) for both interior and exterior work.

   ii. Refer to MPI Painting Manual for additional requirements.

l. The painting contractor will not paint unless substrates are acceptable and/or until all environmental conditions (e.g., heating, ventilation, lighting, and completion of other sub-trade work) are acceptable for applications of products.

9.3.6.2. Staining and Transparent Finishing:

a. Finish must comply with SCAQMD rules for VOC levels to meet U.S. Green Building Council IEQc4.2 standards:

   i. Interior Stains: 250 g/L

ii. Sanding Sealers: 350 g/L

iii. Varnish: 350 g/L

b. All specified staining and transparent finishes will be water-based.

9.3.6.3. High-Performance Coatings:

a. The high-performance coating is defined as a pro-industrial, precatalyzed, water-based epoxy.

b. This coating is for interior use only.

c. It can be used on the following surfaces:

i. Drywall

ii. Plaster

iii. Masonry

iv. Block

v. Steel, Aluminum, Galvanized

vi. Wood

d. Adhesion: ASTM D3359, 5B, 100 percent adhesion for light colors; darker colors require longer cure time for the same level of adhesion.

e. Abrasion Resistance: ASTM D4060t, 74.4 mg loss; CS-10 wheels 1000-gram load: 1000 cycles

f. Direct Impact Resistance: ASTM D 2794, >100 inch – lbs

g. Pencil Hardness: ASTM D3363

h. Scrub Resistance: ASTM D2486, 500 – 600 cycles with stiff brush and pumice scrub media

i. Permeability Rating: AD/TS 2002.27A, dry cup 2.0 metric perms @ 1.3 – 1.5 mils DFT

j. Stain Resistance: ASTM D3023

k. Chemical Resistance: ASTM D1308.

l. The manufacturer's recommended application will be the minimum acceptable coating.

10. SPECIALTIES

10.1. Reference Codes, Standards, and Guidelines

10.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 10-specific requirements:

10.1.1.1. American Society for Testing and Materials (ASTM) E84: *Standard Test Method for Surface Burning Characteristics of Building Materials*

10.1.1.2. ASTM E90: *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*

10.1.1.3. ASTM E413: *Classification for Rating Sound Insulation*

10.1.1.4. ASTM E1300: *Standard Practice for Determining Load Resistance of Glass in Buildings*

10.1.1.5. ANSI/Business + Institutional Furniture Manufacturers Association (BIFMA) X5.6: *American National Standard for Office Furnishings – Panels Systems*

10.1.1.6. ANSI Z97.1: *American National Standard for Safety Glazing Materials Used in Buildings*

10.1.1.7. Scientific Certification Systems (SCS) Indoor Air Advantage

10.1.1.8. ASTM E72: *Standard Test Methods of Conducting Strength Tests of Panels for Building Construction*

10.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

10.2. Design Requirements

10.2.1. Signage:

10.2.1.1. Signage design will comply with the Smithsonian Guidelines for Accessible Design (SGAD).

10.2.1.2. All egress signage will comply with Office of Safety, Health, and Environmental Management (OSHEM) requirements outlined in Design Guideline Chapter 3- General Information, Section 3.3 Life Safety Requirements, in Volume 1. Also meet NFPA 101, and local fire codes. Refer to Division 26- Electrical in Volume 1 for additional lighting and exit sign requirements.

10.2.1.3. Design of exterior signage at all SI facilities (on and off the National Mall) will be coordinated with the signage design standards incorporated in the Smithsonian Mall Wide Signage Project, SF Project # 0069914. In addition, exterior signage design will be coordinated with standards incorporated in the Improve Mall Wide Perimeter Security SF Project # 0269910. The designer may obtain a copy of the relevant signage project information from the Contracting Officer's Technical Representative (COTR).

a. Exterior signage at the National Air and Space Museum (NASM) will conform to the requirements in Improve Mall Wide Perimeter Security NASM SF Project # 0269910A.

b. Exterior signage at the National Museum of Natural History (NMNH) shall conform to the requirements in Improve Mall Wide Perimeter Security NMNH SF Project # 0269910B.

c. Exterior signage at the National Museum of American History (NMAH) will conform to the requirements in Improve Mall Wide Perimeter Security NMAH SF Project # 0269910C.

d. For projects located off the National Mall, comply with site/building-specific requirements.

10.2.1.4. Comply with the May 2002 Concept Plan, which identified three (3) types of signs (building, information, and program) and their locations, when applicable. The signs specified in this plan are used beyond the National Mall, for example at the Reynolds Center. A copy of the 2002 plan may be obtained from the COTR.

10.2.1.5. Refer to as-built drawings for relocation or temporary removal of existing signage, for refinishing and maintenance, and for new fabrication.

10.2.1.6. Exterior signage must be legible and easy to clean, and it should coordinate with existing site and landscape features.

10.2.1.7. Exit signage will be per the building-specific standard.

10.2.2. Demountable partitions may be used in exhibition gallery spaces, office/administration areas, and retail/food-service spaces.

10.2.3. Mobile Storage:

10.2.3.1. Coordinate the design of mobile storage shelving with building systems.

a. Ensure there is adequate protection from the sprinkler system design. The shelving and automatic sprinkler design must always be considered together, as a change in shelving design will change the sprinkler system requirements. Coordinate requirements with OSHEM through the COTR and comply with any local jurisdiction code when determining the required sprinkler system.

b. Coordinate the mobile storage design with the floor slab design, including required floor loading, flatness, and inserts for recessed tracks.

c. Coordinate the mobile storage design with the ceiling height, lighting layout, and fire protection and mechanical distribution above the shelving.

10.2.3.2. The design of mobile shelving (compact storage) for collections and archives will be in accordance with the requirements of National Fire Protection Association (NFPA) 909.

10.2.3.3. All mobile storage shelving requires SI OSHEM review as soon as possible to evaluate the fire sprinkler density and design issues.

10.2.3.4. The design of mobile storage will comply with the SGAD.

10.2.3.5. The decision to use manual versus motorized controls for the mobile shelving will be based on project-specific requirements; however mechanical-assisted manual systems are generally preferred in all instances where mobile storage houses collections.

10.3. <u>Specifications</u>

10.3.1. Display Cases:

10.3.1.1. Coordinate any required additional structural framing inside the partition for the support of display cases and shelving in SI retail design.

10.3.1.2. Consider the following for retail case design: glare, security, conservation, etc.

10.3.1.3. Refer to Appendix J- Facilities Design Standards Smithsonian Enterprises Supplement in Volume 3 for SE requirements for retail specifications.

10.3.1.4. Quality Assurance:

a. Installer Qualifications: An authorized representative of the manufacturer for installation and maintenance of units required for the project.

b. Source Limitations: Obtain each type of product through one source from a single manufacturer.

c. Product Options: Drawings indicate size, profiles, and dimensional requirements of display cases and are based on the specific system indicated.

i. Do not modify intended aesthetic effects, as judged solely by the COTR, except with the COTR's approval. If modifications are proposed, submit comprehensive explanatory data to the COTR for review.

d. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction (AHJ) and marked for intended use.

10.3.2. Toilet Partitions:

10.3.2.1. Stainless Steel Toilet Compartments:

a. Toilet Compartments will be floor-mounted, overhead-braced construction.

b. All toilet compartments will be stainless steel.

c. Provide tamper-proof bolts.

d. Avoid the use of piano hinges for toilet partition doors.

e. Provide urinal dividers where feasible. Base the height of the divider on the specific application.

f. Doors, panels, and pilasters will be constructed of two sheets of panel flatness Type 304 #4 brushed stainless steel, laminated under pressure to a “Vertical” 12.5 mm (1/2 in) honeycomb core for impact resistance, rigidity, and sound deadening. The honeycomb is to be of virgin, long-fiber paper with a maximum 12.5 mm (1/2 in) cell size. In the highest traffic areas, the architect/designer may elect to use a reinforced Masonite core in lieu of the honeycomb. Formed edges are to be welded together and interlocked, under tension, with a roll-formed oval crown locking bar, mitered, welded, and ground smooth at the corners.

g. Doors will be 25 mm (1 in) thick with cover sheets not less than 0.8 mm (.030 in). The surface of the doors will be Type 304, #4 brushed satin finish stainless steel.

h. Panels will be 25 mm (1 in) thick with cover sheets not less than 0.8 mm (.030 in). The surface of the doors will be Type 304, #4 brushed satin finish stainless steel.

i. Pilasters will be 32 mm (1.25 in) thick with cover sheets not less than 0.9 mm (.036 in). The surface of the doors shall be Type 304, #4 brushed satin finish stainless steel.

j. Where needed, the panels will be reinforced with wood to accept the mounting of grab bars. The load-bearing quality is subject to the grab bar itself, the fasteners used, and the blocking in the wall that supports the panel.

k. The headrail will be 25 mm (1 in) by 41 mm (1.625 in) extruded anodized aluminum with anti-grip design. The wall thickness of the headrail will be 1.5 mm (.060 in) and will be securely attached to the wall and pilasters with the manufacturer's fittings in such a way as to make a strong and rigid installation. All the joints in the headrail will be made at a pilaster.

l. The pilasters will be securely and rigidly fastened to the floor and fitted with a jack-leveling screw for vertical adjustment. The floor fastening will be concealed and protected by a 102 mm (4 in) high, die-formed #4 brushed finish stainless steel pilaster shoe.

m. Full-height continuous stainless steel channels will be used for all panel-to-pilaster, panel-to-wall, and pilaster-to-wall connections. Slide latch and keeper will be cast stainless steel and allow for emergency access. Fasteners are to be #4 brush finished stainless steel 305 mm x 44 mm (12 in x 1-3/4 in) and 305 mm x 16 mm (12 in x 5/8 in) TR-27 6-lobe security screws. Doors will be equipped with a full-height continuous 16-gauge stainless steel hinge with a stainless steel hinge pin. Each door will be fitted with a combined coat hook and bumper of Zamak, finished to match hardware items. Pilaster shoes will be stainless steel with a #4 brushed finish.

n. Urinal screens will be 25 mm (1 in) thick with cover sheets not less than 22 gauge. Supporting pilasters will be 127 mm (5 in) wide and 32 mm (1.25 in) thick with cover sheets not less than 18 gauge.

10.3.2.2. Solid Plastic Toilet Compartments:

a. Toilet compartments will be floor-mounted, overhead-braced construction.

b. Partition materials will comply with the following requirements, when tested in accordance with ASTM E84:

   i. Smoke Developed Index: Not to exceed 450

   ii. Flame Spread Index: Not to exceed 75

   iii. Material Fire Ratings:

      a) NFPA 286: Class B

      b) International Code Council (ICC): Class B

c. The toilet compartment manufacturer must be a company regularly engaged in manufacture of this specific type of product and whose products have been in satisfactory use under similar service conditions for not less than five (5) years.

d. The toilet compartment installer must be a company or individual, regularly engaged in installation of this specific type of product with a minimum of five (5) years of experience.

e. The toilet compartment manufacturer must provide a warranty of its solid plastic against breakage, corrosion, and delamination under normal conditions for a minimum of ten (10) years from the date of receipt by the SI.

f. Doors, panels, and pilasters will be 25 mm (1 in) thick constructed from High Density Polyethylene (HDPE) resins. Partitions will be fabricated from polymer resins compounded under high pressure, forming a single component that is waterproof, nonabsorbent, and has a self-lubricating surface that resists marks from pens, pencils, markers, and other writing instruments. All plastic components will be covered with a protective plastic masking.

g. Doors, panels, and pilasters will be 25 mm (1 in) thick with all edges rounded to a radius.

h. Doors and dividing panels will be 1397 mm (55 in) high and mounted at 356 mm (14 in) above the finished floor. An aluminum edge trim may be fastened to the bottom edges.

i. Pilasters will be 2083 mm (82 in) high (standard) and fastened into a 76 mm (3 in) high pilaster shoe with a stainless steel tamper-resistant torx head sex bolt.

j. Hinges will be 203 mm (8 in) and fabricated from heavy-duty extruded aluminum (6463-T5 alloy) with bright-dip anodized finish with wrap-around flanges, through-bolted to doors and pilasters with stainless steel, torx head sex bolts. Hinges operate with field-adjustable nylon cams. Cams can be field -et in 30-degree increments. A third hinge will be added to all accessible doors over 762 mm (30 in) wide.

k. Door strikes/keepers will be 152 mm (6 in) long and made of heavy-duty extruded aluminum (6436-T5 alloy) with a bright-dip anodized finish and secured to the pilasters with stainless steel, torx head sex bolts. The bumper will be made of extruded, black vinyl.

l. The latch and housing will be made of heavy-duty extruded aluminum (6463-T5 alloy). The latch housing will have a bright-dip anodized finish, and the slide bolt and button will have a black anodized finish.

m. Each door will be supplied with one coat hook/bumper and door pull made of chrome-plated Zamak. Accessible doors will be supplied with a second door pull and out-swing doors with one door stop made of chrome-plated Zamak.

n. Pilaster shoes will be 76 mm (3 in) high (type 304, 20 gauge) stainless steel. Pilaster shoes will be secured to the pilaster with a stainless steel tamper-resistant torx head sex bolt.

o. Wall brackets will be 1372 mm (54 in) long and made of heavy-duty extruded aluminum (6463-T5 alloy) with a bright-dip anodized finish. The aluminum brackets will be fastened to the pilaster with stainless steel tamper-resistant torx head sex bolts.

p. The headrail will be made of heavy-duty extruded aluminum (6463-T5 alloy) with anti-grip design and integrated curtain track. The headrail will have a clear anodized finish and will be fastened at the top of the pilaster with stainless steel tamper-resistant torx head screws.

q. Headrail brackets will be 20-gauge stainless steel with a satin finish and secured to the wall with stainless steel tamper-resistant torx head screws.

10.3.3. Demountable Partitions:

10.3.3.1. Specified demountable partitions will be a non-progressive, moveable, and reconfigurable system of unitized panels from a single manufacturer.

10.3.3.2. Structural analysis is required for the design of any demountable partition system.

10.3.3.3. The demountable partition’s solid panels, when tested in accordance with ASTM E90, will achieve the following acoustic performance ratings in accordance with ASTM E413, without site alteration:

a. Steel faced panels: Minimum STC 44

b. Gypsum board panels: Minimum STC 42

c. Wood composite panels: Minimum STC 42

10.3.3.4. Provide butt hinged doors where acoustic performance of the wall system is paramount.

10.3.3.5. The surface burning performance of the painted steel panels is to be as follows: maximum flame spread of 25 when tested in accordance with ASTM E84.

10.3.3.6. The surface burning performance of the wall covering faced panels is to be as follows: maximum flame spread of 25 when tested in accordance with ASTM E84.

10.3.3.7. The design and size of the demountable partitions and components must withstand dead and live loads as calculated in accordance with the International Building Code (IBC).

10.3.3.8. The design and size of the demountable partitions and components must withstand seismic loads as calculated in accordance with the IBC.

10.3.3.9. The load-bearing capacity of the demountable Partitions will be tested to not less than the requirements for panel systems as defined by ANSI/BIFMA X5.6, latest edition. Specifically, a load of 136 kg (300 lbs) on either side of each panel at both overhead and desktop elevations with a CG of no greater than 203 mm (8 in) from the panel face.

10.3.3.10. Panels or panel framing members of the demountable partitions will exhibit lateral deflection not greater than 1/240 of span when subjected to a uniformly distributed load of 0.24 kPa (5 psf).

10.3.3.11. At a minimum, glass thickness will conform to the requirements of ASTM E1300.

10.3.3.12. Glass framing members will be sized to limit glass edge deflection not greater than 1/175 or 19 mm (3/4 in), whichever is less, when subjected to a uniformly distributed load of 0.24 kPa (5 psf).

10.3.3.13. Glazing materials will comply with the requirements of 16 CFR Part 1201 and/or ANSI Z97.1, and will bear markings as required by Chapter 24 of the IBC.

10.3.3.14. Assembled panels will be UL Classified to comply with NFPA 70: *National Electric Code*.

10.3.3.15. Modular Wiring System Components will be UL Listed to comply with NFPA 70 and Article 604: *Manufactured Wiring Systems*.

10.3.3.16. The indoor air quality performance of the demountable partitions will be as follows: Product will be Indoor Air Advantage Gold certified by SCS for conformance to the requirements of California 01350 Specification (Ca-DHS-EHLB-R-174 addendum 2004-1) and the Collaborative of High Performance Schools.

10.3.3.17. The combustibility performance of the demountable partitions will be as follows: Product will have finishes and construction acceptable for use in non-combustible buildings, in accordance with Chapters 6 and 8 of the IBC.

10.3.3.18. The demountable partition system will be rectilinear in design and expression with crisp corners and well-defined horizontal and vertical elements.

10.3.3.19. The system will be a minimum of 102 mm (4 in) thick, and designed and sized in horizontal and vertical modules to accommodate the partition layout indicated.

a. Panel heights will be available in 1.6 mm (1/16 in) increments from a minimum of 203 mm (8 in) to a maximum of 3658 mm (144 in) as required. Actual floor-to-ceiling heights will be verified in the field.

b. Solid panel widths will be available in 1.6 mm (1/16 in) increments from a minimum of 203 mm (8 in) to a maximum of 1219 mm (48 in) for solid panels and 1524 mm (60 in) for glass panels.

10.3.3.20. Gypsum board, glass, and steel panels will be constructed of materials acceptable for use in non-combustible construction. Painted metal and wallcovering finishes will exhibit Class 1 or Class A surface burning performance (with Class A, smoke is covered).

10.3.3.21. The system will be non-progressive, allowing for removal and re-installation of panels, including door frames, at any position, without disturbing adjacent panels.

10.3.3.22. Solid panels will have monolithic or horizontally segmented panel faces on each side. Panel faces will be removable and reusable, attached to the panel frame without the use of screws or other mechanical fasteners.

10.3.3.23. Each unitized panel will be able to be removed, relocated, and re-installed in different layouts, with all parts reusable. Scribing and fitting of panels on site to individual locations is not acceptable.

10.3.3.24. The panel-floor interface will have a reveal, recessed 19 mm (3/4 in) from the face of the panel on both sides and adjustable in height from 32 mm (1-1/4 in) to 64 mm (2-1/2 in). Surface-mounted base trim is not permitted.

10.3.3.25. The panel-ceiling interface will have a reveal, recessed 19 mm (3/4 in) from the face of the panel on both sides and adjustable in height from 16 mm (5/8 in) to 35 mm (1-3/8 in). Surface-mounted top trim is not permitted.

10.3.3.26. The system will provide a vertical adjustment of not less than 50 mm (2 in) in overall height to accommodate floor and ceiling irregularities.

10.3.3.27. The system will include a freestanding option that does not require a connection or attachment to the ceiling.

10.3.3.28. The system must be erected and removed in a manner to prevent damage to adjacent building surfaces and elements, including floors, walls, ceilings, columns, and window mullions. All system connectors to fixed-in-place building components will be non-marking, removable, and reusable.

10.3.3.29. The system will be capable of extending in multiple directions using two-way, three-way, four-way, and variable-angle corner posts.

10.3.3.30. Doors will be single, double, sliding, or butt-hinged doors utilizing adjustable metal frames. All door panels will utilize standard panel connection methods and be reversible in the field without additional modifications or materials.

10.3.3.31. Provide cut-able panels to address irregularities in the interface between the panel system and fixed-in-place construction (e.g., sills, columns, bulkheads).

10.3.3.32. Solid panels will be capable of providing integrated, factory-installed modular power and voice/data distribution utilizing plug-and-play technology for ease of panel reconfiguration.

10.3.3.33. The system will include an integrated, factory-installed modular power option. Power distribution will be consistent and compatible with the power system used in the furniture system and below a raised-access floor.

10.3.3.34. Components will be free of distortion and uniform in dimension, construction, and appearance.

10.3.3.35. Total recycled content will be greater than 10 percent, combining both post-consumer and pre-consumer recycled content.

10.3.3.36. Steel, aluminum, and glass components will be 100 percent recyclable.

10.3.3.37. Packing materials, including polyethylene film, corrugated cardboard, and wood, will be readily recyclable.

10.3.3.38. Product will be free of hexavalent chrome, chlorofluorocarbons (CFCs), Polybrominated Diphenyl Ethers (PBDEs), Persistent Organic Pollutants (POPs), and heavy metals.

10.3.3.39. Fiberglass insulation materials will be formaldehyde-free and have a minimum 53 percent recycled content.

10.3.3.40. Product will be SCS IndoorAdvantage™ Gold certified as a low emitting product.

10.3.3.41. No Ozone-Depleting Substance (ODS) will be used in the manufacturing process.

10.3.3.42. The warranty period will be ten (10) years from date of substantial completion.

10.3.4. Operable Panel Partitions:

10.3.4.1. Operable panel partitions will be unitized, movable, non-progressive steel partitions.

10.3.4.2. Consider sound control requirements and performance when utilizing operable panel partitions.

10.3.4.3. Structural analysis is required for the design of any operable panel partition.

10.3.4.4. All panels will be readily removable and easily opened and closed by one individual.

10.3.4.5. Flush panels will be designed for maximum sound control and will provide a minimum Sound Transmission Class (STC) rating of 40 when tested in accordance with ASTM E90 by an approved testing laboratory.

10.3.4.6. All panels will be Class A noncombustible rated. Wall panel flame spread rating will be 25 or less and smoke developed rating will be 100 or less as per ASTM E84.

10.3.4.7. Partitions will be laboratory tested according to ASTM E72 to prove that deflection will not exceed L/120 with a 24 kg/m2 (5 lb/sq ft) uniform load applied over the surface of the panel.

10.3.4.8. Specify steel suspension track, designed for the type of operation, size, and weight of operable panel partitions. Coordinate suspension of track with required overhead structural support.

10.3.4.9. All electrical components of an electrically operated panel partition system will comply with NFPA 70, be listed and labeled by UL or other qualified testing agency, be marked for intended use, and be tested as a system.

10.3.4.10. Performance Requirements:

a. Delegated Design: Design operable panel partitions, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

b. Seismic Performance: Operable panel partitions will withstand the effects of earthquake motions as determined by seismic requirements.

    i. The term "withstand" means "the panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."

c. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

    i. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E90, determined by ASTM E413, and rated for not less than the STC indicated.

ii. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C423, and rated for not less than the Noise Reduction Coefficient (NRC) indicated.

iii. Acoustical Performance Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E413, NIC 43.

10.3.4.11. Quality Assurance:

a. Installer Qualifications: An employer of workers trained and approved by manufacturer:

i. A single firm will have undivided responsibility for design, fabrication, and erection. The firm must be capable of showing successful experience in operable wall construction of the scope, size, and type as specified herein for not less than five (5) years.

b. The testing agency will be qualified based on industry standards.

c. The manufacturer will submit results of Noise Isolation Class (NIC) tests conducted by an independent testing agency of the installation, in accordance with ASTM E336 84, indicating an NIC 43 rating or greater for single partitions. Laboratory test data is not acceptable.

10.3.5. Wall and Door Protection:

10.3.5.1. Provide wall and corner guards in service corridors and other areas where service carts and other similar equipment will typically be used.

10.3.5.2. Wall guards will be designed to protect door frames wherever possible by returning the ends into the frame.

10.3.5.3. Provide stainless steel wall protection behind all cooking equipment in food service spaces. Coordinate height requirements on a project-by-project basis.

10.3.5.4. Fiber Reinforced Plastic (FRP) wall protection is acceptable for small installations but requires SI approval.

10.3.5.5. All corner guards will be stainless steel.

10.3.5.6. Provide wall protection in back-of-house and high-use spaces.

10.3.5.7. Stainless steel wall protection will be a minimum of 42 in atop finish floor.

10.3.6. Toilet Accessories:

10.3.6.1. Consider distance of electric hand dryers from adjacent acoustically sensitive spaces.

10.3.6.2. Accessories will be the products of a single manufacturer. Accessories with tumbler locks will be keyed alike with the exception of coin boxes in vending equipment.

10.3.6.3. Toilet room accessories will be specified by the A/E to the greatest extent possible. When not feasible, the A/E will coordinate with vendor-provided toilet accessories.

10.3.6.4. State minimum height for coat hook on door.

10.3.6.5. Operation of accessories will comply with guidelines set forth by the American with Disabilities Act, Title III. Documentation and samples will be provided to the architect upon request.

10.3.6.6. The contractor will furnish a one (1) year guarantee against defects in material and workmanship on all accessories. In addition to the above, the following shall apply:

a. Hand and hair dryers will have a ten-year limited warranty.

b. Welded stainless steel framed mirrors will have a 15-year guarantee against silver spoilage.

10.3.6.7. All cabinets will be constructed of 18-8, type-304 stainless steel.

10.3.6.8. All waste receptacles will be constructed of 18-8, type-304 stainless steel or rigid molded leak-proof plastic.

10.3.6.9. All tumbler locks will be fastened to accessories with lock nuts. Fastening locks to units with spring clips is not acceptable.

10.3.6.10. The contractor will install items with non-corrosive anchoring devices.

10.3.6.11. Installation methods will conform to manufacturer recommendations for backing and proper support.

10.3.6.12. All hands-free fixtures will be specified hard-wired, not battery operated.

10.3.6.13. Do not use hands-free soap dispensers as they do not function well consistently.

10.3.7. Fire Extinguisher Cabinets:

10.3.7.1. Fire Extinguishers, Cabinets, and Accessories:

a. The Smithsonian Specification Section 104400 *Fire Extinguisher Cabinets* is included in Volume 2.

b. Fire extinguisher cabinet guidelines in this section are to be reviewed with standards specific to the facility where the work is located. All final selections require OSHEM approval.

c. Specify fully recessed or semi-recessed fire extinguisher cabinets in public areas of SI buildings.

d. Back of house spaces will have surface-mounted accessories for greater accessibility.

e. SI prefers recessed fire extinguisher cabinets with magnetic holds.

f. There will be no locks on fire extinguisher cabinets.

g. Fire extinguisher cabinets are required in all Information Technology (IT) rooms.

h. Coordinate cabinet finishes on a project-by-project basis understanding that finish requirements may differ in various parts of the same building.

10.3.7.2. Portable Fire Extinguishers:

a. Portable fire extinguishers are to be provided in SI facilities based on occupancy, length of travel between extinguishers, and hazard as required per NFPA 10: *Standard for Portable Fire Extinguishers*, and this section.

b. Clean agent or water-mist extinguishers rated for Class A:C fires are to be provided in any area with collections (i.e., all exhibit areas, collection storages rooms, conservations labs, etc.) unless waived by OSHEM. Areas with wet collections will be provided with fire extinguishers appropriate for alcohol-based flammable liquid fires.

<u>COMMENTARY:</u> Clean agent or water mist extinguishing agents do not leave a residue like other extinguishing agents such as dry chemical. A residue film on collections could damage artifacts.

c. Kitchens using deep fat fryers or other appliances utilizing combustible liquids will have the appropriate size Class K fire extinguishers located within 9.1 m (30 ft) of such appliances.

d. Additional requirements on the type and sizes of fire extinguishers for special areas are identified in SDS Design Guidelines Chapter 9- Space Requirements, Section 9.28, in Volume 1. OSHEM will be consulted through the COTR as to the appropriate type of extinguishers for the occupancy.

10.3.8. Mobile Storage Shelving:

10.3.8.1. The contractor will submit the qualifications for the mobile storage shelving system manufacturer and installer.

a. The manufacturer must have a minimum of 25 years of experience in the continuous manufacture of mobile systems. Manufacturer certification is required.

b. The manufacturer must be ISO 9001 certified for a minimum of three (3) years. Certification from ISO is required.

c. The installer must have a minimum of ten (10) years of experience installing systems similar to those required for the specific project and must be certified by the manufacturer.

10.3.8.2. All major storage shelving system components, finishes, and lubricants must be chemically tested for emissions and volatiles. The system will be inert. The results of the tests performed by an independent test lab must be submitted.

10.3.8.3. The contractor will take field measurements before fabrication and indicate dimensions on shop drawings. The contractor will be responsible for the accurate fit of the storage shelving system.

10.3.8.4. The contractor will monitor the condition and levelness of the flooring and coordinate preparatory work performed by other subcontractors that may impact installation of the storage shelving system.

10.3.8.5. The contractor will sequence storage shelving system installation with other work to minimize possibility of damage and soiling during the remainder of the construction period.

10.3.8.6. The contractor will submit a written warranty, executed by the contractor, installer, and manufacturer, agreeing to repair or replace units that fail in materials or workmanship within the specified warranty period.

a. The entire installation will be warranted against defects in material and workmanship for a period of five (5) years from date of acceptance by the SI.

b. All structural beam elements of mobile and shelving systems must carry a lifetime warranty.

10.3.8.7. The manufacturer must provide a prototype storage unit complete with all components for SI review and approval. If applicable in specific projects, the manufacturer must certify that components are compatible and interchangeable with the existing SI storage system.

10.3.8.8. The contractor will submit shop drawings indicating construction details, material, description, dimensions, profiles, and installation of each type of storage equipment. Include details of layout and installation including clearances, spacing, and relation to adjacent construction in plan, elevation, and section; clear exit and access aisle widths; access to concealed components; components, assemblies, connections, attachments, reinforcement, and anchorage. Submit drawings showing location, ranges, and extent of system. Show installation details at nonstandard conditions. Furnish floor layouts and technical and installation manuals for every unit shipment with necessary dimensions for rail layout and system configuration at the project site.

a. Provide layout, dimensions, and identification of each unit corresponding to sequence of installation and erection procedures. Specifically include the following:

i. Location, position, and configuration of cases on all floors.

ii. Details indicating method and configuration of installation on each floor.

b. Provide location and details of anchorage devices to be embedded in or fastened together during construction. Furnish templates if required for accurate placement.

10.3.8.9. The manufacturer will retain an independent licensed structural engineer to certify mobile storage units and all shelving are structurally compliant. The engineer will provide full structural calculations for overturning, system structure, and anchorage based on specified rated load and local seismic zones. Calculations will be submitted with the shop drawings.

10.3.8.10. The storage system carriages, rack/tracks, and associated components will comply with the following requirements:

a. Where there are stringent temperature and humidity requirements, the carriages and associated parts must maintain peak performance under the stated conditions in the rooms indicated. The temperature and humidity specifications are 13°C (55°F) with 30 percent Relative Humidity (RH) and -20°C (-4°F).

b. Other performance considerations include floor loading, deflection tolerances, and specialty environmental conditions.

c. Carriages will be minimum 454 kg (1,000 lbs) per linear carriage meter capacity, fixture unit welded (preferred), uniframe assemblies constructed of minimum 12-gauge steel with main supporting structural face section 146 mm (5-3/4 in) high with two reinforcing flanges running the full length of the carriage. Main supporting structural face sections will provide a 19 mm (3/4 in) minimum shelf mounting recess for positive shelving alignment and attachment. Wheel support section will be minimum 12-gauge steel and will be welded between the main support face sections, one per rail assembly. Carriage face sections will provide a smooth, clean appearance without any exposed assembly holes or protruding hardware. Carriage will be powder coat painted from the manufacturer's standard colors. Stationary platforms as shown on the drawing will be of the same construction and height as the moveable carriages and will be anchored to the rails and floor. Top mount carriages and/or riveted only carriages are unacceptable.

d. Bumper location will be determined by the manufacturer. Bumper design and profile will be rounded to minimize abrupt protrusion into the aisle. Bumper must leave a minimum 102 mm (4 in) space between units unless otherwise required by the fire protection design.

e. All carriage splices will be tongue and groove, offset angle, tension bolted type, and designed to maintain proper unit alignment and weight load distribution.

f. Unless otherwise required by the fire protection design, carriages will have solid metal canopy tops, solid metal longitudinal dividers that span the length and height of the shelving, solid metal transverse dividers that span the width and height of the shelving located every 1219 mm (4 ft) along the length, and solid metal endcaps.

10.3.9. Flagpoles:

10.3.9.1. Automatic Flagpoles:

a. Use maintenance-free finishes.

b. Cleats: external, lockable box covers

c. Provide lighting at flagpole if required. This will be reviewed on a case-by-case basis.

10.3.9.2. Ground-Set Flagpoles:

a. Use maintenance-free finishes.

10.3.9.3. Wall-Mounted Flagpoles:

a. Use maintenance-free finishes.

11. DIVISION 11 – EQUIPMENT

11.1. Reference Codes, Standards, and Guidelines

11.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 11-specific requirements:

11.1.1.1. NSF/ANSI Standards for Food Service Equipment and Commercial Cooking

11.1.1.2. National Fire Protection Association (NFPA) 45: *Standard on Fire Protection for Laboratories Using Chemicals*

11.1.1.3. ANSI Z358: *American National Standard for Emergency Eyewash and Shower Equipment*

11.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

11.2. Design Requirements

11.2.1. Loading Dock:

11.2.1.1. Provide both a coiling overhead door and a personnel door at the loading dock.

11.2.1.2. Planning considerations:

a. Environmental conditions such as odors, plumbing, and electrical requirements

b. Separation of collections and building operations

11.2.1.3. Provide wall and corner protection and guardrails; space planning is required.

11.2.2. Food Service:

11.2.2.1. The design of food service areas will comply with the Smithsonian Guidelines for Accessible Design (SGAD), such as the allowable counter height in food service lines.

11.2.2.2. All countertop surfaces will be 14-gauge stainless steel.

11.2.2.3. Backsplashes at countertops will be integral and therefore 14-gauge stainless steel. Provide a full-height backsplash in any food preparation area.

11.2.2.4. Stainless steel shelves will be 16 gauge.

11.2.2.5. Stainless steel cabinets will be 18 gauge.

11.2.2.6. Stainless steel sinks will be 14 gauge.

11.2.2.7. Stainless steel Type 304 will be used. This type is the most stain resistant for food surfaces.

11.2.2.8. Ceilings will consist of a non-corrosive ceiling grid with vinyl-faced, washable, lay-in tiles.

11.2.2.9. Lights will be recessed, fluorescent fixtures with shatter-proof shields/lenses.

11.2.2.10. Walls will have a minimum of Fiber-Reinforced Plastic (FRP)/ fiberglass finish and, in public view, will be covered with ceramic tile.

11.2.2.11. Quarry tile floor will consist of 152 mm (6 in) x 152 mm (6 in) quarry tile with 15 percent carbide abrasive (for slip resistance) and dark color epoxy grout. Provide integral coved base and corners. For new construction, slope floors at 3 mm (1/8 in) per 304 mm (12 in) in a 1219 mm (4 ft) radius toward the drain.

a. Quarry tile will be utilized at kitchen floors. Deviation from this standard requires review and approval from Smithsonian Enterprises (SE).

b. Quarry tile will have the following properties:

i. Water Absorption: ISO 10545-3: <.1 percent

ii. Thickness: 9.5 mm (3/8 in)

iii. Recommended Grout Line: 3.17 mm (1/8 in)

iv. Breaking Strength: ISO 10545-4: >1700

v. Scratch Hardness: ISO 10545-6: <150

vi. Thermal Shock Resistance: ISO 10545-9: Resistant

vii. Frost Resistance: ISO 10545-12: Resistant

viii. Chemical Resistance: ISO 10545-13: UA ULA UHA

ix. Stain Resistance: ISO 10545-14: 4

x. Coefficient of Friction: DIN 51130: R10 (matte), R11 (bush-hammered)

11.2.2.12. Use seamless flooring in wet areas.

11.2.2.13. Specify high-density plastic for trash receptacles in public areas of cafeterias.

11.2.2.14. Cooking Equipment Suppression Systems:

a. All commercial grease hood, ducts, and kitchen suppression systems will meet the most restrictive requirements of the current editions of NFPA 96: *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, NFPA 17A: *Standard for Wet Chemical Extinguishing Systems* (as appropriate), and the International Mechanical Code.

b. Grease ducts will be protected by approved products, designed with clearance reduction methods, and installed as fire-rated enclosures.

11.2.3. Library Stacks:

11.2.3.1. Coordinate the design of library stacks with building systems.

a. Ensure there is adequate protection from the sprinkler system design. Comply with the Office of Safety, Health, and Environmental Management (OSHEM) Fire Protection and Life Safety Design requirements outlined in Technical Section 21- Fire Suppression in Volume 1 and comply with any local jurisdiction code when determining the required sprinkler system.

b. Coordinate the library stack design with the ceiling height, lighting layout, and mechanical distribution above the shelving.

11.2.3.2. The design of library stacks will comply with the SGAD, such as the requirement for turning radius.

11.2.3.3. The design of library stacks will be coordinated and compatible with floor loading restrictions.

11.2.3.4. The A/E will verify and coordinate all required seismic protective measures.

11.2.4. Audio Visual:

11.2.4.1. Provide a smoke detector on the interior and a power cut-off switch on the exterior of any audio-visual room to meet OSHEM requirements.

11.2.5. Laboratory:

11.2.5.1. The design of laboratories will be in accordance with the requirements of the International Building Code (IBC), NFPA 45, and the SI guidelines contained herein.

11.2.5.2. Planning guidelines for lab spaces:

a. OSHEM guidelines for radiation/laser use

b. Include considerations for utility coordination and connections.

11.2.5.3. The design of laboratories will comply with the SGAD.

11.2.5.4. Provide solid heat seam-welded or seamless flooring with integral base in laboratories.

11.2.5.5. Coordinate safety features, such as eyewash/shower stations, with Appendix O- Laboratory Design Standards in Volume 3. Also refer to ANSI Z358, latest edition.

11.2.5.6. The designer will obtain a copy of the OSHEM design guidelines for radiation/laser facilities, Additional Requirements for Radioactive Material Laboratories, from the Smithsonian Facilities (SF) design manager.

11.2.5.7. Reference Appendix O- Laboratory Design Standards in Volume 3 for more detailed laboratory design requirements.

11.2.5.8. Refer to Division 22- Plumbing in Volume 1 for additional laboratory system requirements.

11.2.6. Collections Storage:

11.2.6.1. Refer to SDS Design Guidelines Chapter 9- Space Requirements, Section 9.8, in Volume 1 for OSHEM for all applicable requirements for collections storage rooms, such as the required fire separation between the storage room and other areas of the building.

11.2.6.2. Refer to SDS Design Guidelines Chapter 9- Space Requirements, Section 9.8, in Volume 1 for the maximum allowable size of a collections storage space.

11.2.6.3. The design of collections storage will comply with the SGAD.

11.2.6.4. The design of collections storage areas and facilities will be in accordance with these SDS and the SI Collections Space Security Standards, a copy of which may be obtained from the COTR.

11.2.6.5. Coordinate collection-specific and/or custom requirements with the Contracting Officer's Technical Representative (COTR).

11.2.6.6. Consider loading requirements for storage components and structural capacity of the building/space.

11.2.6.7. Ensure considerations for rolling units and required fire protection coverage and structural support.

11.3. Specifications

11.3.1. Loading Dock Equipment:

11.3.1.1. At least one loading berth must be equipped with a powered dock leveler.

11.3.1.2. Provide protective metal dock plates at the edge of the loading dock.

11.3.1.3. Commercial grade dock bumpers will be mounted under the load leveler.

11.3.1.4. Provide dock seals at each loading dock platform to conserve energy.

11.3.1.5. Provide a minimum of two trash compactors at the loading dock for compaction of recycled cardboard and for general trash.

11.3.2. Food Service Equipment:

11.3.2.1. Provide equipment that bears the NSF mark certifying compliance with applicable NSF standards and is DOE 2017-compliant.

11.3.2.2. Provide equipment and components that are certified for UL, C-UL, and UL Sanitation compliance and labeled for intended use.

11.3.2.3. All food service equipment will be commercial grade and will comply with all federal, state, and local code regulations.

11.3.2.4. Specify refrigeration equipment with remote compressors to avoid unnecessary heat load in kitchen and public spaces.

11.3.3. Library, Audio-Visual, and Laboratory Equipment:

11.3.3.1. Library Stack Systems:

a. Refer to Design Guidelines Chapter 9- Space Requirements, Section 9.7, in Volume 1 for applicable requirements as well as the required clearance of stacks below sprinkler heads.

11.3.3.2. Coordinate fume hood design requirements, including ventilation, with Appendix O- Laboratory Design Standards in Volume 3.

11.3.4. Collections Storage Equipment:

The SI Collections Space Plan, a study currently in progress, will develop design standards for collections storage equipment to be used at SI facilities. A copy of this plan can be provided by the COTR.

12. DIVISION 12 – FURNISHINGS

12.1. Reference Codes, Standards, and Guidelines

12.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 12-specific requirements:

12.1.1.1. National Fire Protection Association (NFPA) 701: *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*

12.1.1.2. California Technical Bulletin 133: *Flammability Test Procedure for Seating Furniture for Use in Public Occupancies*

12.1.1.3. California Technical Bulletin 117: *Requirements, Test Procedure, and Apparatus for Testing the Flame Retardance of Resilient Filling Materials Used in Upholstered Furniture*

12.1.1.4. American Society for Testing and Materials (ASTM) C1028: *Static Coefficient of Friction*

12.1.1.5. ASTM B117: *Product Corrosion to Salt*

12.1.1.6. ANSI/Business + Institutional Furniture Manufacturers Association (BIFMA) X5.4: *American National Standard for Office Furnishings – Lounge Seating*

12.1.1.7. ASTM D635: *Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position*

12.1.1.8. National Electrical Manufacturers Association (NEMA) Standard for High-Pressure Decorative Laminates

12.1.1.9. ASTM G21: *Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi*

12.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

12.2. Design Requirements

12.2.1. Window Treatments:

12.2.1.1. All fabrics or other materials used in curtains, draperies, or other window treatments must be certified as flame resistant in accordance with the criteria contained in NFPA 701.

12.2.1.2. Coordinate window treatments (i.e., supports, clearances, pocket details) with surrounding construction.

12.2.1.3. Quality Assurance:

a. Installer Qualifications: Installer will be trained and certified by the manufacturer with a minimum of ten (10) years of experience installing products comparable to those specified in this section.

b. Source Limitations: Obtain roller shades through one source from a single manufacturer with a minimum of 20 years of experience manufacturing products comparable to those specified in this section.

c. Electrical Components, Devices, and Accessories: Will be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction (AHJ) and marked for intended use.

d. Anti-Microbial Characteristics: Will be ‘No Growth’ per ASTM G21 results for fungi ATCC9642, ATCC9644, and ATCC9645.

e. Product Standard: Provide roller shades complying with the Window Covering Manufacturers Association (WCMA) A100.1.
f. Mockups: Build mockups to verify selections made by sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

12.2.2. Casework:

12.2.2.1. The design of casework will comply with the Smithsonian Guidelines for Accessible Design (SGAD), such as the clear floor area and the height for built-in work surfaces.

12.2.2.2. Casework will comply with the requirements outlined in Design Guidelines Chapter 10- Building Requirements, Section 10.4, in Volume 1.

12.2.2.3. System Structural Performance Requirements:

a. Casework and the support framing system will withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:

i. Support Framing System: 900 kg/m (600 lb/ft)

ii. Wall Cabinets (Upper Cabinets): 240 kg/m (160 lb/ft)

iii. Shelves: 200 kg/sq m (40 lb/sq ft)

12.2.2.4. Quality Assurance:

a. Manufacturer Qualifications: A qualified manufacturer will produce casework of types indicated for the project that has been tested for compliance with Scientific Equipment and Furniture Association (SEFA) 8.

b. Source Limitations: Obtain casework from a single source from a single manufacturer unless otherwise indicated.

i. Obtain accessories and service fittings from the casework manufacturer.

c. Product Designations: Drawings will indicate sizes and configurations of casework.

d. Casework Product Standard: Will comply with SEFA 8: *Furniture – Casework, Shelving and Tables – Recommended Practices*.

e. Electrical Components, Devices, and Accessories: Will be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

f. Keying Conference: Conduct conference at the project site. Incorporate keying conference decisions into final keying requirements. Coordinate with provisions of Division 08, Door Hardware.

12.2.3. Entrance Floor Mats and Grilles:

12.2.3.1. The design of entrance floor mats and grilles will comply with the SGAD.

12.2.3.2. Coordinate the size and location of the required depression in the concrete floor slab with the installation of any recessed floor mat or grille.

12.2.3.3. Provide walk-off mats at all public and staff entrances to capture dust from outside.

12.2.3.4. The entrance floor mat/grille frame will be anchored securely to the subfloor.

12.2.3.5. Provide access under the floor mat/grille for cleaning and maintenance.

12.2.4. Fixed Seating:

12.2.4.1. Design of fixed auditorium seating will comply with the requirements for new assembly occupancies identified in NFPA 101: *Life Safety Code*.

12.2.4.2. The design of accessible spaces within fixed seating areas shall comply with the SGAD.

12.2.4.3. Theater and bench seating materials will comply with California Technical Bulletins 133 and 117.

12.2.5. Site Furnishings:

12.2.5.1. Projects on the National Mall (Mall) must comply with the Mall Streetscape Manual, National Park Service (NPS) Streetscape Manual – Interagency Initiative for National Mall Road Improvement Program, and the upcoming Monumental Core Streetscape Guidelines, which will supersede the Mall Streetscape Manual when released.

12.2.5.2. Projects at the National Zoological Park (NZP) will follow NZP existing standards or typical details.

a. This includes, but is not limited to, site benches, Olmsted Walk railing, Olmsted pavers, Olmsted Walk light posts, and other existing exhibit details.

12.3. Specifications

12.3.1. Window Treatments:

12.3.1.1. Roller Window Shades:

a. Roller window shades will comply with the following standards:

i. ASTM G21: *Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi*

ii. NFPA 70: *National Electrical Code*

iii. NFPA 701: *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*

b. Obtain roller shades through one source from a single manufacturer with a minimum of 20 years of experience manufacturing products comparable to those specified in this section.

c. Installer will be trained and certified by the manufacturer with a minimum of ten (10) years of experience installing products comparable to those specified in this section.

d. Fire-Test-Response Characteristics: Will pass NFPA 701 for small and large-scale vertical burn. Materials tested will be identical to products proposed for use.

e. Electrical Components: Will be NFPA 70, Article 100 listed and labeled by either UL or ETL or another testing agency acceptable to AHJ, marked for intended use, and tested as a system. Individual testing of components will not be acceptable in lieu of system testing.

f. Anti-Microbial Characteristics: Will be 'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.

g. When a woven shade is selected for use, the transparency will be determined by both the density of the weave and the color of the fiber.

h. The architect/designer should obtain several large samples of woven shade densities and colors to properly specify the level of transparency required.

i. Minimum sample size is 24 in square.

ii. Provide samples for initial selection and samples for verification.

i. Consider motorized versus manual operation based on application and building preference.

12.3.2. Laboratory Casework:

12.3.2.1. Laboratory casework will be easily cleanable and have smooth, non-sharp corners.

12.3.2.2. For most laboratory conditions, the casework will be made of painted enamel steel.

12.3.2.3. In laboratory applications that do not involve heavy usage of corrosive chemicals, the casework may be made of a hard wood, such as maple.

12.3.2.4. Metal shelving will be provided, unless otherwise required by the user's specialized laboratory requirements.

12.3.2.5. Three types of countertop materials are recommended for most biology laboratory applications: solid-surface epoxy resin, solid-surface phenolic resin, and stainless steel.

12.3.2.6. Chemical-resistant plastic laminate countertops may be appropriate for laboratory applications that do not involve heavy water usage or corrosive chemicals. If laminates are used, all top and bottom surfaces will be laminated and all edges will be banded.

12.3.3. Entrance Floor Mats and Grilles

12.3.3.1. Provide a modular, recessed aluminum entrance floor mat system with modules weighing less than 23 kg (50 lb) and prefabricated welded frames that are installed to maintain performance criteria stated by the manufacturer without defects, damage, or failure.

COMMENTARY: Removable panels to allow for cleaning underneath the grille, should not be unwieldy to handle for maintenance purposes. Follow up with building managers for preferences and details.

12.3.3.2. The contractor will submit product data, including manufacturer specification sheets and installation instructions for specified products. Include methods of installation and substrate preparation for each type of substrate.

12.3.3.3. The contractor will submit shop drawings showing layout, traffic direction, profiles, and product components, including anchorage, fibered insert colors, patterns, and textures.

12.3.3.4. The contractor will submit samples for each type of exposed foot grille, entrance mat, and frame assembly required.

12.3.3.5. The contractor will submit all quality assurance submittals provided by the manufacturer, including the following:

a. Certified test reports showing compliance with specified performance characteristics and physical properties

b. Manufacturer installation instructions

12.3.3.6. The contractor will submit all closeout submittals provided by the manufacturer, including the following:

a. Cleaning and maintenance data, including methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance

b. Warranty

12.3.3.7. The contractor will ensure that the installer is highly experienced in the installation of entrance floor mats and grilles and has previously done work similar to that required for this project.

12.3.3.8. To assure a consistent level of quality, there will be a single source manufacturer for all specified foot grilles, assembly frames, and fibered entrance mats.

12.3.3.9. The contractor will comply with manufacturer ordering instructions and lead-time requirements to avoid construction delays.

12.3.3.10. The contractor will store materials received by the manufacturer at the temperature and humidity conditions recommended by the manufacturer and will protect materials from exposure to harmful weather conditions.

12.3.3.11. The contractor will maintain the temperature where products will be installed before, during, and after installation as recommended by the manufacturer.

12.3.3.12. The contractor will verify actual measurements by field measuring before fabrication and will include measurements in shop drawings.

12.3.3.13. The contractor will examine the substrates and conditions where floor mats will be installed and determine that there are proper conditions to accept the floor mats/grilles. If the conditions are unsatisfactory, the installation will not proceed until the conditions are corrected. The subfloor will be clean and dry and within industry-acceptable tolerances.

12.3.3.14. The construction of the foot grilles will be cross bolt-thru design. Swedge, welded, and key-lock fastening are not acceptable.

12.3.3.15. The material content of the foot grilles will be aluminum alloy Type 6061-T6. Soft aluminum alloy such as 6063-T52 is not acceptable.

12.3.3.16. For ease of maintenance and access, the foot grille will be supplied in panels that do not exceed 1219 mm (48 in) x 1067 mm (42 in). A one-piece design will not be acceptable. The load capacity for the foot grille will be 1738 kg (3,831 lbs) per each 610 mm (2 ft) span.

12.3.3.17. The contractor will coordinate with the manufacturer to order the correct frame for each foot grille, taking into consideration the substrate of the area that is receiving the foot grille.

12.3.3.18. The contractor will examine every substrate and all conditions where the foot grilles and/or floor mats will be installed. The contractor will not proceed with an installation until all unsatisfactory conditions are corrected. The subfloor will be clean and dry and within industry-acceptable tolerances.

12.3.3.19. The contractor will strictly comply with manufacturer installation instructions and recommendations and will coordinate the installation with adjacent work to ensure proper clearances and to prevent tripping hazards.

12.3.4. Seating:

12.3.4.1. Fixed Auditorium Seating:

a. The contractor will take field measurements to verify or supplement dimensions indicated. The contractor will be responsible for accurate fit of the work.

b. The contractor will submit a complete seating plan developed from the contract drawings, showing all chairs, sizes, and aisle widths. The contractor will be responsible for the accuracy of all chair measurements shown on the seating plan.

c. Varying lateral sizes of backs will be used in accordance with the approved seating plans, with standards in each row spaced laterally so that the end standards will be in alignment from first to last row whether aisles are of constant or converging width.

d. The seating plan is to be reproduced on the floor and/or risers, all dimensions checked against the plan, and necessary layout adjustments made for all discrepancies. The contractor will cover all products for backs and seats in clear plastic bags to protect the products prior to use.

e. The bidder will submit, as part of its bid, certified copies of test reports by a recognized independent test laboratory establishing conformance to the performance tests. Failure to supply these test reports will result in disqualification of the bidder.

f. Seating will be designed and manufactured in compliance with the intent of ANSI/BIFMA X5.4, latest edition. Seating will exceed all applicable BIFMA performance test criteria.

g. The contractor will provide a manufacturer's warranty covering the material and workmanship for a period of five (5) years from the date of final acceptance.

   i. Repair or replace any part that becomes defective during the warranty period, excepting where the product has been subject to accident, alterations, abuse, misuse, or neglect.

   ii. Provide a manufacturer’s warranty covering the gravity lift seat return for the period of lifetime from the date of final acceptance.

h. Materials for fixed seating will conform to the following requirements:

   i. All steel will have smooth surfaces and be of sufficient gauge thickness and designed to withstand strains of normal use and abuse.

   ii. Seat and back padding material will be of cold-molded polyurethane foam. Padding material will comply with the flammability requirements outlined in California Technical Information Bulletin 117: *Resilient Cellular Materials*, Sections A and D, dated March 2002, when tested in accordance with Federal Test Method Standard 191, Method 5903.2.

iii. Plywood, exposed or concealed, will be hardwood. All plywood will be hot press laminated using a high frequency process. Interior plys will be Class 3 or better. Exposed exterior plys will be Class 1. The particle core will be 25 kg (55 lbs) density.

iv. Plastic will be injection-molded, high-density polypropylene with ultraviolet light inhibitors to retard fading. Plastic will have a burn rate of 25 mm (1 in) per minute when tested in accordance with ASTM D635 or the Department of Transportation of Motor Vehicle Safety Standard No. 302.

v. Plastic laminate will be composed of a core of kraft papers impregnated with phenolic resins, a decorative surface sheet, and overlay sheet containing melamine. Layers are fused together under pressures in excess of 6.9 MPa (1,000 psi), and temperatures over 275 degrees. Plastic laminate will meet or exceed performance standards as established by NEMA: thickness: horizontal surfaces 1.3 mm (.050 in) thick; vertical surfaces 0.8 mm (.030 in) thick.

i. Finishes for the fixed seating will conform to the following requirements:

i. Prior to the application of an epoxy powder finish, all metal parts will be cleaned using a three-step process consisting of an iron phosphate, hot water rinse and a chromic acid rinse. All metal parts, both exposed and non-exposed, will be coated with an electrostatically applied epoxy powder. All metal will have a minimum dry film thickness of at least two millimeters and will pass the 2H hardness test. All coated metal parts will be oven baked at not less than 360 degrees.

ii. All exposed wood parts and surfaces will be stained to the color selected, coated with lacquer of sufficient film depth to afford wear resistance of institutional quality, and oven baked.

iii. The color of plastic parts will be selected from the manufacturer's standard color range.

iv. All assembly hardware will be rust-resistant and black-plated.

v. Fabric and color will be selected from the manufacturer's standard fabric selection.

j. Fixed seating construction will conform to the following standards:

i. The seating will be pedestal design.

ii. The aisle standards will be fabricated in the same manner as the center standards. End panels will be furnished pursuant to the plan of seating.

iii. Riser mounted standards will consider the curvature of the riser.

iv. Seat cushions will be of arch-spring type.

v. The self-lifting mechanism will be a counter-balance system integrated within the seat frame.

12.3.5. Site Furnishings:

12.3.5.1. Bicycle Racks:

a. Bike racks will be in compliance with local jurisdiction requirements, for example District Department of Transportation (DDOT) Bicycle Facility Design Guide.

b. Input from Smithsonian Gardens (SG) is required and will be coordinated through the Contracting Officer's Technical Representative (COTR).

c. Coordinate with Mall requirements as applicable.

d. Use SI standard Bike Hitch Innovative Bike Rack or approved equal.

i. Installation will be embedded or surface-mount.

ii. Color and finish will be approved by the SI project manager.

12.3.5.2. Trash and Litter Receptacles:

a. Trash receptacles will match the facility standard, local jurisdiction, or those existing on site, and will have a rodent-proof design.

b. Recycling bins will be provided where there are trash receptacles.

c. Coordinate with SG.

d. Mall standards apply as applicable (Mall Streetscape).

e. Consider various buildings and applicable styles.

12.3.5.3. Site Seating and Tables:

a. Benches will match the facility standard or those existing on site.

b. Follow facility standard and existing elements on site.

c. Coordinate with the COTR for compliance.

d. Any item involving garden landscape or hardscape requires the input of SG.

13. DIVISION 13 – SPECIAL CONSTRUCTION

13.1. Reference Codes, Standards, and Guidelines

13.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 13-specific requirements:

13.1.1.1. Metal Buildings Manufacturers Association (MBMA) Metal Buildings Systems Manual

13.1.2. Refer to SDS, Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats

13.2. Design Requirements

13.2.1. Not applicable to this section

13.3. Specifications

13.3.1. Metal Building Systems:

13.3.1.1. Metal buildings will be designed to accommodate the loads of the material to be stored, the associated handling equipment, and the needs of the operating personnel.

13.3.1.2. The design of the metal building will be planned to best accommodate the physical dimensions of the material to be stored and/or the operations to be housed.

13.3.1.3. Design of metal building is to be based on the dead and live load requirements of the structure as it will be built. Snow, wind, and seismic loads will be considered where applicable. The minimum structural dead load will be 15psf. The minimum structural live load will be 30psf.

13.3.1.4. Columns supporting the outer edge of the roof will be spaced so as not to interfere with the spacing of exterior loading dock doors or truck berths. Dock widths will be wide enough to allow efficient maneuvering of forklift trucks and other expected types of material-handling equipment. The minimum width shall be 3 m (10 ft). Forklift bumpers will be placed at both sides of all door jambs where forklift traffic will occur to prevent damage to the walls, door track, and door frame.

13.3.1.5. General warehouse or storage space will be floored with a concrete slab of proper design to carry the wheel loads and to withstand the abrasion generated by the continual use of forklift trucks where required. Concrete hardeners and dust proofers are recommended to minimize the wear of forklifts or other heavy equipment on the concrete floor. Surfaces that are subject to wetting, such as outdoor docks, will not have a smooth finish to minimize safety hazards. Office space may be covered with resilient tile or carpet to upgrade the floor slab to office conditions where required.

13.3.2. Fabricated Structures:

13.3.2.1. Fabricated structures, such as guard booths, will be self-contained with all necessary systems as a package unit.

13.3.2.2. Fabricated structures that will be located adjacent to a major building will complement the architectural character of the building through building proportions, lighting, and finishes.

13.3.2.3. Design of fabricated structure will consider the number of personnel assigned during normal operations, space required for electronic and electrical equipment, mechanical equipment, and counter or workspace.

13.3.2.4. Because fabricated structures, especially guard booths, are typically located away from larger building structures, consider the corrosion resistance and maintenance requirements of these facilities as a result of constant environmental exposure.

13.3.2.5. Finished floor elevation will be 152mm (6 in) or more above grade or adjacent walkways, unless the facility is located on a raised island. If the facility is on an island, the minimum finished floor elevation will be the elevation of the island.

13.3.2.6. Provide floors and walkways with anti-skid surfaces. Anti-fatigue mats will be provided at all security personnel posts to relieve fatigue and discomfort if standing for long periods of time is required.

13.3.2.7. Provide heating and cooling appropriate for personnel, the electronic and electrical systems or fixtures, and the security support equipment.

13.3.2.8. Provide adequate interior and exterior lighting for the specific use of the fabricated structure. If the structure will be used for clearing of personnel or verifying identification, provide lighting that will support identification and inspection tasks such as seeing hair, eye, clothing, complexion, and vehicle colors.

13.3.2.9. Electrical design will consider current power demands as well as the communication and power requirements for future traffic control devices (where applicable), identification equipment, and other devices associated with potential automation devices.

13.3.3. Lactation Rooms:

13.3.3.1. Lactation rooms will have a sink as well as a counter to place personal items and breast pump.

13.3.3.2. Provide adequate refrigeration space, which may be outside of the lactation room.

13.3.3.3. Provide adequate electricity to support equipment.

13.3.3.4. Provide a comfortable place to sit.

13.3.3.5. Provide appropriate door locking hardware.

13.3.3.6. Comply with Labor Code Section 6382.

14. DIVISION 14 – CONVEYING SYSTEMS

14.1. Reference Codes, Standards, and Guidelines

14.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guideline Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 14-specific requirements:

14.1.1.1. American National Standard Specification for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People (ANSI A117.1).

14.1.1.2. General Services Administration (GSA) Facilities Standards for the Public Buildings Service – PBS P-100, latest edition as accepted by GSA.

14.1.1.3. National Elevator Industry, Incorporated (NEII) Building Transportation Standards and Guidelines

14.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

14.2. Design Requirements

14.2.1. General Notes:

14.2.1.1. SI prefers standard, readily available materials and components for elevators and escalators. Non-standard and custom components require SI review and approval.

14.2.1.2. Coordinate oversize exhibit freight elevator doors (12 ft x 12 ft) with corridor/circulation requirements.

14.2.1.3. The use of proprietary tools for elevator and escalator maintenance is prohibited.

14.2.1.4. The use of Limited Use/Limited Application (LULA) elevators is prohibited.

14.2.1.5. Where feasible, the A/E and project team will consider the use of elevators with regenerative electric to help meet sustainability goals.

14.2.2. It is the intent of these SDS to provide guidelines in developing vertical transportation systems that provide acceptable levels of elevator service as related to the average interval and handling capacity, as defined in GSA Facilities Standards for the Public Buildings Service – PBS P-100 (http://www.gsa.gov/portal/content/104821) for staff areas, latest edition accepted by GSA, and have a traffic analysis performed by a qualified elevator consultant.

14.2.2.1. Peak Loads: Assume that 10 percent of the population will not require service during the peak time frame. Calculate average interval as the time between departures of elevators from the main lobby during the a.m. peak period. Average intervals will not exceed 30 seconds. Calculate handling capacity as the number of persons the elevator system must move in any given 5-minute period of up-peak traffic used to measure average interval. Design buildings for 16 percent handling capacity.

14.2.2.2. Other Service: Provide separate calculations for passenger and freight or service (combination of passenger and freight) traffic.

14.2.2.3. The traffic analysis will determine the quantity, capacity, and speed requirements of the elevators. Absent formal program populations, calculate population at the rate of one person per every 13.9 sq m (150 sq ft) of gross building area. Elevator waiting times will not exceed 30 seconds during peak time periods in a typical bank. Passenger elevators will have a minimum capacity of 1587 kg (3,500 lbs), with cars sized to ANSI A17.1 standards and ambulance stretcher requirements.

14.2.2.4. Separate traffic calculations will be made for the vertical transportation needs of the public, incorporating elevator, escalator, and stair traffic based on actual formal population data. Design the system with the following assumptions:

a. Design the total system for complete entry or exit from the building in one hour.

b. Assume maximum of 20 percent stair usage.

c. Adequate queuing areas must be provided at both the entry and exit of each escalator and special consideration be paid if escalators feed into another set of escalators so that adequate space is provided for safe access.

d. Both pedestrian stairs and public elevators will be located within proximity and line of sight to escalators to ensure that baby strollers and like devices are directed toward the correct conveyance type.

14.2.2.5. Provide safe and convenient transport of passengers and material.

14.2.2.6. Provide systems that meet the highest level of accessibility for people with disabilities.

14.2.2.7. Incorporate standardized parts for easy maintenance and repair.

14.2.2.8. Provide reliability and achieve desired lifecycle service and cost.

14.2.2.9. Prohibit installation of manufacturer standard proprietary control equipment that requires adjustment or troubleshooting with proprietary diagnostic instruments.

14.2.2.10. Coordinate with the Design Team and OPS for elevator access control and intercommunications systems requirements.

14.2.2.11. Coordinate with the Security Consultant for ESS panel assemblies where elevator access control is required. Unless otherwise required by the project, provide a minimum of 4 x 8 ft wall space for ESS panels in the elevator equipment room. The wall space will be open free and clear access by technicians. ESS panels planned in hazardous areas are not permitted.

14.2.2.12. Coordinate with the Security Consultant for conductors in the traveling cable(s). This will typically include card reader, CAT6 for Intercom, and CAT6 for a video camera.

14.2.3. Design Criteria:

14.2.3.1. To ensure that elevators comply with specifications and installation procedures in the standards, the A/E will retain the services of an elevator consulting firm to provide design, specification, and construction/inspection services.

14.2.3.2. For modernization projects, the SI will retain the rights to salvage existing elevator and escalator components.

14.2.3.3. Hydraulic passenger elevators will be used for applications limited to a maximum travel of 10.6 m (35 ft) or four landings.

14.2.3.4. The maximum speed for hydraulic elevators will be 45.7 m (150 ft) per minute.

14.2.3.5. Hydraulic freight elevators will be limited to a maximum travel of 10.6 m (35 ft) or four landings.

14.2.3.6. Telescopic multi-staged cylinder-plunger units will not be acceptable.

14.2.3.7. Traction elevators will be used for all applications that exceed 10.6 m (35 ft) of travel or four landings.

14.2.3.8. When escalators are provided, there will be redundant service in case of equipment shutdowns and auxiliary means will be provided for pedestrian traffic via adjacent stairways within line of sight to escalators.

14.2.3.9. Machine Room Less (MRL) elevators will not be utilized unless express approval is received from the Office of Planning, Design, and Construction (OPDC) or Office of Facilities Management and Reliability (OFMR) through the project Contracting Officer's Technical Representative (COTR).

14.2.3.10. Whenever possible, elevator machine rooms will be dedicated to elevator equipment only. No non-elevator lines or conduit will be run through the room or elevator shaft.

14.2.3.11. Exposure of elevator and escalator equipment to the elements/weather is prohibited.

14.2.3.12. If the building is determined to require special loading of large or heavy materials, then the minimum standard will be C-1 rating.

14.2.3.13. The use of single speed side slide or single center parting doors is required. Exceptions may be made for service elevators with capacity of greater than 2041 kg (4,500 lbs) for the use of two speed doors.

14.2.3.14. Escalators will be provided with solid high-deck balustrades in lieu of low-deck or glass balustrades.

14.2.3.15. Escalators will be designed to operate at a standard speed of 27.4 m (90 ft) per minute and be provided with a 1016 mm (40 in) step width under all applications.

14.2.3.16. All fire service key switches will utilize a FEOK1 key switch and all other keying for equipment will utilize a J Series key switch to match SI standards.

14.2.3.17. The use of wheelchair lifts, LULA, or platform lifts will not be utilized in new buildings.

14.2.3.18. It is the intent that when emergency power is provided it should provide means for the following systems to be supplied by both normal power and Type 60/Class 2/Level 1 standby power. Refer to Division 26- Electrical in Volume 1 for additional emergency power requirements.

a. Lighting of elevator machinery spaces, machine rooms, control spaces, and control rooms

b. Elevator/escalator equipment

c. Hoistway lighting

d. Machine room ventilation and cooling equipment

e. Sump pump

14.2.3.19. Operational Performance (Passenger Door Open Time Selection Chart):

Door Width	Side Opening		Center Opening	
	Open (seconds)	Close (seconds)	Open (seconds)	Close (seconds)
36"	2.1	3.4	1.5	2.2
42"	2.3	4.0	1.6	2.4
48"	2.5	4.4	1.7	2.7
54"	2.7	5.0	1.8	2.8
60"	2.8	6.1	1.8	2.8

14.3. Specifications

14.3.1. Conveying Systems:

14.3.1.1. Electric Traction Elevators:

a. Designers will develop a project-specific specification utilizing the Smithsonian Specification included in Volume 2 as the base.

b. MRL elevators will not be utilized unless express approval is received from the OEDC/OFMR department through the project COTR.

c. Traction elevators will be used for all applications that exceed 10.6 m (35 ft) of travel or four landings.

d. Provide a solid-state microprocessor system, manufactured by Motion Control Engineering, to provide for continuously changing operations in various traffic situations, and efficiently handle the varying passenger traffic demands. The control system will be non-proprietary in all respects. The system will incorporate on-board diagnostics as part of the standard control design. Use of portable or removal diagnostic equipment is unacceptable.

e. Exposure of elevator equipment to the elements/weather is prohibited.

f. All fire service key switches will utilize a FEOK1 key switch and all other keying for equipment will utilize a J Series key switch to match SI standards.

g. Provide vandal-resistant custom signal fixtures. The intent is not to furnish the new state-of-the-art plastic bezel mounting design. Provide vandal-resistant type pushbutton modules manufactured by Innovation Industries push button style PB-23. Provide LED type illumination in all pushbuttons.

h. The use of single speed side slide or single center parting doors is required. Exceptions may be made for service elevators with capacity of greater than 2041 kg (4,500 lbs) for the use of two speed doors.

i. Passenger elevators will have a minimum capacity of 1587 kg (3,500 lbs), with cars sized to ANSI A17.1 standards and ambulance stretcher requirements.

14.3.1.2. Electric Traction Freight Elevators:

a. Designers will develop a project-specific specification utilizing the Smithsonian Specification included in Volume 2 as the base.

b. MRL elevators will not be utilized unless express approval is received from the OEDC/OFMR department through the project COTR.

c. Traction elevators will be used for all applications that exceed 10.6 m (35 ft) of travel or four landings.

d. Provide a solid-state microprocessor system, manufactured by Motion Control Engineering, to provide for continuously changing operations in various traffic situations, and efficiently handle the varying passenger traffic demands. The control system will be non-proprietary in all respects. The system will incorporate on-board diagnostics as part of the standard control design. Use of portable or removal diagnostic equipment is unacceptable.

e. Exposure of elevator equipment to the elements/weather is prohibited.

f. All fire service key switches will utilize a FEOK1 key switch and all other keying for equipment will utilize a J Series key switch to match SI standards.

g. Provide vandal-resistant custom signal fixtures. The intent is not to furnish the new state-of-the-art plastic bezel mounting design. Provide vandal-resistant type pushbutton modules manufactured by Innovation Industries push button style PB-23. Provide LED type illumination in all pushbuttons.

h. If the building is determined to require special loading of large or heavy materials, then the minimum standard will be C-1 rating.

14.3.1.3. Hydraulic Elevators:

a. Designers will develop a project-specific specification utilizing the Smithsonian Specification included in Volume 2 as the base.

b. MRL elevators will not be utilized unless express approval is received from the OEDC/OFMR department through the project COTR.

c. Hydraulic passenger elevators will be used for applications limited to a maximum travel of 1.6 m (35 ft) or four landings.

d. The maximum speed for hydraulic elevators will be 45.7 m (150 ft) per minute.

e. Telescopic multi-staged cylinder-plunger units will not be acceptable.

f. Provide a solid-state microprocessor system, manufactured by Motion Control Engineering, to provide for continuously changing operations in various traffic situations, and efficiently handle the varying passenger traffic demands. The control system will be non-proprietary in all respects. The system will incorporate on-board diagnostics as part of the standard control design. Use of portable or removal diagnostic equipment is unacceptable.

g. Exposure of elevator equipment to the elements/weather is prohibited.

h. All fire service key switches will utilize a FEOK1 key switch and all other keying for equipment will utilize a J Series key switch to match SI standards.

i. Provide vandal-resistant custom signal fixtures. The intent is not to furnish the new state-of-the-art plastic bezel mounting design. Provide vandal-resistant type pushbutton modules manufactured by Innovation Industries push button style PB-23. Provide LED type illumination in all pushbuttons.

j. The use of single speed side slide or single center parting doors is required. Exceptions may be made for service elevators with capacity of greater than 2041 kg (4,500 lbs) for the use of two speed doors.

k. Passenger elevators will have a minimum capacity of 1587 kg (3,500 lbs), with cars sized to ANSI A17.1 standards and ambulance stretcher requirements.

14.3.1.4. Hydraulic Freight Elevators:

a. Designers will develop a project-specific specification utilizing the Smithsonian Specification included in Volume 2 as the base.

b. MRL elevators will not be utilized unless express approval is received from the OEDC/OFMR department through the project COTR.

c. Hydraulic passenger elevators will be used for applications limited to a maximum travel of 10.6m (35 ft) or four landings.

d. The maximum speed for hydraulic elevators will be 45.7 m (150 ft) per minute.

e. Telescopic multi-staged cylinder-plunger units will not be acceptable.

f. Provide a solid-state microprocessor system, manufactured by Motion Control Engineering, to provide for continuously changing operations in various traffic situations, and efficiently handle the varying passenger traffic demands. The control system will be non-proprietary in all respects. The system will incorporate on-board diagnostics as part of the standard control design. Use of portable or removal diagnostic equipment is unacceptable.

g. Exposure of elevator equipment to the elements/weather is prohibited.

h. All fire service key switches will utilize a FEOK1 key switch and all other keying for equipment will utilize a J Series key switch to match SI standards.

i. Provide vandal-resistant custom signal fixtures. The intent is not to furnish the new state-of-the-art plastic bezel mounting design. Provide vandal-resistant type pushbutton modules manufactured by Innovation Industries push button style PB-23. Provide LED type illumination in all pushbuttons.

j. If the building is determined to require special loading of large or heavy materials, then the minimum standard will be C-1 rating.

14.3.1.5. Escalators:

a. Designers will develop a project-specific specification utilizing the Smithsonian Specification included in Volume 2 as the base.

b. When escalators are provided, there will be redundant service in case of equipment shutdowns and auxiliary means will be provided for pedestrian traffic via adjacent stairways within line of sight to escalators.

c. Exposure of escalator equipment to the elements/weather is prohibited.

d. Escalators swill be provided with solid high-deck balustrades in lieu of low-deck or glass balustrades.

e. Escalators will be designed to operate at a standard speed of 27.4 m (90 ft) per minute and be provided with a 1016 mm (40 in) step width under all applications.

f. All key switches will utilize a Yale style key switch to match SI standards.

g. Intermittent operation will not be utilized on any escalators.

21. FIRE SUPPRESSION

21.1. Reference Codes, Standards, and Guidelines

21.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design.

21.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

21.2. Fire Safety During Construction and Renovation

21.2.1. Coordinate with the facility prior to and concurrent with design.

21.2.2. Separate all occupied areas from demolition, renovation, or construction activities by temporary smoke-tight construction partitions of gypsum board or other approved non-combustible or limited-combustible material in accordance with the requirements of the National Fire Protection Association (NFPA) 241: *Safeguarding Construction, Alteration, and Demolition Operations*. Barrier design will be detailed in project documents.

21.2.3. Partitions will be full height, extending through suspended ceilings to the floor slab or roof deck above and will be one-hour fire-rated, unless sprinklers are installed and are operational on both sides of the temporary partition, whereupon the partition may be permitted to terminate at the ceiling in accordance with NFPA 241.

COMMENTARY: This requirement is due to the inherently greater potential for fire or hazardous materials incidents associated with the combustibles and operations of demolition/construction. This risk is heightened by the likelihood of compromised fire protection systems and fire/smoke-resistant barriers. This does not obviate the need to provide other protective measures to contain dust and debris as specified under other SI requirements.

21.2.4. Sprinklers are considered to be operational when they are installed and maintained in accordance with NFPA 13: *Installation of Sprinkler Systems* (including spacing, protection, distance from the ceiling, and adequate automatic water supply).

21.2.5. Phase construction as necessary to ensure that exits are not obstructed or reduced in width. If exits must be obstructed during construction, provide alternate exit routes during each phase of construction and identify the alternate routes on the construction drawings.

COMMENTARY: The impact of construction on nearby occupied areas must be evaluated to ensure adequate egress is maintained for occupants in these spaces. Temporary egress paths may need to be provided. Where adequate egress cannot be maintained, it may be necessary to temporarily close areas adjacent to the construction.

21.2.6. Minimize or avoid disruptions to fire alarm and sprinkler system service. Delineate construction phasing to expedite installations of new systems; where possible, maintain existing systems in service until the replacement systems are operational. If fire protection systems will be impaired, follow the SI fire system impairment permit to ensure procedures are implemented. Maintain equivalent levels of fire protection and provide formal notification to the facility while systems are down via the fire protection system impairment process (See SI Safety Manual, Chapter 36, Fire Protection, a copy can be provided by the COTR).

COMMENTARY: Impairment of fire systems during modifications and construction activities can subject SI facilities and occupants to greater risk. Application of these guidelines manages this risk to allow continued operations of the facilities concurrent with construction. Provision of adequate exits and sprinkler protection are especially effective in providing adequate fire protection and life safety.

21.2.7. Contractors will furnish their own fire extinguishers when an area is vacated for renovations. SI-owned fire extinguishers will be removed from the vacated area and returned (or replaced with new) prior to re-occupation by the SI.

21.2.8. Hot-work operations involving open flames or spark-producing processes will be minimized through the use of offsite fabrication or alternate work methods.

21.3. CLEAN AGENT EXTINGUISHING SYSTEMS

21.3.1. Clean agent fire extinguishing systems are suitable for protection of certain types of special occupancies, hazards, and facilities. Clean agent fire extinguishing systems are not a substitute for required automatic sprinkler systems.

<u>COMMENTARY:</u> Clean agent fire extinguishing agents are designed for mission critical rooms and sensitive collection storage areas where quick detection and suppression are appropriate. This type of system has a rapid response time and usually does not warrant the activation of the automatic sprinkler system. However, clean agent systems do not provide the same level of reliability as automatic sprinkler systems. Additionally, the fire sprinkler system is designed to protect the structure whereas the clean agent system is designed to protect the equipment and artifacts within a space.

21.3.2. Design Requirements:

21.3.2.1. Clean agent fire extinguishing systems must conform to NFPA 2001: *Clean Agent Fire Extinguishing Systems*.

21.3.2.2. Provide stand-alone (not dependent upon the building fire alarm system for operation) control panels that are listed for releasing device service and monitored by the building fire alarm system.

21.3.2.3. Careful consideration must be given to compartment under/over-pressurization during the discharge of total flooding clean agent systems. Pressure-relieving vents, located near the finished ceiling, may be necessary to regulate rapid pressure changes during discharge. Comply with manufacturer-recommended procedures relative to enclosure venting.

22. DIVISION 22 - PLUMBING

22.1. Reference Codes, Standards, and Guidelines

22.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 22-specific requirements:

22.1.1.1. District of Columbia Construction Codes Supplement of 2010 – DCMR 12F Plumbing Code Supplement

22.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats

22.2. Design Requirements

22.2.1. Any deviation from these standards requires the approval of the SI. The A/E will provide written justification for all deviations from these SDS. The justification will be included in the design narrative and will include, at a minimum:

22.2.1.1. Specific section deviation addresses

22.2.1.2. Title of deviation request

22.2.1.3. Brief reasoning for deviation request

22.2.1.4. Brief analysis of positive or negative impacts to the project based on deviation

22.2.2. Commissioning is required for all projects. Commissioning will be completed through an independent third-party commissioning agent unless directed otherwise. Refer to Smithsonian Specification Section 01 91 13 *Commissioning* in Volume 2 for additional requirements.

22.2.3. Power and utility usage will be monitored and budgeted on a yearly basis for comparison. As a result of this requirement, additional sub-metering and control is required. Reference and follow the Leadership in Energy and Environmental Design (LEED) Advanced Energy Metering Credit and Federal Advanced Metering Guidelines in addition to requirements indicated herein.

22.2.4. The designer must provide a plumbing systems design narrative and the calculations specified in the A/E special conditions at each submission as part of the design analysis book. This includes, but is not limited to, the roof areas used in determining storm drainage pipe sizes, any tables/charts used as a design basis, water demand calculations, domestic hot water heater sizing calculations, plumbing pipe sizing charts/calculations, compressed air/lab gas equipment and pipe sizing, pump sizing calculations, and all plumbing equipment and plumbing fixture cut sheets with model numbers highlighted. The design narrative shall also include the following information:

22.2.4.1. Code interpretations

22.2.4.2. All deviations from SI standards and museum standards

22.2.4.3. Conflicts between SI standards and museum standards

22.2.4.4. Corrosion protection

22.2.4.5. Control Strategies

22.2.5. Calculations for all plumbing systems will be submitted alongside the design narrative in the design analysis manual and must include all design criteria and assumptions including pipe size and equipment size. These assumptions must also be described in the design narrative. Calculations will be required on all relevant systems pertaining to the project.

22.2.6. All plumbing fixture accessibility clearances, installation, and accessories will be compliant with the Americans with Disabilities Act and the Americans with Disabilities Act Accessibility Guidelines.

22.2.7. All water-serving food preparation areas will be heated to 60° degrees C (140° F). Hot water temperature will be boosted to 82° C (180° F) for final sanitizing rinse for commercial dishwashers. Commercial type laundries will be heated to 82° C (180° F). General service (e.g., showers, sinks, family housing, administration facilities, etc.) will be heated to 49° C (120° F). Cold water supply to ice makers must be maintained between 40° F and 90° F. Other areas will be supplied with water heated or tempered to International Plumbing Code (IPC) and Occupational Safety and Health Administration

(OSHA) requirements. Reference health department requirements for commercial kitchens as applicable.

22.2.8. Provide Legionella growth-prevention design in the building hot water distribution system including the cooling tower.

22.2.9. Hot water recirculation or point-of-use heaters will be provided so that hot water is available at each hot water outlet within 15 seconds of activation.

22.2.10. All supply and drainage piping will be removed back to the main(s) and/or riser(s) for renovation projects in which plumbing fixtures are being replaced. No piping is permitted to be abandoned in place unless directed otherwise by the SI. All piping that is no longer needed to serve, drain, or vent a fixture will be removed back to the main(s) and/or riser(s) and capped water- and air-tight.

22.2.11. Any piping that is direct-buried will have an appropriate means of corrosion protection.

22.2.12. Do not route any plumbing piping through electrical or telecommunications rooms and closets unless it directly serves equipment in those areas. To the greatest extent possible, minimize routing directly over electrical equipment within the room. When unavoidable, SI approval for routing is required. The A/E will then provide leak pans with leak detection and alarms.

22.2.13. All plumbing equipment clearances will be coordinated with manufacturer recommendations, but also will have a minimum of 0.9 m (3 ft) clearance around it for access and maintenance. Enlarged-scale detailed plumbing equipment room layouts will be included in the design documents and will clearly indicate service clearance requirements.

22.2.14. Piping corrosion is a common occurrence in SI buildings. Methods for limiting or preventing these occurrences will be explored during design. Provide a narrative of the methodology in the design analysis manual.

22.2.15. At a minimum, the following systems will be considered during design if applicable: solar water heating, heat recovery from steam condensate for preheating domestic water, siphonic roof drainage, rainwater harvesting, domestic water leak detection, and sustainable storm water management practices.

22.2.15.1. Explore the use of urine cycling as a sustainable practice where feasible.

22.2.16. SI prefers that irrigation systems be supplied from harvested rainwater or other sustainable water source. Direct supply from the domestic water system for irrigation is not preferred. Water sources utilized for irrigation will be tested in advance to verify the water quality supports plant health.

22.2.17. Plumbing systems will support the needs of the building occupants; be easily maintained and operated; have reliable and redundant components; and be efficient to operate. Typically, each facility will have numerous piping connections that will be concisely detailed and engineered in the contract documents to suit the applications intended to be supported or serviced.

22.2.18. All design projects are required to complete a checklist for each discipline's services (i.e., architectural services, mechanical services, plumbing services, electrical services, etc.) at each submission of design development as part of the SD-410 review.

22.2.19. The designer will place a note on the applicable drawing that provides a basis (minimum working pressure of ____[kPa (psig)] at a flow rate of ____[L/s (gpm)] for sizing the main water service entering the building.

22.2.20. A non-potable water supply, when used in an entirely separate system and when approved by the local health department, may be used for flushing water closets and urinals, and for other approved purposes where potable water is not required. Piping containing non-potable water (e.g., water not meeting accepted potable water standards) will be a different material and color and will be labeled NONPOTABLE WATER. Alternative pipe materials must be reviewed and approved by the Office of Safety, Health, and Environmental Management (OSHEM).

22.2.21. When the pressure of water supply to the building exceeds the required water pressure by 69 kPa (10psig), a pressure-reducing valve will be provided. Consider increasing pipe sizes based on the anticipated future installation of fixtures when performing design calculations. Building potable water pressure will not exceed 552 kPa (80 psig).

22.2.22. Division One Supplementary Conditions for Construction will be provided by the Contracting Officer's Technical Representative (COTR). This information includes specific building operations and when certain types of construction, demolition, welding times, deliveries, etc. can be accomplished.

22.2.23. Special Cases: Zoos

22.2.23.1. PEX piping will be used where applicable.

22.2.23.2. Appropriately size animal drinking troughs and make-up water lines for drinking troughs per individual animal requirements.

22.2.23.3. Pressure boosters may be required for washing mechanical equipment and roof areas.

22.2.23.4. Provide hose bibbs in all animal washing areas. Provide floor drains with hair interceptors.

22.2.23.5. Provide two-way cleanouts outside of areas containing animals, where possible, as opposed to cleanouts located integral with the drain. Drain covers will be lockable stainless steel.

22.2.23.6. Comply with the Animal Welfare Act of 1966.

22.2.23.7. Comply with applicable standards and guidelines from the Association of Zoos and Aquariums.

22.2.23.8. Comply with Section 8-1: Plumbing Design Considerations: National Institutes of Health Office of Research Facilities Biomedical and Animal Research Facilities Design Policies and Guidelines.

22.2.23.9. Comply with the Guide for the Care and Use of Laboratory Animals: U.S. Department of Health and Human Services, Bethesda, MD: National Institutes of Health, Pub. No.86-23

22.3. <u>Specifications</u>

22.3.1. General Plumbing Items:

22.3.1.1. All motors for plumbing equipment will be premium efficiency motors.

22.3.1.2. Expansion fittings and loops will be provided for plumbing piping as necessary.

22.3.2. Sleeves and Sleeve Seals for Plumbing Piping:

22.3.2.1. Wall and floor sleeves for plumbing piping will be provided at each penetration.

22.3.2.2. Sleeve seals for plumbing piping will be provided at each exterior or foundation wall penetration. For new construction, the pipe sleeves will be cast into the wall with the weep ring.

22.3.3. Escutcheons for Plumbing Piping:

22.3.3.1. Escutcheons for plumbing piping will be chrome finish unless directed otherwise. Escutcheons will be provided for plumbing piping where penetrations are exposed in finished areas.

22.3.4. Meters and Gages for Plumbing Piping:

22.3.4.1. Provide direct-mounted, metal case, liquid-filled, industrial style dual-unit temperature gages. Provide temperature gages on all inlets and outlets of plumbing heating equipment.

22.3.4.2. Provide direct-mounted, metal case, industrial style dual-unit pressure gages. Provide pressure gages on all inlets and outlets of booster pumps. Provide a pressure and temperature gage and/or an accessible fitting at the most hydraulically remote plumbing fixture to measure pressure reading in the future. Pressure gages will be glycerin-filled and 4 in minimum.

22.3.4.3. Mercury gauges are prohibited.

22.3.5. General Duty Valves for Plumbing Piping:

22.3.5.1. Shutoff valves will be provided at each toilet room and at each piping branch. Full port, two-piece ball valves are preferred for plumbing piping shutoff.

22.3.6. Hangers and Supports for Plumbing Piping and Equipment:

22.3.6.1. Hangers and supports for plumbing piping and equipment will be provided per the latest edition of Manufacturers Standardization Society (MSS) standards MSS SP-58 and MSS SP-69.

22.3.7. Heat Tracing for Plumbing Piping:

22.3.7.1. Electric self-regulating heat tracing will be provided for all domestic water piping, pump discharge piping, trap primer piping, and traps exposed to freezing conditions. Heat tracing will be connected to emergency power if available and must be properly insulated.

22.3.7.2. Use the formula and method described in American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Applications Handbook for determining the capacity of heat tracing.

22.3.7.3. Install the following types of electric heating cable for the applications described:

a. Snow and ice melting on roofs and in gutters and downspouts: self-regulating, parallel-resistance heating cable

b. Temperature maintenance for domestic hot water: self-regulating, parallel-resistance heating cable

22.3.7.4. Install electric heating cable across expansion, construction, and control joints according to the manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

22.3.7.5. Install electric heating-cable for snow and ice melting on roofs and in gutters and downspouts: Install on roof and in gutters and downspouts with clips furnished by the manufacturer that are compatible with roof, gutters, and downspouts.

22.3.7.6. Install electric heating cables for freeze protection for piping:

a. Install electric heating cables after piping has been tested and before insulation is installed.

b. Install electric heating cables according to Institute of Electrical and Electronics Engineers (IEEE) 515.1.

c. Install insulation over piping with electric cables according to Section 22.3.11- Plumbing Piping Insulation.

d. Install warning tape on piping insulation where piping is equipped with electric heating cables.

22.3.7.7. Install electric heating cables for temperature maintenance for domestic hot water:

a. Install electric heating cables after piping has been tested and before insulation is installed.

b. Install insulation over piping with electric heating cables according to Section 22.3.11- Plumbing Piping Insulation.

c. Install warning tape on piping insulation where piping is equipped with electric heating cables.

22.3.8. Vibration and Seismic Controls for Plumbing Piping and Equipment:

22.3.8.1. Provide required seismic controls for plumbing piping and equipment for the appropriate site class as defined by the International Building Code (IBC).

22.3.8.2. Floor-mounted water heaters will be provided with neoprene pads. Floor-mounted plumbing pumps will be provided with floor spring isolators and/or inertia bases, dependent on the size of the pump per the latest edition of the ASHRAE HVAC Applications Handbook.

22.3.8.3. Air compressors will be provided with floor spring isolators.

22.3.9. Identification for Plumbing Piping and Equipment:

22.3.9.1. All plumbing piping and equipment will be identified. Piping will be provided with adhesive pipe labels with flow direction arrows. All labeling color schemes will be per the latest edition of American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) Standard ANSI/ASME A13.1.

CLASSIFICATION	BACKGROUND COLOR	STRIPES
Domestic Cold Water	Green	1 – Black
Domestic Hot Water	Green	2 – Black
Domestic Hot Water Recirc	Green	3 – Black
Natural Gas Piping	Yellow	
Fuel Oil Piping	Yellow	
Non-Potable Water	Purple	

22.3.9.2. All plumbing equipment will be identified with a brass or stainless equipment tag listing equipment designation.

22.3.9.3. Plumbing valves will be provided with brass or stainless tags that indicate service type and valve number. A valve tag schedule that includes valve service type, number, location, and normal operating position (normally open/closed) will be provided with operation and maintenance data.

22.3.10. Plumbing Equipment Insulation:

22.3.10.1. Foam plastic insulation is prohibited. Insulation will have a smoke developed index of 50 or less and flame spread index of 25 or less. Canvas covering will be provided over all insulation in exposed areas.

22.3.11. Plumbing Piping Insulation:

22.3.11.1. Foam plastic insulation is prohibited. Insulation will have a smoke developed index of 50 or less and flame spread index of 25 or less. Canvas covering will be provided over all insulation in exposed areas.

22.3.11.2. Provide insulation on all domestic hot water, cold water, and hot water recirculation piping. Provide insulation on all piping with heat tracing and all piping where condensation may occur, such as drain piping from a floor drain receiving cooling coil condensate. Insulation will be a minimum thickness of 25 mm (1 in).

22.3.11.3. Insulation that can wick and hold condensation, such as mineral fiber, will not be used on piping containing fluids below 27° C (80° F).

22.4. <u>Domestic Water/Dual Service Water/DWV/Compressed Air Piping/Plumbing Pumps</u>

22.4.1. Facility Water Distribution Piping:

22.4.1.1. Below-grade facility water distribution piping, both domestic and dual service, will be Type K copper up to 65 mm (2-1/2 in) and ductile iron for sizes 80 mm (3 in) and larger. Above-grade will be Type L copper for sizes up to and including 50 mm (2 in) and galvanized steel for sizes larger than 50 mm (2 in).

22.4.1.2. Water meters will be provided for each incoming domestic water service. Provide water meters with a manual bypass. Each water meter will be tied to the building automation system for remote readout. Location of the water meter will be coordinated with preferences of the local jurisdiction and mounted outside of the building. Where combined domestic water and fire protection lines are used, the water meter will be located downstream of the line split so as to not meter fire-protection water. Provide a strainer with blowdown valve upstream of all water meters. Mechanical make-up water for hot water, chilled water, and cooling tower make-up will be metered separately. Refer to Division 32- Exterior Improvements in Volume 1 for irrigation system requirements.

22.4.1.3. Water meters will be provided for each incoming domestic water service and sub-metered for major uses including the following at a minimum: irrigation, kitchen, cooling tower, water features, humidification, and boiler makeup.

22.4.1.4. Contact the domestic water provider for metering. For DC Water, the meter has to come from its shop. The domestic water service meter will be picked up from the utility supplier (i.e., DC Water). Coordinate with the utility supplier. Make sure the transmitter is programmed and properly set to its account. If possible, get a meter that has two outputs: one for the utility company and one for the SI Building Automation System (BAS). All water sub-meters will be connected to either the BAS or other data-collection system. Install the water meter's transmitter for the utility company outside of the building so that it can freely transmit the signal. When installing water meters, make sure there is enough straight pipe before the meter and after the meter per manufacturer recommendations. The transmitting cable shall be in ¾ in conduit. Run conduit to it from the meter and pull communication wire along with extra pull string. The transmitter will be labeled with a nameplate.

22.4.1.5. No standalone meter is acceptable. All meters must have data recorded and monitored. Niagara is an unacceptable water meter for use in SI facilities. Refer to energy management information in Division 23- Mechanical in Volume 1 for additional requirements.

22.4.1.6. Any sewer additive and sewer subtractive sub-meters that are needed to properly bill will also come from the domestic water provider (i.e., DC Water).

22.4.1.7. All utility meters must be reviewed for use by the SI Energy Management Branch.

22.4.2. Domestic Water Piping:

22.4.2.1. Below-grade domestic water piping will be Type K copper up to 65 mm (2-1/2 in) and ductile iron for sizes 80 mm (3 in) and larger. Above-grade will be Type L copper for sizes up to and including 50 mm (2 in) and galvanized steel for sizes larger than 50 mm (2 in).

22.4.2.2. Domestic water piping riser diagrams will be included in the contract documents. Complete sizing of the riser diagrams is required.

22.4.2.3. Provide pressure gage at the domestic water and fire water service entrance to museum buildings.

22.4.2.4. Piping will conform to NSF-61.

22.4.2.5. Domestic piping water velocities will not exceed 3.28 m/s (10 ft/s; SI recommends not exceeding 8 ft/s). In hospitals and similar facilities, velocities will not exceed 2.13 m/s (7 ft/s).

22.4.2.6. A PEX distribution system for indoor domestic water distribution may be considered with SI Design Manager and OSHEM approval.

22.4.2.7. Domestic water piping is prohibited in collections storage and processing spaces unless it is serving that space.

22.4.3. Domestic Water Piping Specialties:

22.4.3.1. As appropriate, non-freeze wall hydrants will be provided on the building exterior every 61 m (200 ft) for new buildings. Provide vacuum breakers.

22.4.3.2. Air vents will be provided at high points in closed water systems to allow purging of trapped air.

22.4.3.3. Drain valves will be provided at low points in closed water systems to allow draining of system.

22.4.3.4. Provide dielectric fittings when connecting piping of dissimilar metals.

22.4.3.5. Provide water hammer arrestors on domestic water piping upstream of quick-closing valves. Water hammer arrestors will be compliant with Plumbing and Drainage Institute (PDI)

Standard PDI-WH201. Provide a water hammer arrestor schedule with PDI ratings on drawings.

22.4.3.6. Reduced Pressure Zone (RPZ) backflow preventers will be provided for all incoming non-fire protection domestic water services. If incoming domestic water service is combined with fire protection service, services will split interior to the building, a double check backflow preventer will be provided for the fire protection line after the split, and a RPZ backflow preventer will be provided for domestic water after the split. Indoor RPZ installations will comply with DC Water and Sewer Authority (DCWASA) standards and guidelines, while outdoor RPZ installations will comply with Washington Suburban Sanitary Commission (WSSC) standards and guidelines. Outdoor vaults housing RPZs and/or meters will be freeze-protected (maintain a minimum of 4.4° C (40° F)) with a unit heater tied to the BAS and FAS. Indoor installations will have a floor drain to receive discharge from the relief valve and a means to drain water out of the building. Coordinate with building user for confirmation of requirement for a redundant, parallel RPZ for continuous supply of domestic water should one RPZ fail or be under service or repair. Include an alarm system for unit heater failure.

Where service RPZ backflow preventers are installed below grade, or in any location where a catastrophic failure of the backflow preventer could result in the flooding of its relief valve if not addressed, either an automatic shutdown valve on the water service, or a wall- or floor-mounted water level sensor tied into an alarm point on the BAS, should be installed immediately adjacent to the backflow preventer.

22.4.3.7. Provide pressure gages at upstream and downstream of the RPZ and double-check assemblies for domestic and fire protection services backflow preventers.

22.4.3.8. Provide a Pressure-Regulating Valve (PRV) and RPZ where incoming pressure is greater than 80 psi. The PRV will have by-pass assembly for low water flow. Provide manufacturer instructions for the smooth operation of the ultra-low flow plumbing fixtures.

22.4.4. Domestic Water Pumps:

22.4.4.1. The quantity (duplex versus triplex), size, and arrangement of the booster pumps operating to meet the building demand will be selected by the designer to suit the specific project needs. Short cycling of the pumps will be avoided.

22.4.4.2. A water flow test will be conducted to determine the street pressure and flow capacity at peak conditions.

22.4.4.3. Thorough calculations are required to be performed to determine if a booster pump is necessary. Determine the required capacity of the booster pump system by evaluating the building demand in terms of peak flow.

22.4.4.4. A hot water recirculation pump and piping will be provided where any fixture requiring hot water is 23 m (75 ft) or more away from the source of domestic hot water.

22.4.4.5. Variable-frequency drives may be used if energy and lifecycle cost effective. The pressure sensor will be located at the top of the riser.

22.4.4.6. A hydropneumatic tank may be used to meet low-flow demands without operating the booster pumps.

22.4.5. Facility Elevated, Potable-water Storage Tanks:

22.4.5.1. This section is not applicable.

22.4.6. Facility Ground-Mounted, Potable-Water Storage Tanks:

22.4.6.1. Ground-mounted potable-water storage tanks will be of nontoxic welded steel construction with cathodic protection. Provide a roof hatch, roof manhole, side manhole, and vent as necessary. Tanks will be equipped with level indicators and remote read capability. Tanks will be disinfected per the American Water Works Association (AWWA) Standard AWWA C652. Tanks will conform to NSF-61.

22.4.6.2. SI will consider the use of glass-lined bolted steel and concrete tanks. Alternative tank materials must be reviewed and approved by SI.

22.4.6.3. Provide either a hydraulically or electronically operated altitude control valve for storage tanks to control the water level.

22.4.7. Facility Indoor Potable-Water Storage Tanks:

22.4.7.1. Indoor potable water storage tanks will be of nontoxic welded steel construction or a material that is appropriate for the application. Any alternative tank materials must be approved by OSHEM. Tanks will be insulated where condensation may occur.

22.4.7.2. Tanks will conform to NSF-61

22.4.8. Facility Sanitary Sewers:

22.4.8.1. Piping will be cast iron hub and spigot. Polyvinyl Chloride (PVC) piping is not permitted for sanitary waste and vent piping. Hubless fittings are permitted for above-grade installations only.

22.4.9. Sanitary Waste and Vent Piping:

22.4.9.1. Piping will be cast iron hub and spigot. PVC piping is not permitted for sanitary waste and vent piping. Hubless fittings are permitted for above-grade installations only.

22.4.9.2. Sanitary waste and vent piping riser diagrams will be included in the contract documents. Complete sizing of the riser diagrams is required.

22.4.9.3. Provide invert elevation of the building sanitary drain leaving the building at 1.5 m (5 ft) exterior. Indicate direction of flow on the plumbing hot water, cold water, sanitary, and stormwater piping.

22.4.9.4. Sanitary waste and vent piping routes will be carefully coordinated to avoid being over any sensitive space such as a collections area or exhibit. When unavoidable, routing must be carefully reviewed with the Contracting Officer's Technical Representative (COTR).

22.4.10. Sanitary Waste Piping Specialties:

22.4.10.1. Cleanouts will be provided per the IPC and will not be located above sensitive spaces.

22.4.10.2. Provide at least one floor drain in each new or renovated toilet room. Floor drains will be cast iron bodied with bronze tops.

22.4.10.3. Provide floor drains as necessary in utility spaces such as mechanical rooms. Floor drains will be cast iron bodied with cast iron strainers.

22.4.10.4. Electronic, timed trap primers will be provided for all floor drains in toilet rooms and other utility spaces such as mechanical rooms.

22.4.10.5. The use of air admittance valves is prohibited but may be approved for use by the SI Design Manager or COTR. The use must also be reviewed and approved by the building in which they are proposed to be used to ensure they meet building standards.

22.4.11. Sanitary Waste Interceptors:

22.4.11.1. Provide grease interceptors for any food-preparation areas. Locate grease interceptors for serviceability. Avoid routing piping near any collections storage or receiving areas. Food waste grinders will not discharge into grease interceptors. Oil/water separators will be provided for any maintenance areas in which oil may be washed into the sanitary system. All separators will be accessible for regular cleaning and maintenance. Where possible, separators will be located on the building exterior in a concrete vault.

22.4.11.2. Grease interceptors will be compliant with Standard PDI-G101.

22.4.11.3. Refer to local jurisdiction requirements, codes, and standards for grease interceptors.

22.4.11.4. Refer to local jurisdictions DC Water and DC Department of Health for all facilities located in Washington, D.C.

22.4.12. Sanitary Sewerage Pumps:

22.4.12.1. Provide submersible, quick-disconnect, double-seal duplex sewage pumps for discharge of any sanitary waste that cannot be evacuated from the building via gravity alone. Provide a high water alarm connected to the BAS and guide-rail supports. Pumps will be connected to emergency power if available.

22.4.13. Facility Septic Tanks:

22.4.13.1. Provide facility septic tanks where applicable, such as at the Smithsonian Environmental Research Center (SERC) Edgewater. Septic tanks and septic fields will be provided in conjunction with wastewater treatment plants and facilities.

22.4.14. Storm Drainage Piping:

22.4.14.1. Piping will be cast iron hub and spigot. PVC piping is not permitted for storm water piping. Hubless fittings are permitted for above-grade installations only.

22.4.14.2. Stormwater drainage systems for new buildings will be designed and sized per the IPC to provide sufficient drainage for a 100-year storm scenario.

22.4.14.3. Overflow and secondary drainage will be provided per the IPC.

22.4.14.4. Storm drainage piping is prohibited in and over collections spaces and galleries.

22.4.14.5. Storm drainage piping riser diagrams will be included in the contract documents. Complete sizing of the riser diagrams is required.

22.4.15. Storm Drainage Piping Specialties:

22.4.15.1. Cleanouts will be provided per the IPC and will not be located above sensitive spaces.

22.4.15.2. Plastic roof drains are prohibited.

22.4.16. Sump Pumps:

22.4.16.1. Elevator sump pumps will be sized for a minimum flow rate of 3.15 L/s (50 gpm) or higher as required by code. Sump pumps serving hydraulic elevator sump pits will be equipped with a hydrocarbon sensing and isolation system or oil separator. Hydrocarbon sensing alarms will be connected to the BAS.

22.4.16.2. Submersible sump pumps may be used.

22.4.17. General Service Compressed Air Piping:

22.4.17.1. Compressed air piping will be Type L copper for sizes 100 mm (4 in) and smaller. Schedule 40 black steel piping will be used for sizes larger than 100 mm (4 in).

22.4.18. General Service Packaged Air Compressors and Receivers:

22.4.18.1. General service air compressors will be oil-free reciprocating type. Compressors will be simplex single stage and tank-mounted on horizontal receiver tanks. Vertical receiver tanks may be used if space does not allow for a horizontal tank. The system will be provided with a refrigerated air dryer and air-cooled after cooler.

22.5. <u>Water Softening/Heating Equipment</u>

22.5.1. General:

22.5.1.1. Sustainable practices will be used for heating domestic water when possible. These include, but are not limited to, preheating of domestic water using solar collectors, chiller condenser water, and/or steam condensate.

22.5.1.2. Hot water will be provided at the following temperatures:

Service	Degrees C (Degrees F)
General use such as showers, sinks, family housing, administration facilities, etc.	49 (120)
Commercial type dishwashers with internal boosters	60 (140)
Commercial type dishwashers without internal boosters	82 (180)
Commercial type laundries	82 (180)

The IPC currently requires temperature-limiting devices at general use fixtures to limit outlet temperature to 43.3° C (110° F) max, although 49° C (120° F) is still a recommended circulation temperature.

22.5.2. Domestic Water Softeners:

22.5.2.1. Water softeners will be the regenerating tank type. Water softeners will be provided for any kitchen areas and for any steam-generating humidification equipment. Domestic water leak detectors will be installed and tied into the BAS for monitoring and alarms.

22.5.3. Domestic Water Filtration Equipment:

22.5.3.1. Domestic water used for consumption (i.e., at drinking fountains and water coolers) will be filtered by a centralized filtration system or point-of-use filters. Filters will be 98 percent efficient for particles 10 micrometers and larger. Domestic water leak detectors will be installed and tied into the BAS for monitoring and alarms.

22.5.4. Electric Domestic Water Heaters:

22.5.4.1. Electric tank type water heaters are not preferred. Instantaneous water heaters will be used as often as possible. Provide appropriately sized expansion tanks for domestic hot water systems. Domestic water leak detectors will be installed and tied into the BAS for monitoring and alarms.

22.5.4.2. Heat pumps will be considered if proven effective in a lifecycle cost analysis.

22.5.5. Fuel-Fired Domestic Water Heaters:

22.5.5.1. Tank type water heaters will be natural gas where tank type heaters are deemed more cost- and energy-efficient and natural gas is available. Tanks will be glass lined and be direct vented where possible. Provide appropriately sized expansion tanks for domestic hot water systems.

22.5.6. Domestic Water Heat Exchangers:

22.5.6.1. Domestic water heat exchangers will be shell and tube type where steam or high temperature hot water is available for heating of domestic water. Steam is not the preferred method of heating domestic water if other methods are available.

22.6. <u>Plumbing Fixtures</u>

22.6.1. General:

22.6.1.1. Provide the appropriate number of plumbing fixtures per the A/E special conditions, as determined by the project architect.

22.6.2. Residential Plumbing Fixtures:

22.6.2.1. This section is not applicable.

22.6.3. Commercial Water Closet and Urinal Fixtures:

22.6.3.1. All commercial water closet and urinal fixtures will have hands-free activation unless directed otherwise. All hands-free devices will be hard wired. Battery-powered devices are prohibited unless specifically authorized by the SI on an individual project basis.

22.6.3.2. Water closets will be flush valve type. Tank type water closets are prohibited.

22.6.3.3. All commercial water closet and urinal fixtures will be low-flow type. Water closet flush valves will be dual-flush type or 4.85 L/flush (1.28 gal/flush). Urinals will be 0.5 L/flush (1/8 gal/flush).

22.6.3.4. Waterless urinals are prohibited in public spaces. Waterless urinals may be considered for private/staff bathrooms with SI Design Manager and tenant approval.

22.6.4. Commercial Lavatories and Sinks:

22.6.4.1. All commercial lavatory and sink fixtures (except kitchens) will have hands-free activation unless directed otherwise. All hands-free devices will be hard wired. Battery-powered devices are prohibited unless specifically authorized by the SI on an individual project basis.

22.6.4.2. All commercial lavatory and sink fixtures (except kitchens) will be low-flow type with a maximum flow of 1.9 L/min (0.5 gal/min).

22.6.5. Commercial Showers, Receptors, and Basins:

22.6.5.1. All commercial showers, receptors, and basins will be low-flow type with a maximum flow of 6.8 L/min (1.8 gal/min).

22.6.5.2. Provide showers with anti-scald thermostatic mixing valves.

22.6.6. Wash Fountains:

22.6.6.1. All wash fountain fixtures will have individual hands-free activation unless directed otherwise. All hands-free devices will be hard wired. Battery-powered devices are prohibited. Provide with thermostatic mixing valves.

22.6.6.2. All wash fountain fixtures will be low-flow type with a maximum flow of 1.9 L/min (1/2 gal/min).

22.6.7. Emergency Plumbing Fixtures:

22.6.7.1. All emergency fixtures will be hard plumbed where possible. Self-contained fixtures are not preferred. All emergency fixtures will be designed and installed per the latest edition of ANSI Standard Z358.1. Emergency shower minimum flushing fluid performance will be 1.26 L/s (20 gal/min) at 207 kPa (30 PSI) for 15 minutes. Eyewash minimum flushing fluid performance will be 0.025 L/s (0.4 gal/min) at 207 kPa (30 PSI) for 15 minutes. The tempered water range will be 16-38° C (60-100° F).

22.6.7.2. Provide thermostatic mixing valves, tank type water heaters, or instantaneous water heaters to supply emergency fixtures with tempered water.

22.6.8. Security Plumbing Fixtures:

22.6.8.1. The latest SI security requirements may be obtained from COTR.

22.6.9. Drinking Fountains:

22.6.9.1. Drinking fountains will have bar activation. Provide models with grid drains and integral bottle filling stations.

22.6.9.2. Drinking fountains in outdoor locations will be of frost-free design in climates where freezing occurs. Provide capability for winter shut-off.

22.6.9.3. Indoor drinking fountains will have integral bottle fillers.

22.6.10. Pressure Water Coolers:

22.6.10.1. Water coolers will be local condenser type with tri-bar activation. Provide models with grid drains.

22.7. Laboratory Plumbing Specialties

22.7.1. General:

22.7.1.1. Refer to Appendix O- Laboratory Design Standards in Volume 3 for additional information.

22.7.2. Compressed Air Piping for Laboratory Facilities:

22.7.2.1. Compressed air piping will be provided for laboratory applications where required.

22.7.2.2. Compressed air riser diagrams will be included in the contract documents. Complete sizing of the riser diagrams is required.

22.7.3. Compressed Air Equipment for Laboratory Facilities:

22.7.3.1. Compressed air equipment will be provided for laboratory applications where required. Compressed air systems will be tied into the BAS for monitoring and alarms.

22.7.4. Vacuum Piping for Laboratory Facilities:

22.7.4.1. Vacuum piping will be provided for laboratory applications where required. Piping shall be Type L copper water tubing with wrought copper fittings and soldered joints.

22.7.5. Vacuum Equipment for Laboratory Facilities:

22.7.5.1. Vacuum equipment will be provided for laboratory applications where required. Vacuum pump will be packaged, oil-free, rotary, sliding-vane type pumps unless directed otherwise. Minimum laboratory vacuum pressure will be 68 kPa (20 in of mercury).

22.7.6. Specialty Gas Piping for Laboratory Facilities:

22.7.6.1. Laboratory gases will be provided as necessary. Gas cylinder storage racks with manifolds are the desired storage and distribution method for laboratory gases. Laboratory gases include, but are not limited to, nitrogen, oxygen, nitrous oxide, and carbon dioxide.

22.7.6.2. Laboratory gas riser diagrams will be included in the contract documents. Complete sizing of the riser diagrams is required.

22.7.7. Medical Gas Alarms:

22.7.7.1. Provide a master alarm panel that utilizes a separate trouble alarm and indicator for all laboratory systems including, but not limited to, compressed air, vacuum, natural gas, oxygen, nitrogen, nitrous oxide, and carbon dioxide. The master alarm will be tied to the BAS.

22.7.7.2. Laboratory natural gas systems will be provided with emergency shutdown valves located within the space utilizing the gas and near the exit.

22.7.8. Chemical Waste Systems for Laboratory Facilities:

22.7.8.1. Provide chemical waste systems for laboratories as required. Provide double-wall containment and appropriate piping materials as dictated by laboratory functions and contaminants to be discharged to the waste system.

22.7.8.2. Provide neutralization systems and containment as necessary for the laboratory function. Provide leak detection systems as necessary.

22.7.9. Processed Water Systems for Laboratory Facilities:

22.7.9.1. Provide central reagent, deionized (DI), distilled, or reverse osmosis (RO) distribution system(s) as dictated by laboratory function. Provide piping material appropriate for use with the type of water to be distributed.

22.7.9.2. Processed water riser diagrams will be included in the contract documents. Complete sizing of the riser diagrams is required.

22.7.9.3. DI water piping riser diagrams will be included in the contract documents. Complete sizing of the riser diagrams is required.

23. DIVISION 23 – HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

23.1. Reference Codes, Standards, and Guidelines

23.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of the design. Below are additional Division 23 specific requirements:

23.1.1.1. Associated Air Balance Council (AABC) National Standards for Total System Balance

23.1.1.2. Air-Conditioning, Heating, and Refrigeration Institute (AHRI) 1060: *Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation*

23.1.1.3. American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) A13.1: *Scheme for the Identification of Piping Systems*

23.1.1.4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Guideline 36: *High Performance Sequences for Operation of HVAC Systems*

23.1.1.5. ASHRAE 183: *Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings*

23.1.1.6. American Society for Testing and Materials (ASTM) E84: *Standard Test Method for Surface Burning Characteristics of Building Materials*

23.1.1.7. American Water Works Association (AWWA) M14: *Backflow Prevention and Cross-Connection Control*

23.1.1.8. Cooling Tower Institute (CTI) ATC-105: *Acceptance Test Code for Water Cooling Towers*

23.1.1.9. CTI WTB-148: *Legionellosis – Guideline: Best Practices for Control of Legionella*

23.1.1.10. Department of Energy (DOE) Federal Building Metering Guidance

23.1.1.11. International Performance Measurement & Verification Protocol (IPMVP): *Concepts and Options for Determining Energy Savings in New Construction, Volume III*

23.1.1.12. Manufacturers Standardization Society (MSS), applicable standard practice documents

23.1.1.13. National Air Duct Cleaners Association (NADCA): *The NADCA Standard for Assessment, Cleaning, and Restoration (ACR) of HVAC Systems*

23.1.1.14. National Environmental Balancing Bureau (NEBB): *Procedural Standard for Testing, Adjusting, and Balancing of Environmental Systems*

23.1.1.15. Underwriters Laboratories (UL) 181: *Standard for Factory-Made Air Ducts and Air Connectors*

23.1.1.16. UL 971: *Nonmetallic Underground Piping for Flammable Liquids*

23.1.1.17. UL 1978: *Standard for Grease Ducts*

23.1.1.18. 40 CFR 122.26: *Storm Water Discharges*

23.1.1.19. 40 CFR 141: *National Primary Drinking Water Regulations*

23.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure; security; and chemical, biological, and radiological threats.

23.1.3. Refer to the ASHRAE Handbook, HVAC Applications, latest version, chapter titled “Museums, Galleries, Archives, and Libraries” for additional requirements.

23.1.4. Alternative compliance paths may be approved by the Subject Matter Expert (SME) through the Contracting Officer's Technical Representative (COTR) and pilots may be approved by the respective division chief.

23.1.5. SI National Zoological Park (NZP): These SDS apply to administrative buildings and offices located at the NZP. Other facilities at the NZP are excluded from these standards due to unique requirements that differ from the rest of the SI facilities.

23.1.6. Policy Directives:

23.1.6.1. Commissioning is required for all projects. Commissioning will be completed through an independent third-party commissioning agent unless directed otherwise. Refer to SI Construction Specification Section 01 91 13: Commissioning for additional requirements. This specification can be found in Volume II of the SDS.

23.1.6.2. Power and utility usage are monitored and budgeted on a yearly basis for comparison. As a result of this requirement, additional sub-metering and control is required. Reference and follow the DOE Federal Building Metering Guidance in addition to requirements indicated herein. For projects pursuing Leadership in Energy and Environmental Design (LEED) certification, achieving the LEED credits for advanced energy metering and enhanced commissioning, monitoring-based commissioning (measurement and verification) is required.

23.1.6.3. Work safety plans must address the design requirement for sufficient mechanical equipment rooms (MER) and shaft space(s) including adjacent clearances for maintenance and accessibility. Establishing necessary space for MER very early in the design process is crucial for a successful project.

23.1.6.4. Any deviation from these standards requires the approval of the SI. The A/E must provide written justification for all deviations from these SDS. The justification must be included in the design narrative and must include, at a minimum:

a. Specific section deviation addresses

b. Title of deviation request

c. Brief reasoning for deviation request

d. Brief analysis of positive or negative impacts to the project based on deviation

23.2. Design Requirements

23.2.1. General Requirements:

23.2.1.1. Overarching Goals:

a. Quoting Dr. Marion Mecklenburg's article titled "Preserving Legacy Buildings," written for ASHRAE: "Preserving cultural and national history collections and buildings that contain them requires an integrated approach to indoor temperature and relative humidity requirements. Adopting an integrated approach that considers the needs of the building shell along with the needs of the collection can reduce degradation of the collections and in the buildings. It also establishes the importance of monitoring the reliability and effectiveness of the building systems that maintain the environmental conditions."

b. It is imperative that each new facility or existing facility be designed so that all components comprise an integrated solution that works in conjunction with specific building programs, so that operation of the facility, energy usage, and other criteria are optimized.

c. Building quality level has a direct correspondence to the type of building, its primary purpose and function, the building components, and the anticipated life expectancy of the components.

Building Class	Description	Years to Component Replacement
A. Principal	Major, monumental buildings of historic quality	25-50
B. Support	Buildings of long service life of 50-100 years that support staff and related activities	25-50
C. Service	Buildings with a service life of 25 to 50 years that support maintenance	20
D. Research	Special conditions based on usage	25-50

Table 1 – Building Quality Level

23.2.1.2. Division One (Supplementary Conditions for Construction) Specifications are provided by the COTR. This information includes specific building operations and when certain types of construction, demolition, welding times, deliveries, etc. can be accomplished.

23.2.1.3. The design must be in accordance with the A/E special conditions. Where a conflict occurs for any item between the A/E special conditions and the SDS, the most stringent will apply.

23.2.1.4. The designer must provide an HVAC systems design narrative and the calculations specified in the A/E special conditions at each submission as part of the design analysis book. The design narrative must include the following, at a minimum:

a. Code research and interpretations

b. All deviations from Office of Engineering, Design, and Construction (OEDC) standards and museum standards

c. Conflicts between OEDC standards and museum standards

d. Design criteria including interior and exterior temperature and humidity

e. Existing conditions assessments (where applicable)

f. Approach to load calculations and energy modeling and associated assumptions

g. Description of proposed systems and preliminary sizing

h. Pipe and duct sizing criteria and materials

i. Energy conservation strategies

j. Control strategies with initial control sequences submitted at 65 percent for review

k. Corrosion protection

l. Legionella control strategy (for open systems)

23.2.1.5. Provide both metric and English units for all measurements, sizing, air flow, pressure requirements, and dimensioning. Use of soft conversion is permitted except for pipe sizing, which must use Diameter Nominal (DN) conversions.

23.2.2. Design Requirements:

23.2.2.1. Climatic Design:

a. The most recently issued version of the ASHRAE fundamentals handbook must be utilized for the location closest to the project site. National Mall (Mall) sites must utilize Ronald Regan International Airport.

b. Utilize 99.6 percent heating and 0.4 percent cooling outdoor conditions for general designs. Designers must consider both the 0.4 percent dry bulb and mean coincident wet bulb condition along with the 0.4 percent humidity ratio and mean coincident dry bulb temperature for system sizing.

c. Cooling towers must be designed for the 0.4 percent evaporation wet bulb condition plus 1° C (2° F). The maximum acceptable approach temperature is 4° C (7°

F). Lower approach temperatures may be considered based on lifecycle cost effectiveness.

d. The SI may impose more stringent requirements for design points in some cases.

23.2.2.2. Interior Design Conditions:

a. The indoor temperature and humidity conditions must meet the requirements of the latest edition of ASHRAE 55: Thermal Environmental Conditions for Human Occupancy, SI Declaration on the Collections Preservation Environment found in Appendix E in Volume 3, or specialized requirements as communicated by the design Contracting Officer’s Technical Representative (COTR).

b. Designs must account for design air speed, expected activity, and expected clothing levels for occupants. Conditions must be determined using a thermal comfort computer tool; use of graphical methods for typical indoor environments as indicated in ASHRAE 55 is not acceptable.

c. Process cooling requirements are those space conditions that require specific temperature and/or humidification to be rigidly maintained. Examples are computer rooms, collections, archival storage spaces, clean rooms, or rooms with other rigid temperature requirements that must be maintained 100 percent of the time.

23.2.3. Ventilation Design:

23.2.3.1. Minimum ventilation rates must comply with ASHRAE 62.1: *Ventilation for Indoor Air Quality.*

23.2.3.2. Ventilation rates must be increased as required to meet overall pressurization and make-up air requirements. All buildings must be designed for a minimum positive pressure to the exterior of 5 Pa (0.02 in wg).

23.2.3.3. Energy recovery strategies must be analyzed to aid in meeting the project's sustainability goals. Air streams must be analyzed for the appropriate recovery technology.

23.2.4. Heating and Cooling Load Calculations and Energy Modeling:

23.2.4.1. Load calculations must be performed utilizing computer software in compliance with ANSI/ASHRAE/Air Conditioning Contractors of America (ACCA) Standard 183. The most recent version of the software at the time of project start must be utilized.

23.2.4.2. Load calculations must be submitted for review at each design submission. The submission must include all inputs and outputs and a psychrometric analysis showing the following, at a minimum:

a. Indoor and outdoor design conditions

b. Mixed air conditions

c. Coil leaving air conditions

d. Heat gain due to supply and return fans

e. Effects of energy recovery (if included)

23.2.4.3. System evaluation, including total owning and operating costs (lifecycle cost analysis), must be submitted to the SI for evaluation. System and large component design must be evaluated on the total owning and operating costs based on a 40-year design analysis.

23.2.4.4. Energy analyses of annual energy usage of the standard and/or a proposed alternative building and system design must be performed to permit the evaluation of:

a. Climate Data: Coincident hourly data for temperatures, solar radiation, wind, and humidity of typical days in the year representing seasonal variation

b. Building Data: Orientation, size, shape, mass, air moisture, and heat transfer characteristics

c. Operational Data: Temperature, humidity, ventilation, illumination, and control mode of spaces during occupied and unoccupied hours

d. Energy Consumption: Maximum demand and annual usage of all energy sources used at the project site

e. Mechanical Equipment: Design capacity and past load data

f. Building Loads: Internal heat generation, lighting, equipment, and number of people during occupied and unoccupied periods

g. The calculation procedure must simulate the operations of the building and its services through a full year of operation and must permit the evaluation of the effects of system design, climatic factors, operational characteristics, and mechanical equipment on annual energy usage. Manufacturer data or comparable field test data must be used when available in the simulation of all systems and equipment. The calculation procedure must be based upon 8,760 hours of operation and must utilize design methods specified in the ASHRAE handbooks.

23.2.4.5. Building envelope characteristics must be based on existing conditions and proposed upgrades or new construction details. Calculation of U-values must include provisions for thermal bridging with appropriate backup from ASHRAE 90.1 or a thermal modeling software program.

23.2.4.6. Lighting characteristics must be based on design drawings from the electrical engineer or lighting designer. Load calculations must utilize full wattage of the design fixture. Energy models must include wattage reductions informed by the daylighting model where automatic dimming systems are installed. Diversities may also be taken for occupancy sensors in the building energy model.

23.2.4.7. Equipment heat gains must be calculated based on the planned equipment located in each space indicated in the room equipment list. Watt per sq ft rules of thumb are not permitted, unless specifically approved by the SI. The design engineer must calculate the equipment heat gain by one of the following methods, listed in descending order with the preferable approach listed first:

a. Actual heat gain data (watts or btu/hr) published by the equipment manufacturer

b. Estimated heat gain data based on equipment type listed in the ASHRAE fundamentals handbook, latest version

c. Calculated heat gain based on nameplate electrical data with appropriate diversity factors applied

23.2.4.8. Occupancy must be based on expected occupancies as discussed with the COTR during the planning process. In the absence of expected occupancy data, default occupancy listed in ASHRAE 62.1 will be utilized.

23.2.4.9. Designers must use an energy model to aid in determining the most energy efficient design of the project and to provide inputs into the lifecycle cost analysis. The energy model must be updated at each design phase and be included in the project deliverables. Documentation must clearly list all parameters and assumptions used in the model (inputs and outputs).

23.2.4.10. Inputs to the energy model must be representative of the project as designed. Use of default scheduling, occupant densities, equipment efficiencies, or lighting densities is not permitted beyond the 35 percent submission. The modeling inputs must be reviewed by SI representatives and the agreements must be memorialized.

23.2.4.11. A preliminary energy model must be included with the 35 percent submission and any changes to the inputs or additional information requests must be highlighted and discussed as the design progresses.

23.2.4.12. Energy modeling must be performed in accordance with ASHRAE 90.1, Appendix G, *Performance Rating Method*.

23.2.4.13. Provide an archive file of the final energy model at project completion in eQUEST (DOE2) format. The final version must reflect the as-built conditions of the project.

23.2.4.14. Energy models must be calibrated following the IPMVP using 12 months of actual utility data, provided by SI Energy Management upon request, after one calendar year of full building operation and occupancy. Both as built and calibrated models must be provided to SI Energy Management in electronic form on non-rewriteable media. Scope of work responsibilities for the measurement and verification period will be established during design contract award.

23.2.4.15. Life Cycle Cost Assessment (LCCA) must be completed using the latest version of the National Institute of Standards and Technology (NIST) Building Life-Cycle Cost (BLCC) software at the time of project start. Utility rates must be established by the SI to ensure consistency across the project.

23.2.5. HVAC System Selection:

23.2.5.1. Systems must be selected to meet the requirements of the project and must balance efficiency, cost, and maintainability.

23.2.5.2. The following systems have been pre-approved by the SI for evaluation. Other systems may be considered but must be approved by the SI.

a. Constant volume, single zone: limited to smaller systems and zones. Systems must be capable of 50 percent turndown for unoccupied operation. Provide reheat coil where required for dehumidification control.

b. Variable volume, single zone with reheat: limited to larger systems with larger temperature control zones (i.e., exhibit halls).

c. Variable volume, terminal Variable Air Volume (VAV) with reheat: utilize for larger central distribution systems.

d. Four-pipe fan coil units with dedicated outside air system: direct ventilation is not permitted.

e. Water source heat pump with dedicated outside air system: direct ventilation is not permitted.

23.2.5.3. The following systems may be considered based on application and approval by the SI design manager:

a. Active chilled beam systems for office/administrative areas: A dehumidification unit must be provided to ensure humidity control at peak outdoor humidity conditions. Do not utilize in existing buildings with poor envelopes unless the envelope is upgraded.

b. Variable Refrigerant Flow (VRF) systems for smaller, standalone administrative buildings or retrofits: VRF systems must be paired with an upstream Dedicated Outside Air System (DOAS) capable of heating and dehumidification control; direct ventilation is not permitted.

c. Gas furnaces may be considered on smaller projects depending on the availability of other heat sources, lifecycle cost analysis, maintenance implications, and complexity.

23.2.5.4. The following systems are not permitted for SI projects without specific approval:

a. Building-wide electrical heating systems in ASHRAE climate zones 4 or higher

b. Two-pipe (changeover) fan coil unit systems

c. Fuel-fired duct heaters. Duct heaters must be electric, hot water, or steam.

d. Spot coolers and window units

e. Direct-fired gas heating units

f. Unit ventilators

23.2.5.5. Standalone direct expansion or gas heating systems are strongly discouraged. Plans for the expansion of the steam and chilled water distribution system into undeveloped areas of the campus have been prepared and should be consulted for new buildings.

23.2.6. Space-Specific Design Criteria:

23.2.6.1. Historic Buildings:

a. Rehabilitation of federally owned historic buildings must utilize best practices and technologies in retrofitting to promote long-term viability of the buildings and to reduce deterioration of the building structure.

23.2.6.2. Collections Spaces:

a. Collections spaces are defined as an area, owned or leased, enclosed or outdoors, the primary purpose of which is to permanently protect and preserve, through managed environmental and security controls, collections owned by or in the custody of the SI in furtherance of its mission; and may include adjacent areas that provide managed environmental and security controls suitable to accommodate temporary use of collections, as defined in the SI Collections Space Framework Plan. A copy of this document may be obtained by the COTR as required.

b. Refer to Appendix E- SI Declaration on the Collections Preservation Environment in Volume 3 for further information.

c. Determine specific requirements with the design COTR.

d. The building envelope must be carefully evaluated and insulated to meet minimum recommendations per ASHRAE 90.1 or greater as required, with vapor and air barriers required to satisfy the indoor room design requirements. Thermal bridging must be accounted for in the envelope analysis. Where envelope upgrades are not included in a project scope, adjustments to design interior conditions due to envelope limitations must be reviewed with the design COTR.

e. Provide temperature and humidity sensors in all areas referenced in this section, minimum of one per 175 sq m (1,900 sq ft). Where multiple sensors are utilized, information must be averaged for control with alarming for space gradients in temperature or humidity that exceed the design criteria. Sensor readings must also be continuously compared in the Building Automation System (BAS) to alarm if individual readings vary more than 10 percent from each other.

f. All water-bearing equipment and associated piping must be located outside of collection areas. Where terminal control units with reheat coils must be installed in these spaces, utilize an electric reheat coil.

g. Redundancy needs must be evaluated with the design COTR based on the type of space being designed. Diversity of cooling sources must be considered. Use of direct expansion systems in parallel with chilled water may be considered to provide redundant cooling sources and to meet the specialized temperature and humidity requirements of these space types. Use of standalone, electric humidifiers may be considered for critical humidification.

23.2.6.3. Dry, Low-Temperature Refrigerated Storage:

a. Provide specialized cooling systems to meet temperature requirements. Consider the use of hot gas bypass for capacity control and hot gas reheat.

b. Include an actively regenerated desiccant dehumidification system where required to meet design temperature and humidity levels.

23.2.6.4. Hypoxic Chambers:

a. Reserved for future use.

23.2.6.5. Conservation and Paleo Laboratories:

a. Reserved for future use.

23.2.6.6. Alcohol Storage Rooms:

a. Alcohol storage rooms must be continuously exhausted in accordance with the International Mechanical Code (IMC) and the National Fire Protection Association (NFPA) 30.

b. Provide explosion-proof construction for all devices and equipment within and serving the alcohol storage room.

23.2.6.7. Administrative Areas (Offices, Meeting Rooms):

a. Meeting and conference rooms must be designed on a standalone temperature control zone with carbon dioxide sensing.

23.2.6.8. Classrooms:

a. Classrooms must be placed on a standalone temperature control zone with carbon dioxide sensing.

b. Provide occupancy sensing in classrooms to de-energize lighting, reduce ventilation, and set back temperature when the space is unoccupied.

23.2.6.9. Chemical (Wet) Laboratories:

a. Laboratories must be placed on a standalone temperature control zone.

b. Chemistry storage areas, classrooms, and laboratories must be exhausted in accordance with Appendix O: Laboratory Design Standards in Volume 3.

c. Hood-intensive classrooms and laboratories must utilize a combination of energy recovery and/or variable volume strategies as required to meet performance requirements of the energy code.

d. If a variable volume strategy is utilized, the system must be designed for laboratory applications and provide constant space pressurization at all operating conditions. The project designer must analyze the air streams being exhausted and determine if variable flow control will negatively impact airborne material entrainment or system performance.

e. Energy recovery strategies must provide total separation of the supply and exhaust air streams when including fume hood or otherwise hazardous exhaust.

23.2.6.10. Food Service Areas:

a. Redundancy requirements of water-cooled food service equipment (or any other critical equipment) must be reviewed with the SI. For smaller systems, provide a once-through domestic water bypass system in the event of a chilled water outage and alarm to the BAS to indicate activation. Provide floor drains as necessary. Moreover, consider the impact of the bypass system requirements on the domestic water system. For larger systems, provide redundancy through valved connections for an auxiliary cooling source. Redundancy evaluation must consider both refrigeration equipment and the condenser heat rejection source.

b. Where feasible or mandated by code, condenser energy recovery must be evaluated.

c. Where approved by the Office of Safety, Health, and Environmental Management (OSHEM), the kitchen exhaust hoods will be provided with a UL-listed demand-control ventilation system that automatically adjusts the exhaust rate based on smoke and heat generation at the cooking surface.

d. Kitchens with cooking hoods must be provided with make-up air through a dedicated make-up air unit with appropriate freeze protection. For demand-control systems, provide variable speed supply fans with terminal VAV boxes at each kitchen hood make-up air plenum.

e. Modulation of the make-up air VAV box and exhaust fan must be controlled by the demand-control system to ensure consistent negative pressure in the kitchen is maintained at all operating conditions. The demand-control ventilation system must be integrated into the BAS.

f. A separate fan and exhaust system must be provided for dishwashing exhaust.

23.2.6.11. Telecommunications Rooms:

a. Load calculations and cooling equipment selection must be based on 100 percent of sensible load.

b. Unit sizing must include a 25 percent upsizing factor for future growth.

c. Equipment must be designed to maintain specified conditions and must be independent of the main building HVAC system. Space temperature and humidity must be trended and alarmed through the BAS.

23.2.6.12. Security and Fire Control Rooms:

a. Where security or fire control rooms are provided, air-conditioning and ventilation must be provided 24 hours per day / 7 days per week. Provide a standalone system so that air from other parts of the building does not circulate into this space.

b. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for additional design guidance.

23.2.6.13. Mechanical/Electrical/Plumbing (MEP) Equipment Rooms:

a. The mechanical system is considered an essential element of each building with adequate space allocated for it and in a manner that will permit installation of a well-designed mechanical system capable of being operated and maintained.

b. Adequate area must be dedicated to building support spaces based on building type to meet the requirements specified herein and as dictated during an overall equipment accessibility review with the design COTR. Provisions for expansion must also be considered and planned for on a project-by-project basis

c. All mechanical rooms must be designed to provide full access to the housed equipment. The designer must indicate manufacturer-recommended clearances on all mechanical room plans to indicate adequate clearance. Provide a minimum of two drawing sections or 3D isometric views for each mechanical room to illustrate accessibility. Design drawings must also indicate service pathways and major equipment removal pathways.

d. Project specifications must require the construction contractor to submit coordination drawings detailing all equipment, ductwork, and piping to be installed within the mechanical rooms. Service clearances must be clearly defined on the design and coordination drawings. Elevation views must be provided at all service areas to show clearance to overhead obstructions.

e. Plan and illustrate space around each piece of equipment based on the manufacturer's published recommendation, 0.9 m (3 ft) on all sides, minimum per code, or space required and shown for tube, coil, or filter pull, whichever is the greatest.

f. Allow for access to service and operate valves; allow space in front of electrical equipment and panels per electrical codes. Do not install pipes or mechanical equipment above electrical panels, switch gears, transformers, or starters. If drain pans are required, provide copper construction.

23.2.6.14. Elevator Machine Rooms:

a. Equipment must be designed to maintain specified conditions as required by the equipment manufacturer and must be independent of the main building HVAC system.

b. Where possible, equipment serving elevator machine rooms should be located outside of the room. In no case may utilities not serving the elevator machine room pass through the space.

c. For hydraulic elevators, provide a minimum of 50 l/s (100 cfm) of exhaust for negative pressure odor control.

23.2.6.15. Entry Vestibules and Lobbies:

a. All building entries must include a vestibule as required by the adopted energy code. Vestibules must be appropriately sized to ensure that both sets of doors are not open simultaneously during normal use. Use of double or offset vestibules or revolving doors should be considered to meet this requirement.

b. Provide a heating source sized to offset expected infiltration when the exterior doors are open. For vestibule ceilings higher than 2.7 m (9 ft), heat must be provided from an elevation of 2.7 m (9 ft) or lower. Consider the use of high-capacity air curtains for high-use entries.

c. Lobbies must be served from dedicated HVAC systems. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for additional design guidance.

23.2.6.16. Loading Docks:

a. Provide heated air curtains for loading docks in ASHRAE climate zones 4 and higher. Alternatively, gas-fired radiant heaters may be used. When using gas-fired equipment, ensure proper venting of combustion air and exhaust is incorporated.

b. Provide snow melting systems for loading docks located in ASHRAE climate zones 4 and higher. Refer to the snow melting section of this standard for additional requirements.

c. Loading docks must be served from dedicated HVAC systems. Refer to SDS Design Guidelines, Chapter 11- Safety and Security Engineering Requirements in Volume 1 for additional design guidance.

23.2.6.17. Mail Rooms:

a. Mail rooms must be served from dedicated HVAC systems. Refer to SDS Design Guidelines, Chapter 11- Safety and Security Engineering Requirements in Volume 1 for additional design guidance.

23.2.7. General Equipment Requirements:

23.2.7.1. All equipment must be new, of the latest design, and of the best quality available for the application.

23.2.7.2. Project specifications must require that the contractor inspect all equipment prior to delivery to the job site to ensure freedom from defects in workmanship and materials.

23.2.7.3. All equipment and products specified and installed must be standard items of production having not less than three years of proven successful field experience that involved operation or usage under conditions equivalent to those of the project on which they are applied.

23.2.7.4. All equipment must be applied and installed strictly in accordance with manufacturer recommendations.

23.2.7.5. For any equipment that is stored prior to installation, the project specifications must require the contractor to submit a storage plan.

23.2.8. Redundancy Requirements:

23.2.8.1. Review redundancy and maintainability of main systems and provide standby and back-up power for critical equipment.

23.2.8.2. Redundant systems must be provided for critical uses. In general terms, redundancy must comply with Table 2.

System	HVAC Equipment Redundancy	Standby Power for HVAC
Data Centers	N+1	Yes
IT Closets (>7 kW Load)	N+1	Yes
Central Chiller Plants	N+1	*
Central Boiler Plants	N+1	*
Main System Pumps	N+1	Same as System Equipment
Steam Condensate Pumps	N+1	Same as System Equipment
Large Walk-In Coolers	N+1	Yes
Equipment on Emergency Power	*	Yes
Security Operations Center (SOC) / Unit Control Room (UCR)	N+1	Yes
Security Server Room (SSR)	N+1	Yes

* Confirm requirement with the SI design COTR

Table 2 – Redundancy Requirements

23.2.9. Central Heating and Cooling Design Criteria:

23.2.9.1. All buildings must be provided with capped and valved piping for an emergency boiler and chiller hookup in the event of a boiler or chiller failure. The piping must be sized to cover failure of the largest boiler and chiller. Piping must be extended to the exterior wall and location of the temporary boiler/chiller must be shown on the design drawings. Piping can either extend through the exterior wall or be terminated on the inside face of the wall if nearby access for temporary piping is provided.

23.2.9.2. General Services Administration (GSA) Steam

a. Use of GSA steam must be evaluated on a project-by-project basis with consideration for steam quality, reliability, and cleanliness. A lifecycle cost analysis must be performed to determine if utilization of GSA steam or standalone hot water generation is more optimal.

b. If GSA steam is utilized, provide a pressure-reducing station inside the building with a pilot-operated regulating valve and mechanical relief. Do not exceed 345 kPa (50 psig) of pressure drop over a single reducing valve.

c. Steam supply pressure from GSA pressure-reducing station to building: 207 kPa (30 psig)

d. Building operation steam pressure: 69 kPa (10 psig)

e. Provide 1/3 and 2/3 valves where large variations in load are expected and for all applications exceeding 900 kg/hr (2,000 lb/hr).

f. For each steam heat exchanger, provide an isolation valve on the inlet piping connection with stainless steel chemical injection port between the valve and exchanger for chemical cleaning of the tube bundles. Provide DN25 (1 in) test port with valve and hose bib on condensate drainage line between equipment and trap isolation valve.

g. The preferred building heating medium is hot water. Steam for heating may only be utilized with specific approval by the SI.

h. When using hot water, provide steam-to-water, shell and tube type heat exchanger(s) with a variable speed pumping system.

23.2.9.3. On-Site Hot Water Generation:

a. Where lifecycle cost effective, where GSA or central steam is not available, or where using GSA steam is not deemed appropriate by the SI, building heating must be provided through a hot water boiler system.

b. Where natural gas service is available, the boilers must be gas-fired. If natural gas is not available, the boilers must be either #2 oil-fired or propane with an on-site storage tank. Sizing of the tank and fuel type must be reviewed with the SI.

c. While high-efficient, gas-fired, condensing type boilers are the preferable technology, their suitability for the specific application must be proven through a lifecycle cost analysis. The designer must consider the benefits of a low temperature distribution system with relation to the boiler efficiency and evaluate this against the heating needs of the facility to determine the optimal configuration.

d. Where possible, boilers must be direct-vented to prevent freeze-ups within the boiler room. Where direct-vented options are not available, a heating and ventilating unit with hot water preheat coil must be installed to provide required combustion air and heating in ASHRAE climate zones 4 and higher.

e. All rooms containing fuel-burning equipment must be provided with carbon monoxide gas monitoring. The sensors must be connected to the BAS and fire alarm systems. In addition, provide a fuel-burning equipment shutdown switch at each boiler room exit and hard wire directly into the equipment's safety circuit.

23.2.9.4. GSA Chilled Water:

a. Use of GSA chilled water must be evaluated on a project-by-project basis with consideration for reliability and cleanliness. A lifecycle cost analysis must be performed to determine if utilization of GSA chilled water or standalone chilled water generation is more optimal.

b. Coordinate any requirements for building pumps or valve assemblies with the SI and GSA.

c. Provide chilled water isolation valves at the building piping entry to permit complete isolation of the building.

23.2.9.5. On-Site Chilled Water Generation:

a. When using a local chiller plant, the designer must evaluate the most optimal configuration and technologies based on a lifecycle cost analysis. This must include evaluation of air-cooled versus water-cooled plants and screw, centrifugal, and magnetic bearing chiller technologies. Other technologies such as absorption, adsorption, or steam turbine chillers may be considered upon review with the SI and if lifecycle cost effective.

b. Pumping configuration must be primary-secondary or variable flow primary based on the life cycle cost analysis and approval by the SI.

c. Chilled water distribution temperature must be between 5.6° C (42° F) and 7.2° C (45° F) depending on space conditions. Systems will target a delta-T between 6.6° C (12° F) and 7.7° C (14° F).

d. The condenser must be configured for a maximum entering water temperature of 29.5° C (85° F) and leaving water temperature of 35° C (95° F) when paired with a cooling tower. The use of an open cooling tower versus a closed-circuit cooler may be evaluated based on lifecycle cost effectiveness and maintenance complexity.

e. Provide a dedicated condenser water pump per cooling tower cell (minimum one cell per chiller). Condenser water pumps must include variable speed drives. Automatic isolation valves must be provided at the inlet and outlet of each cooling tower cell and on the inlet of each chiller evaporator and condenser for multi-chiller plants. Provide an equalizing line with isolation valves between all cooling tower cells.

f. Provide a temperature-controlled bypass on all condenser water systems for low load / low ambient operation.

g. Configure multi-tower installations with appropriate valves to permit draining of a single cell without affecting the performance of the other cells.

h. All water-cooled plants must include a plate and frame heat exchanger for waterside economization. The cooling towers must be freeze protected with electric pan heaters and all exterior piping must be heat traced. Equipment requiring year-round chilled water must be selected at an elevated winter entering water temperature to maximize economizer run hours. The designer must determine the optimal water temperature to serve the system.

i. Air-cooled chillers must be provided where water-cooled plants are not lifecycle cost effective or are not otherwise feasible. Air-cooled chillers must include economizer coils to permit free cooling and full winter operation. The chilled water system must utilize a propylene glycol solution for freeze protection in areas subject to freezing temperatures. All chillers, cooling coils, and pumps must be appropriately de-rated for systems utilizing glycol.

j. The use of modular chillers, heat recovery chillers, and thermal energy storage systems may be considered where lifecycle cost effective.

23.2.9.6. Ground-Coupled Geo-Exchange Heat Pumps:

a. The use of ground-coupled, closed-loop, geo-exchange systems may be considered to aid in meeting the sustainability and energy targets for the project and if determined to be lifecycle cost effective and if reviewed and approved by the SI. Designers must consider the availability of site area for the well field and the geotechnical nature of the site.

23.2.10. Air-Handling Systems:

23.2.10.1. Air-Handling Units:

a. Units must be indoor, or rooftop mounted as available space permits and as dictated by the architectural review.

b. Cooling coils must be selected to meet space cooling and dehumidification requirements with a cooling coil discharge temperature between 8.9° C (48° F) and 12.8° C (55° F). Lower temperatures may be justified based on final space design conditions.

c. Multiple fans or fan arrays with Variable Frequency Drive (VFD), direct drive motors must be utilized to provide a level of redundancy and easier motor removal.

d. Fans must be sized based on a minimum filter loading of two times the initial (clean) condition and then rounded up to the nearest 125 Pa (0.5 in wg) per filter bank. Provide all filter banks with differential pressure sensors to report actual pressure drop across the filters to the BAS. Magnehelic gauges must also be provided at each filter bank for manual monitoring of the filter loading at the unit.

e. Calculated air-handling unit peak supply air volume must be rounded off to the next 10 l/s (100 cfm) and increased by a minimum of 5 percent to account for air leakage from the ductwork and system components. Increase as required to account for expected duct leakage based on the specified duct leakage class.

f. All exterior equipment must be analyzed for both accessibility and visibility. Provide screen walls, walking paths, access ladders, and platforms to provide full serviceability and acceptable visibility in accordance with the architectural review.

g. Return fans must be mounted within rooftop units. Indoor units may have the return fans duct- or unit-mounted.

23.2.10.2. Freeze Protection:

a. Preheat coils must be hot water with a circulation pump. Coils must be selected for a minimum tube velocity of 0.9 m/s (3 ft/s).

b. Where steam preheat coils are approved for use, provide integral face and bypass dampers with a two-position steam valve. Elevate unit to the appropriate height to permit installation of the steam trap.

c. Air blenders must be included where space permits in climates subject to freezing temperatures. If air blenders cannot be accommodated, the designer must carefully analyze the mixing plenum to ensure optimal mixing conditions. Evaluate damper orientations and provide additional baffles as needed.

d. All rooftop units located in climates subject to freezing temperatures must include a preheat coil regardless of calculated mixed air temperature. Indoor units must include preheat coils where calculated mixed air condition falls below design discharge air temperature at the minimum air flow condition.

e. Provide a manual-reset, low-limit thermostat on the incoming side of the cooling coil in climates subject to freezing temperatures.

23.2.10.3. Economizers:

a. Waterside economizers are the preferred approach. For facilities without waterside economizers, provide airside economizers where required by code or to meet the project’s energy performance goals.

b. Airside economizers must be controlled so that space temperature, humidity, and pressure are not sacrificed. The sequences of operation must specifically indicate how this will be accomplished.

23.2.10.4. Filtration:

a. Provide all air-handling units with pleated, MERV 8 pre-filters located downstream of the air mixing point and upstream of all coils.

b. All air-handling units must be provided with a bag type, MERV 13 intermediate filter. The filter must be upgraded to MERV 14 when serving exhibit spaces, galleries, archival and collections spaces, or other spaces as recommended by ASHRAE applications.

c. Provide gas phase (activated carbon) filtration where required for odor control or as dictated by programmatic needs or outside air intake analysis. Outdoor air sampling is required for all critical storage and exhibit spaces. Verify with the SI if site air quality data is available at the pre-design phase.

23.2.10.5. Ultraviolet Germicidal Irradiation (UVGI):

a. Incorporation of UVGI technology for surface decontamination within the air-handling unit must be reviewed with the SI. For projects where UVGI is not deemed appropriate, space downstream of the cooling coil must be reserved for installation of future emitters.

b. Refer to SDS Design Guidelines, Chapter 11- Safety and Security Engineering Requirements in Volume 1 for additional design guidance on UVGI systems for active biological control.

23.2.10.6. Energy Recovery:

a. Enthalpy wheels are the preferred heat recovery technology. Other technologies may be evaluated through a lifecycle cost analysis. Supply and exhaust fans must be configured to eliminate exhaust to supply crossflow leakage. The wheel must include an air purge section to limit carryover leakage to 1 percent maximum. Adjust fan sizing to accommodate additional purge air flow.

b. Provide an energy study for system comparisons. Verify the increased fan energy with these devices does not offset their energy savings.

c. Refrigerant heat pipes and heat plates may be used if energy efficient and lifecycle cost effective.

d. Energy recovery systems with cross contamination or carryover potential must not be used within areas with hazardous exhaust in accordance with the IMC. A system that will not permit cross-contamination may be used based on energy savings and lifecycle cost analysis.

23.2.10.7. Humidification:

a. Where required by these SDS, provide humidification to meet specified interior conditions. Steam quality must be evaluated for humidification sources. Provide clean steam generators where steam quality is not appropriate for direct injection humidification. Steam-to-steam units are preferred, but smaller systems may be electric or gas-fired.

b. Determine and specify the best appropriate pre-treatment for humidifiers based on use and maintenance concerns. Pre-treatment options include de-chlorinators, water softeners, and Reverse Osmosis (RO) systems.

c. Install humidifiers in air-handling units or supply ductwork. Ductwork and air-handling unit sections housing humidifiers must be constructed of Type 304 stainless steel for a minimum of 0.3 m (12 in) upstream and 1.0 m (36 in) or three times the manufacturer’s published absorption distance at the design condition, whichever is greater, downstream of the humidifier. Provide a sloped drain pan with drain and p-trap to floor drain. Utilize Type 316L stainless steel for ductwork and piping associated with clean steam systems served from RO systems.

d. For new construction projects housing humidified spaces, the building envelope must be designed for the expected humidity level plus or minus 5 percent at the extreme outdoor air condition. For renovation projects, the existing envelope must be evaluated and upgraded as required to accommodate the interior humidity levels to eliminate risk of condensation. Analysis must consider any thermal bridges in the design or existing condition.

23.2.10.8. Fans:

a. Direct-drive fans will be used to the maximum extent possible.

b. Fans must be provided with all required guards and safety covers as required by Occupational Safety and Health Administration (OSHA) regulations.

c. Provide gravity backdraft dampers on all fans, including fans in an array configuration.

23.2.11. Duct Distribution Systems:

23.2.11.1. Duct Requirements:

a. Industrial ventilation systems must be provided in areas where indicated by the user groups.

b. Locate any water-bearing equipment (coils, humidifiers, fan coil units, air-handling units, etc.) outside of collections areas.

23.2.11.2. Interior Acoustic Lining and Insulation:

a. Acoustic lining is not permitted except on transfer ductwork. All other noise mitigation must be done through sound attenuators and/or exterior-mounted sound lagging.

23.2.11.3. Design Pressure Class and Velocity:

a. The designer must determine the appropriate ductwork pressure class by evaluating the maximum total fan pressure at the expected minimum flow condition due to unexpected closing of dampers in the system.

b. Ductwork must be sized using the equal friction method. Design friction factors must be selected to meet noise criteria and to meet ASHRAE 90.1 fan power limitations. Maximum duct velocities are limited to 8 m/s (1,600 fpm).

c. Duct pressure classes must be indicated on the design drawings. Provide a duct pressure class schedule indicating duct system, design pressure class, test pressure, seal class, and leakage class.

23.2.11.4. Thermal Zoning Guidelines:

a. Systems must be zoned to provide optimal comfort. Zoning considerations must include:

b. Exposure: Thermal zones must not include more than one exposure except where the thermal zone serves one space.

c. Occupancy: Occupancy patterns and types must be consistent within the same thermal zone.

d. Proximity: Thermal zones must be defined to minimize extent of ductwork downstream of the VAV box.

e. Space Function: Space functions must be consistent within the same thermal zone.

f. Schedule: Occupancy schedules must be consistent within the same thermal zone.

g. Maximum Air Flow: VAV boxes serving multiple spaces shall not exceed 560 l/s (1,200 cfm) and must be limited further by established acoustic targets. VAV boxes serving large, open areas may exceed 560 l/s (1,200 cfm) as limited by established acoustic targets.

h. Do not serve more than three offices from a single thermal zone.

23.2.11.5. Air Devices:

a. Air devices must be selected to provide optimal air mixing and distribution within the space. Special consideration must be taken to ensure that noticeable drafts are not created on building occupants by limiting air flow velocity within the occupied zone to 0.25 m/s (50 fpm).

b. Where linear slot diffusers are utilized, provide adjustable throw deflectors to permit airflow pattern adjustment.

c. Select air devices to meet specified noise criteria for each space type on the project.

23.2.11.6. Emergency Generators:

a. Dampers serving generator room intake and exhaust must fail in the open position (fail safe). Where possible, provide a room recirculation damper from the radiator exhaust that is normally open, fail closed, for generator startup and space heating.

b. Exhaust duct/piping for emergency generators must comply with NFPA 110, NFPA 37, and the IMC.

c. The exhaust must have an integral muffler/silencer with a spark arrestor provided or approved by the generator manufacturer.

d. Generator rooms must be continuously exhausted at a minimum of 7.62 L/s per square meter (1.5 CFM/sf) or higher as required by the IMC and NFPA 855 for battery storage areas.

e. Provide additional ventilation to limit the space temperature to the generator manufacturer's maximum limitations under full load operating condition of the generator on a design cooling day.

f. The generator room must continuously maintain negative pressure in relation to the adjacent space.

23.2.12. Hydronic, Steam, and Refrigerant Piping Systems:

23.2.12.1. Piping Requirements:

a. Provide shut-off valves at the entrance of the building and on each floor on riser takeoffs.

b. Balancing and triple-duty valves must not be utilized for isolation service. Provide an additional isolation valve downstream of all balancing and triple-duty valves for dedicated isolation service.

c. Do not install balancing valves in the discharge of pumps driven by a variable speed drive.

d. Install automatic air vents on all air separators and air handling unit chilled and hot water coils. Install manual air vents on smaller coils and at all system high points. All automatic air vents and pressure-relief valves must be piped to the nearest code-compliant disposal point; do not discharge onto the floor.

e. High pressure steam-relief valves and refrigerant-relief valves must discharge to the building exterior in accordance with the IMC.

f. Hard piped expansion loops are preferred where space permits. Flexible expansion loops similar to Metraflex Metraloop may be utilized where space is limited.

g. Expansion joints can only be utilized with specific approval by the SI and where space does not permit the installation of hard piped or flexible expansion loops.

h. Taps must be provided to measure flow at each pump and heat exchanger.

i. Wells for thermometers must be provided at each heat exchanger.

j. Gauges must be specified on supply and return piping of pumps, boilers, cooling towers, chillers, converters, and where lines enter and exit mechanical rooms.

k. Thermometers must be specified on supply/return piping associated with water chillers, boilers, cooling towers, air-handling units, fan coil units, and at other points as necessary.

23.2.12.2. Perimeter Heating:

a. Perimeter heat must be provided in all areas where the calculated heating load cannot be offset by raising the air temperature a maximum of 11.1° C (20° F) above the indoor design condition when the VAV box is at calculated minimum heating air flow.

b. The designer must consider reduction in diffuser throw velocity in heating mode when not including a perimeter heating system.

23.2.12.3. Snow Melting and Radiant Systems:

a. Snow melt systems must be utilized at loading docks, ramps, and stairs in ASHRAE climate zones 4 and higher. The systems must be hydronic or electric resistance type suitable for direct burial in concrete or asphalt. The extent of snow melting system and type must be reviewed with the SI.

b. Hydronic snow melting systems must be designed to an ASHRAE snow-free ratio of 0.5 at 99 percent heat flux based on the design winter outside air temperature. Design wind speed must be the greater of the mean coincident wind speed for the 99.6 percent heating dry bulb as per the current ASHRAE data, but in no case less than 4.5 m/s (10 mph).

c. Radiant heating systems may be considered by the designer where appropriate and approved by the SI.

23.2.13. Natural Gas Distribution:

23.2.13.1. Provide a gas main meter and regulator on the building exterior at the building entrance. Install an intrinsically safe barrier for connection of the gas meter to the BAS.

23.2.13.2. Provide solenoid valves for gas shutoff in all kitchens and food preparation areas.

23.2.13.3. Project designers must review the gas pressure requirements for all equipment installed on the project against the available gas pressure from the utility. Include pressure regulators or pressure boosters as required to meet the requirements. In general, natural gas will be distributed through buildings at 13.8 kPa (2 psi) maximum pressure, unless a higher pressure is required by the appliances.

23.2.13.4. Provide shutoff valves for each natural gas piping branch and at each piece of natural gas equipment. Shutoff valves must be American Gas Association (AGA) rated ball or plug valve type. Do not conceal valves above ceilings or in walls.

23.2.13.5. Natural gas system design and installation must be compliant with NFPA Standard 54.

23.2.14. Vibration Isolation and Acoustics:

23.2.14.1. Acoustic levels attributed to the HVAC system must meet the recommendations of the acoustician or the ASHRAE applications handbook, latest version. Where a conflict occurs, the more stringent criteria governs.

23.2.14.2. For acoustically sensitive areas, defined as areas having NC 30 or less, an acoustician must be engaged to review and calculate the appropriate noise mitigation measures to meet the design guidelines.

23.2.14.3. For small projects without acoustically sensitive areas, defined as areas having NC 35 or greater, the mechanical design engineer may perform, certify, and submit the calculations in lieu of an acoustician.

23.2.14.4. For acoustically sensitive areas, noise-generating HVAC equipment will be located outside the sensitive space. Where this is not feasible, the acoustician must evaluate both the discharge and radiated noise from the equipment, and the design engineer must include required noise mitigation measures for both sound paths in the design.

23.2.14.5. Sound power levels used for the acoustic analysis, by octave band, must be scheduled on the drawings for all motor-driven equipment.

23.2.14.6. Sound data for air volume control boxes must be scheduled on the drawings and must include both discharge and radiated NC levels. The air volume control box noise data must be scheduled at the expected inlet pressure based on the fan system design.

23.2.14.7. At the completion of project balancing and with the HVAC systems operating in occupied mode, but prior to occupancy, all acoustically sensitive areas must be acoustically tested by the acoustician to ensure target NC levels are met. If spaces fail to meet the NC targets, the acoustician must recommend remediation measures to be taken to bring the spaces into compliance, and these measures must be incorporated by the design and construction team.

23.2.14.8. Main pumps, fans, and cooling towers must be continuously monitored for vibration through a dedicated system by the SI predictive maintenance group. Extent of vibration monitoring and system details must be coordinated with the predictive maintenance group and incorporated into the project design.

23.2.15. Energy Management:

23.2.15.1. Provide motors, commercial packaged air-conditioning units, chillers, and lighting products that are either Energy Star-qualified or Federal Energy Management Program (FEMP) designed products.

23.2.15.2. Load and expected energy usage calculations required in meeting the guidelines and policy directives, including LEED, must be submitted to the SI for review as part of design.

a. Energy consumption devices must be tied into the BAS for monitoring and harvesting data for billing reports.

23.2.15.3. At a minimum, the following systems must be sub-metered within the project scope:

a. Total electrical energy

b. Interior lighting

c. Exterior lighting

d. Plug loads (receptacle circuits)

23.2.15.4. Additional sub-metering of the following systems must be considered on a project-by-project basis and reviewed with the COTR:

a. Fans

b. Pumps

c. Heating and humidifying equipment

d. Cooling and dehumidification equipment

e. Heat rejection equipment

f. Service hot water

g. Natural gas meters

h. Renewable energy systems

i. Elevators

j. Exhibit power/lighting

k. Any other end use exceeding 10 percent of total building energy use

23.2.15.5. Provide the following areas with revenue grade sub-metering for HVAC serving reimbursable areas:

a. Air-handling unit electricity

b. Refrigerator condensing unit electricity

c. Heating energy used for kitchen water heating

d. Main chilled water-cooling energy produced or main chilled water to building (MMBtu)

e. Hot water heating or steam heating plant's heating energy output (MMBtu)

f. Total electricity used for chilled water plant

g. Total electricity used for steam and/or heating water plant

23.2.15.6. Meters must be permanent type set up to record on 15-minute intervals with data archived for a minimum of 36 months. The program must include calculations for monthly total as well as displaying the previous month total. Users must be able to create a report to display the past three months' total and the system must display continuous running total, running daily total, running monthly total, and past month total. The report must also be capable of reporting all metering reports in one report per site.

23.2.15.7. All meters must be integrated into the BAS for ease of reference and archiving. The BAS must include the following parameters:

a. Cooling and hot water heating energy produced or used, measured in XXX.X MMBTU

b. Steam output measured in XXX.X MLBS (1,000 lbs)

c. Daily and monthly energy totals with monthly reports

d. Display of the meter's daily total, monthly total, flow, supply temperature, and return temperature on the graphics page

e. Metering of additional heating, cooling, or humidifying is not required unless specifically requested by the SI.

23.2.16. Building Automation Systems (BAS):

23.2.16.1. General:

a. The primary purpose of the BAS is to provide dynamic control, economical operation, and operational information of the equipment to the operating staff.

b. When this system is installed, it will aid the engineer in certifying that the contractor has installed and set up the equipment to the engineer's specifications.

c. This standard is mandatory before the SI will accept the mechanical portion of the project. Contact the SI Systems Engineering Division – Controls Branch for the vendor contacts. It is intended that the Direct Digital Control (DDC) vendor work with the project engineers to develop the most efficient system and to aid the engineers with developing control specifications to achieve such a system.

23.2.16.2. Acceptable Manufacturer:

a. The DDC building controls system must be manufactured and installed by Siemens Industry, factory/corporate branch office in Beltsville, Md. The system must be an extension of, and fully integrated with, the existing SI-wide Siemens Facility Management and Control System

(FMCS). All new projects must utilize the Desigo platform. For renovation projects where a legacy Apogee platform exists, review whether to migrate to Desigo or extend Apogee with the SI Systems Engineering Division – Controls Branch.

23.2.16.3. System Architecture:

a. The new DDC system must be connected to the FMCS database server within the Herndon Data Center (HDC) for full database management via the Siemens software. All new controls must be fully accessible through the existing site-wide operator terminals and FMCS database server. Siemens contact information must be obtained through the SI design manager. The control contractor is responsible for determining compatibility prior to submitting a bid.

b. Design drawings must include a system architecture diagram showing all communication protocols, DDC panels, supervisory controllers, and communication interfaces.

c. DDC panels and the DDC FMCS database server must be connected through the SI.edu network, using TCP/IP over an ethernet routed network. Provide all equipment, materials, and software necessary to connect DDC panels via the owner-provided network drops. It must be possible to access any DDC panel through the network. Such access must include full read-write capability from an operational as well as programming standpoint. Total system information must be available to the FMCS database server at all new or existing operator workstations.

d. All third-party devices and controllers must be connected (via the FLN or MS/TP network) downstream of, and routed through, the Siemens panel where the control is being performed. Direct connection of third-party devices and controllers to the SI.edu network is prohibited.

e. The control system must be set up and configured in such a way that communication between panels is eliminated or kept to an absolute minimum.

f. The control system must be set up and configured in such a way to eliminate communications between BLN/ALN. Cross trunk service will not be utilized.

23.2.16.4. Direct Digital Control (DDC) Panels:

a. Provide a DDC panel for each system to be controlled. All equipment including controllers, expansion modules, transformers, etc. must be housed within a lockable, NEMA 1 enclosure for indoor applications.

b. DDC panels must include minimum 10 percent spare capacity of each point type (AI, AO, DI, DO). Universal inputs/outputs may be used in the spare calculation but cannot be double counted.

c. DDC panels must be provided with minimum 0.9 m (3 ft) of service clearance directly in front of the panel.

d. All DDC panels must be permanently labeled with engraved plastic nameplates, white with black center cores.

e. DDC panels that are critical in nature, such as emergency generator monitoring or life safety control, must be provided with standby power and standalone Uninterruptible Power Source (UPS) units so that conditions can be monitored during a power outage. DDC panels serving equipment on normal power may be connected to the normal power system.

f. Life safety systems such as atrium smoke exhaust and stair pressurization must be initiated through the fire alarm system with end devices monitored through the BAS. Provide centralized control rooms in larger buildings and where required by code.

23.2.16.5. Graphics and Logs:

a. Provide new global graphics for a user-friendly interface to the new and existing detail graphics. Provide an overall riser diagram page that will allow instant access to new floor plan graphic pages, individual air handling units, and central plants. An individual floor plan graphic will be provided for each floor of the building. The floor plan will show air-handling zone layout and provide a link to the associated air handler graphic within each zone. Each space temperature and humidity available on the DDC system must be interactively displayed on the floor plan. Provide sub-area graphics as required to fit all readings.

b. The DDC contractor must program the building controllers and all operator central computers to locally log trend data. The FMCS database server must maintain communications with the building controllers and retrieve the trend data. The FMCS database server must store all historical trend data over the period of trend capture.

c. The DDC contractor must install all graphic displays for all systems and controlled devices in the FMCS database server located in the HDC. The graphic displays must illustrate the depiction of the device, sensor, and control point locations. The graphics must display dynamic sensor readings in engineering units.

d. Graphics must conform to SI standards and must include equipment names and areas of service. All graphics must be submitted to the SI and the project engineer for review and approval.

e. The DDC contractor must update the SI Siemens FMCS database with all set points, analog and digital input points, analog and digital output points, programs, application-specific controllers, schedules, alarm parameters, and user rights.

f. The FMCS database server must contain an exact copy of all DDC control sequences in the project.

23.2.16.6. Alarms:

a. Alarms must be configured and annunciate in accordance with SI requirements, which must be coordinated on a project-by-project basis. At a minimum, alarms must be included for:

i. Equipment failure or status failure

ii. Temperature out of range

iii. Humidity out of range

iv. Pressure out of range

v. Airflow out of range

vi. Filter or UV light change

vii. General equipment alarms

b. All critical alarms must be hard-wired between the DDC control panel and equipment. Use of network communications for annunciation of critical alarms is not acceptable.

23.2.16.7. Devices and Sensors:

a. Indicate all space sensors on the design drawings. Locate sensors so they record accurate space conditions and will not be influenced by exterior conditions, interior equipment heat, or air flow patterns from the HVAC system. Locate temperature and humidity space sensors on interior walls near return air openings where possible.

b. Include any temperature and/or pressure sensors that will provide enough information to complete the thermodynamic picture of the engineer’s project; for example, if you are connecting to the central chilled water distribution system, the engineer should include temperature and pressure sensors on the supply and return. Also include a flow transducer. Specify KW-hour (BTU) calculations on the water extracted from the distribution system.

c. Install CO2 sensors in high occupancy areas to help reduce the amount of outside air being brought into the building and to reduce the energy to pre-heat or pre-cool the air to ensure requirements outlined in ASHRAE 62.1 are met. Provide graphic override of CO2 control on the operator workstation.

d. Provide occupied/unoccupied signal from spare contacts on the Division 26 lighting system occupancy sensor to switch terminal units from occupied to unoccupied set points to conserve energy in exhibit areas, classrooms, and laboratories. Space design temperature ranges and humidity must continue to be maintained in unoccupied mode.

e. Provide a pressure sensor downstream of all steam pressure-reducing valves to alarm upon a rise in pressure above set point.

f. Provide a temperature sensor downstream of all terminal reheat coils.

23.2.16.8. Valves:

a. Control valves must be two-way configuration when utilized on variable flow systems. Use of three-way valves is limited to heating systems for end-of-line applications.

b. For all new facilities or large-scale renovation projects where all existing control valves in the system will be replaced, utilize pressure-independent control valves to maintain design system differential temperature on chilled water systems and heating systems using condensing boilers. Other systems may use traditional control valves paired with automatic flow control valves.

c. Pressure differential bypass valves must be sized for 50 percent of pump head at full flow.

d. A combination of valve actuator and trim must provide a minimum close-off pressure rating equal to the pump dead head (zero flow) pressure for two-way vales and 100 percent of pressure differential across valve for three-way valves.

e. Install actuators on all steam valves out of the heat path (side orientation) to extend actuator life.

f. Fail Positions:

   i. Reheat and steam coils must fail open if they are conditioning the outside air.

   ii. Reheat coils will fail in last position if they service interior loads, except reheat valves serving collections or archival areas must fail closed.

   iii. Heat exchanger steam valve must fail closed and heating water valve must fail open.

   iv. Chilled water valves must fail closed except where serving critical cooling areas (IT rooms, electrical rooms, etc.) with no exterior exposures that would subject them to freezing.

23.2.16.9. Communication Interfaces:

a. Major equipment including chillers, boilers, variable speed drives, packaged equipment, and elsewhere where available, must be provided with a network communications interface card for integration to the BAS.

b. Preferred protocol is BACnet MS/TP. If BACnet is not available, MODBUS RTU may be utilized, but hard-wired controls must be used to the maximum extent possible. Coordinate extent of hard-wired controls with the SI controls group.

c. Network interfaces, sequences of operation, trending, and metering must be shown on design drawings and the control contractor must be responsible for mapping all available points from the network interface to the BAS server.

d. System graphics must include a one-click interface to access the contents of the network information. The extent of information displayed on the graphics must be coordinated between the control contractor and the SI.

e. Information obtained from communication interfaces must not be utilized for critical control or alarming. All start/stop, alarm, and set points must be hard-wired from the DDC panel to the equipment.

23.2.16.10. Sequence of Operation Requirements:

a. The control sequences must be specified by the design project engineer for all airside and waterside systems and equipment. Sequences must be in accordance with ASHRAE Guideline 36: High Performance Sequences of Operation for HVAC Systems.

b. Expected times of operation must be listed on the design drawings. All systems must include programmable occupied/unoccupied scheduling capabilities and optimal start/stop logic. In general, facilities will operate on either a 24-hour per day / 7-day per week schedule or a 16-hour daily occupancy schedule with night setback.

c. Design for night setback in acceptable spaces, allowing the resetting of the supply air or shutdown of the Air Handling Units (AHUs). Night setback temperatures must be indicated in the sequences of operation.

d. All new air handlers, exhaust fans, and fume hoods must be programmed for an emergency shutdown sequence mode.

e. Where waterside economizers are not included in the design, provide airside economizer control to bring in free outside air (cooling air) when the enthalpy differences are optimal for such operation. Economizer must be controlled based on comparative enthalpy between the return air stream and outdoor air condition with an adjustable high and low limit set point.

f. Include control and monitoring sequences for plumbing systems specified in Division 22 for each project. This may include water treatment systems for water features, domestic hot water generators, sump pumps, pressure booster pumps, or compressed air monitoring, among others. Coordinate full scope of Division 22 monitoring with the project plumbing engineer and the SI.

23.3. Specifications

23.3.1. General HVAC Items:

23.3.1.1. HVAC Air Duct Cleaning:

a. The intent of this specification section is to limit duct cleaning to systems affected by the construction project. Adequate care must be taken by the contractor to prevent construction dust and debris from affecting areas outside of the construction boundary.

b. Protect and cover all openings before the start of demolition and throughout construction. Clean all AHU inside surfaces and interior ductwork before startup.

c. All new ductwork must be delivered to the site internally cleaned with all openings sealed with polyethylene film. Similarly protect openings in ductwork, casings, and plenums.

d. Any ductwork that becomes visibly dirty during construction per the engineer or SI review will require full cleaning per NADCA standards at the contractor's expense.

23.3.1.2. Common Motor Requirements for HVAC Equipment:

a. All HVAC equipment must have a Short Circuit Current Rating (SCCR) equal to or greater than the electrical distribution equipment feeding it. SCCR ratings must be clearly marked on equipment and noted in equipment submittals.

b. Motors driven by VFDs must be inverter duty rated, NEMA MG-1 Part 31, with Class H insulation.

c. Provide all motors driven by a VFD with shaft grounding rings to protect against Electrical Discharge Machining (EDM) motor bearing damage.

23.3.1.3. Expansion Fittings and Loops for HVAC Equipment:

a. Provide access to all flexible expansion loops and expansion joints.

23.3.1.4. Sleeves and Sleeve Seals for HVAC Piping:

a. Provide a modular hydrostatic mechanical seal, similar to Link-Seal, for penetrating and sealing at underground wall penetrations. Pipe sleeves must be cast directly into the wall for structures with hydrostatic force. Provide steel sleeves with integral water stops and weep rings.

b. Provide sleeves at all wall and floor piping penetrations. Extend sleeve minimum 25 mm (1 in) above finished floor in all mechanical rooms, toilet rooms, and other wet areas.

23.3.1.5. Escutcheons for HVAC Piping:

a. Provide polished, chrome-plated, one-piece escutcheons at any exposed piping penetration in finished areas.

23.3.1.6. Meters and Gages for HVAC Piping:

a. Hydronic flow meters must be insertion type, electromagnetic meters with a minimum accuracy of plus or minus 1.0 percent over the rated velocity range with local LCD display. Meters must be capable of insertion and removal without requiring a system shutdown.

b. Steam flow meters must be a vortex shedding type, full bore, or insertion type, with integral temperature and pressure sensors and local LCD display. Include flow straighteners if required by the installation condition. Provide 3-valve bypass around meter assemblies.

c. Provide each flow meter with a thermal energy management system consisting of the flow station, computer, transmitter, and matched temperature sensors. The system must provide energy, flow, and temperature data on a local LCD display and integrate to the BAS network via a BACnet communications protocol.

d. Thermometers must be tube type, minimum 225 mm (9 in) liquid tube with cast aluminum case and black baked epoxy finish. Provide adjustable angle type with locking device and brass union type separable socket. Select range of thermometer to indicate normal operating temperatures at midpoint of scale with a scale division of 0.5° C (1° F) for cold service and 1° C (2° F) for hot service.

e. Where non-digital readout gauges are used, the following applies:

    i. Gauges for general use must be screw-type recalibration, bronze bushed movements, and single unit construction.

    ii. In main mechanical rooms, provide 115 mm (4.5 in) diameter gauges for all steam pressures, mounted a maximum of 2.5 m (8 ft) above the operating floor.

    iii. Gauges must be calibrated for static head.

    iv. All gauges must be non-pulsating.

v. Provide coil syphon for steam gauges. Provide brass snubber for hydronic gauges with needle valves.

vi. Select gauge range to indicate normal operating pressure of system at midpoint of scale.

23.3.1.7. General Duty Valves for HVAC Piping:

a. Isolation valves for hydronic service must be either ball or butterfly type. Ball valves must be used in piping sizes DN50 (2 in) and smaller; butterfly must be used elsewhere.

b. Hydronic ball valves must be copper-alloy type, MSS SP-110 compliant, two-piece with bronze body and stainless-steel ball and trim.

c. Butterfly valves must be high-performance type with stainless steel disc and stem, designed for bubble-tight, bi-directional dead-end service at full pressure and rated for a minimum of 1034 kPa (150 psi) or higher based on expected maximum system pressure. Valves must be MSS SP-68 compliant. Seat material must be designed for the fluid passing through the valve.

d. Isolation valves for steam service must be gate valves. Ball valves may be used on low-pressure steam piping in pressures of 100 kPa (15 psi) and less in sizes DN50 (2 in) and smaller.

e. Gate valves must be cast iron, OS&Y type with bronze trim, rising stem, and solid wedge disc.

f. Steam ball valves must be ferrous-alloy type, MSS SP-110 compliant, with carbon steel body, stainless steel trim, and carbon-filled PTFE seat rated for 13,770 kPa (2,000 psi) and 1,725 kPa (250 psi).

g. All high-pressure steam valves upstream of the pressure-relief device must be minimum 1,725 kPa (250 psi) rated.

h. All valves installed in insulated piping systems must have extended stems to raise the valve handle above the level of the adjacent insulation.

i. Provide chainwheel actuators on valves DN100 (4 in) and larger located within central plants and mechanical rooms when installed in a line over 2.1 m (7 ft) above the floor. Chains must reach within 1.8 m (6 ft) of floor.

j. Recommended manufacturers are Milwaukee, Jamesbury, Belimo, and Victaulic.

k. Where traditional two-way or three-way control valves are utilized, provide automatic flow balancing valve in lieu of manual balancing valves. Do not provide for applications using pressure independent control valves.

23.3.1.8. Hangers and Supports for HVAC Piping and Equipment:

a. Hangers and supports for HVAC piping and equipment must be provided per the latest editions of MSS SP-58 and MSS SP-69.

23.3.1.9. Heat Tracing for HVAC Piping:

a. Heat tracing is required for all piping subject to freezing temperatures.

b. Heat tracing systems must utilize self-regulating cables with pipe wall or ambient sensing control based on application.

c. Heat tracing systems must include a BACnet communication interface for remote monitoring by the BAS.

23.3.1.10. Vibration and Seismic Controls for HVAC Piping and Equipment:

a. Provide vibration baseline data in accordance with the SI Reliability Centered Maintenance (RCM)-related specifications and reference, developed under the Office of Facilities Management and Reliability (OFMR) and available through design managers.

b. Mechanical and electrical equipment associated piping and ductwork must be mounted on vibration isolators to minimize transmission of vibration and noise to the building structure or spaces. All motors over 3.7 kW (5 hp) must be solidly attached to bases common with the driven units to minimize alignment problems. Solid sheaves and band belts must be used to minimize vibration in multiple V-belt driven equipment.

c. All rotating equipment must be balanced, both statically and dynamically. The structure supporting the equipment must not have any natural frequencies within plus or minus 20 percent of the normal operating speeds.

d. Vibration test pickup must be placed on bearing caps in the horizontal, vertical, and axial directions or on equipment mounting feet if the bearing caps are concealed.

e. Precut, purpose-built, S/S alignment shims are required. Site-cut shim stock is not acceptable.

23.3.1.11. Identification for HVAC Piping, Ductwork, and Equipment:

a. All equipment, ductwork, piping, valves (except those located directly next to equipment), dampers, and actuators must be identified as specified herein.

b. Identify piping by name of pipe content and direction of flow. Ductwork must be similarly labeled with duct system and direction of flow. Ductwork must be labeled on the most visible surface (side or bottom).

c. Identification must be either stenciled onto the system with an oil-based paint or with pressure-sensitive vinyl markers with permanent adhesive. For piping 100 mm (4 in) and smaller, provide full-band pipe markers extending 360 degrees around pipe.

d. Use ANSI A 13.1 for identification of piping systems with revisions as noted in Table 3.

e. All ductwork must be labeled similar to piping and in accordance with ANSI A13.1. Minimum lettering height must be 32 mm (1-1/4 in) for ducts 150 mm (6 in) and smaller and 65 mm (2-1/2 in) in height for ducts 200 mm (8 in) and larger.

f. Plastic tape for color identification must be 3M Scotch brand No. 471 vinyl tape, 5 mil thickness, in colors specified. Equal Texcel or Permacel tape is acceptable.

g. All exposed piping must be painted continuously in the background colors listed in Table 3. For exposed piping in occupied spaces, coordinate painting with the COTR.

h. Provide identification at the following locations and according to Table 3:

   i. All exposed piping:

      a) All exposed piping within 0.5 m (18 in) of each valve

      b) All exposed piping within 75 mm (3 in) of each 90-degree elbow, connection to equipment or vessel, point where pipe enters shaft to upper floors, and point where pipe pierces outside wall

      c) Additional identification at not over 6 m (20 ft) intervals, measured along center line of pipe

      d) Omit identification on piping 40 mm (1 ½ in) size and smaller exposed at connections to equipment or plumbing fixtures.

ii. Above suspended ceilings:

a) Within 0.5 m (18 in) of each valve or valve assembly

b) At tees, both main and branch must be identified within 7.6 m (25 ft) of tee.

c) Within 0.9 m (3 ft) of each 90-degree elbow

d) Minimum of one label per room (each side of partition)

iii. Piping concealed in cases or shafts:

a) Identify each pipe visible through access door panel.

i. Arrows showing the direction of flow must be painted on the piping near the location of each piping identification label.

j. Ductwork must be identified in a similar manner to piping.

CLASSIFICATION	BACKGROUND COLOR	TEXT COLOR
Equipment Drains	Green	White
High Pressure Steam	Orange	Black
High Pressure Condensate	Orange	Black
Low Pressure Steam	Orange	Black
Low Pressure Condensate	Orange	Black
Pump Condensate Return	Orange	Black
Hot Water Supply From Converter or Boiler (Heating)	Yellow	Black
Hot Water Return To Converter or Boiler (Heating)	Yellow	Black
Steam Vent, Steam Relief, Valve Discharge, etc.	Orange	Black
Chilled Water Supply	Blue	White
Chilled Water Return	Blue	White
Condenser Water Supply	Green	White
Condenser Water Return	Green	White
Glycol Supply	Yellow	Black
Glycol Return	Yellow	Black
Fuel Oil Piping (Supply and Return)	Yellow	Black
Natural Gas Piping	Yellow	Black

Table 3 - Schedule of Piping Identification

23.3.1.12. Testing, Adjusting, and Balancing (TAB) for HVAC:

a. TAB is required for all HVAC systems. TAB must be performed using NEBB, AABC, or Testing, Adjusting, and Balancing Bureau (TABB) procedures.

b. TAB companies must be certified by NEBB, AABC, or TABB.

c. The TAB contractor must perform final diffuser throw adjustments during the balancing effort to eliminate drafts within occupied zones.

23.3.1.13. Duct Insulation:

a. Exposed interior sound lining must not be used except at transfer air ducts.

b. Exterior duct insulation must be non-asbestiform mineral fiber or fiberglass, minimum thickness as required per ASHRAE 90.1 or to prevent surface condensation, whichever is greater.

c. Polyisocyanurate insulation must not be utilized within the building.

d. Exposed indoor ductwork must be insulated with a semi-rigid insulation with white kraft All Service Jacket (ASJ) bonded to aluminum foil, with a white paintable finish. Minimum density of 96 kg/m3 (6 lb/cu ft) where subject to damage or when installed below 2.4 m (8 ft), minimum 64 kg/m3 (4 lb/cu ft) elsewhere.

e. Install paintable canvas wrapping on all ductwork located within mechanical rooms and exposed ductwork in occupied spaces. Coordinate paint colors in occupied areas with the COTR.

f. Concealed indoor ductwork must be insulated with either semi-rigid or flexible fibrous duct wrap with Foil Scrim Kraft (FSK) and formaldehyde-free bonding resin.

g. Outdoor duct insulation must be one of the following as reviewed and approved by the SI for the application. All outdoor ductwork must have pitched horizontal surfaces to prevent water ponding.

i. Double-wall construction with semi-rigid insulation, solid galvanized steel inner liner, and stainless-steel outer covering with welded joints for a weathertight installation.

ii. Fiberglass semi-rigid insulation with additional 26-gauge aluminum jacketing with interlocking seams and corner beads, completely sealed and watertight, or an equivalent cladding product.

iii. Closed cell polyisocyanurate foam insulation with foil facing and sealed joints for a watertight installation. Polyisocyanurate insulation is only acceptable for exterior applications.

23.3.1.14. HVAC Equipment Insulation:

a. Insulate equipment with a service temperature below 15.5° C (60° F) with foamed plastic, closed-cell insulation with a maximum vapor transmission rating of 0.08 perms maximum flame spread rating of 25, smoke developed 50, conforming to ASTM E84 with thermal properties of 0.04 k-value at 24° C (0.28 k-value at 75° F). Insulation must be approved according to FM Approval Standard 4924: Approval Standard for Pipe Insulation.

b. Insulate equipment with a service temperature between 15.5° C (60° F) and 175° C (350° F) with a semi-rigid fiberglass insulation with white kraft ASJ bonded to aluminum foil, with a white paintable finish. Minimum density of 96 kg/m3 (6 lb/cu ft) where subject to damage or when installed below 2.4 m (8 ft), minimum 64 kg/m3 (4 lb/cu ft) elsewhere.

c. Insulate equipment with a service temperature exceeding 175° C (350° F), but not exceeding 650° C (1200° F) with an asbestos-free hydrous calcium silicate insulation, with a scored block or radius shape to suit equipment.

d. All equipment must be insulated with 100 percent surface coverage except for nameplates or other accessories. All seams must be sealed with mastic or vapor tape as applicable.

e. Polyisocyanurate insulation must not be utilized within buildings.

f. All exposed insulation must be canvas-wrapped.

23.3.1.15. HVAC Piping Insulation:

a. Insulate piping with a service temperature equal to or below 15.5° C (60° F) with one of the following:

i. Foamed plastic, closed-cell insulation with a maximum vapor transmission rating of 0.08 perms, maximum flame spread rating of 25, smoke developed 50, conforming to ASTM E84 with thermal properties of 0.04 k-value at 24° C (0.28 k-value at 75° F). Insulation must be approved according to FM Approval Standard 4924: *Approval Standard for Pipe Insulation*.

ii. Cellular glass insulation with a maximum vapor transmission rating of 0 perms, maximum flame spread rating of 0, smoke developed 0, conforming to ASTM E84 with thermal properties of 0.045 k-value at 24° C (0.31 k-value at 75° F).

b. Insulate piping with a service temperature above 15.5° C (60° F) with fiberglass insulation with white kraft ASJ bonded to aluminum foil, with a white paintable finish.

c. Provide package removable formed covers for valves 50 mm (2 in) and larger.

d. Indoor piping that is exposed, located below 2.4 m (8 ft), or otherwise subject to damage must be jacketed with either 0.02 mil thick Polyvinyl Chloride (PVC) jacket or 0.41 mm (0.016 in) thick aluminum jacket of alloy Nos. 5005 or 3003. Where systems are specified to be painted, use color-coded PVC jacketing. PVC jacketing is not permitted on steam and steam condensate piping systems.

e. All outdoor piping must be jacketed with 0.41 mm (0.016 in) thick aluminum jacket of alloy Nos. 5005 or 3003. Seal circumferential joints with 50 mm (2 in) wide aluminum snap-strap and clip with a permanently plastic weatherproof sealant. All joints must be sealed, and the entire installation must be weathertight.

f. Insulation installation must be reviewed by the project engineer prior to the installation of the exterior jacketing. If this inspection is not performed prior to installation of the jacketing, installation must be verified through infrared testing.

g. Install paintable canvas wrapping on all piping located within mechanical rooms and exposed piping within occupied spaces. Coordinate paint colors in occupied areas with the COTR.

h. Polyisocyanurate insulation must not be utilized within buildings.

23.3.1.15. Commissioning of HVAC:

a. Refer to SI specification section 01 91 13 *Commissioning* in Volume 2 for general commissioning requirements.

b. Commissioning is the primary responsibility of the commissioning agent, with secondary and support responsibility of the various contractors. The commissioning process does not relieve the contractors from participation in the process or diminish their roles and obligations to complete all portions of the work in a satisfactory and fully operational manner.

c. The commissioning process, to be successful, requires the cooperation and coordination of all members of the commissioning team. The commissioning agent will coordinate directly with each contractor on the project specific to their responsibilities and contractual obligations relative to the commissioning process.

d. Sensor recalibration requirements must be included in the retro-commissioning manual.

23.3.1.16. Instrumentation and Control for HVAC:

a. This section includes all labor, materials, equipment, and service necessary for a complete and operating control system for all HVAC equipment, including control of units not supplied with factory-wired controls and installation and wiring of loose controls shipped with equipment.

b. The SI presently has an existing FMCS (Siemens BAS) as part of past projects. The intent of this specification is to extend and interoperate with this system and to provide a peer-to-peer, networked control system for the control work that is part of the project. All components, software, and operations must be interoperable with the existing FMCS. The installed system will interface directly with the existing FMCS database server. The existing software and database will be modified to accept the new equipment being installed under the project to maintain integrity for centralized scheduling, graphic trending, programming, alarming, and remote notification. PC desktop icons that link to a separate system are not acceptable. Any costs associated with connecting to the existing FMCS, including licensed software, programming, training, etc., must be part of the controls contractor's bid. The contractor must demonstrate ability to perform the integration to the existing FMCS prior to bid submittal acceptance. All systems as described in the sequence of operation will be shown via dynamic graphics with all pertinent system alarms for proper operation and maintenance. The use of separate PC workstations, gateways, metalinks, replacement of existing controllers and control devices, and additional software graphic packages to accomplish this integration will not be accepted.

c. All new HVAC equipment must be provided with DDC control through the BAS, except the following:

d. Boilers, chillers, computer room units, split system units, and water source heat pumps must be provided with factory microprocessor controls and must be monitored and enabled through the DDC system. Provide BACnet MS/TP or MODBUS RTU interface. All critical monitoring and controls (enable/disable, alarm, temperature set point adjustment) must be through hard-wired control to the DDC panel.

e. The SI requires all BAS controls (DDC) to be of the same manufacturer as and connect to the existing SI-wide Siemens FMCS. The DDC vendor must be part of the project during design.

f. The renovation or new building mechanical contractor must hire the Division 230900 (or 15900) contractor to connect the new controls with the existing Siemens FMCS. It must be the responsibility of the Division 230900 contractor to coordinate all work associated with the FMCS connection. The new DDC controls must be connected/integrated to the FMCS over the SI.edu WAN via ethernet connections.

g. All damper and valve actuation must be electric/electronic. Pneumatically operated devices are not acceptable.

h. All control wiring must be installed in minimum DN20 (3/4 in) conduit. Conduit must be blue in color to distinguish control wiring from other systems. Conduits must not exceed 50 percent fill capacity.

i. The DDC contractor must provide a complete set of DDC drawings as part of shop drawings; these shop drawings must show all logic, set points, and control schedules. A complete points list with range and scale for electrical and engineering units must be provided as part of the submittal.

j. During the submittal process, full point names must be submitted. All point names must adhere to SI point naming conventions for both points and panels. A naming convention list will be provided by the SI upon request.

k. The control contractor must perform full point-to-point check-outs prior to the commissioning effort.

l. At project closeout, the DDC contractor must submit as-built drawings with operations and maintenance manuals in .pdf format. The contractor must also import the as-built drawings into the FMCS database for accessibility to end-users.

m. Control valves must be globe or ball type. Butterfly valves may be used for hydronic service in sizes 65 mm (2-1/2 in) and larger for two-position service and in sizes 150 mm (6 in) and larger for modulating service. Control valves must have stainless steel trim.

n. Hydronic control valves must have equal percentage characteristics. Steam control valves must have modified linear characteristics.

o. Pressure-independent valves must include heavy-duty actuators with stainless steel trim and must maintain required flow regardless of pressure variations in the system. Provide with BACnet communications card for interface to the BAS. Selected valves must be fully compatible with the Siemens system.

p. Utilize current sensors for status indication on pumps and fans. Current sensors must be self-gripping, split core type, powered from the monitored load, and capable of detecting belt breakage and coupling shear.

q. Airflow measuring stations must be a thermal dispersion type with multiple sensing probes. Provide paired transmitter with an installed reading accuracy of the sensor plus transmitter of plus or minus 3 percent of reading. Transmitter must communicate via BACnet protocol and scalable analog outputs to the BAS.

23.3.1.18. Sequence of Operations for HVAC Controls:

a. Where possible, control sequences will be provided on the drawings.

b. Design for night setback in acceptable spaces, allowing the resetting of supply air or shut-down of the air-handling units. Temperature setbacks must be compliant with ASHRAE 90.1.

c. Provide controls for specialty systems such as stairwell pressurization controls and atrium smoke removal controls. Ensure all systems are appropriately rated for life safety system control.

d. All new air-handling units, exhaust fans, and fume hoods must be programmed for an emergency shutdown sequence mode.

23.3.2 Fuel and Gas Piping:

23.3.2.1 Facility Fuel-Oil Piping:

a. Provide duplex fuel-oil pumps with inlet strainers, isolation valves, and discharge check valves on each pump.

b. Provide shutoff valves on the inlet and outlet of each piece of fuel-oil equipment, including but not limited to pumps and storage tanks.

c. Fuel-oil piping located indoors or above-ground outdoors must be schedule 40 black steel with welded joints with steel containment type. Containment must be drained to a containment sump with leak detector.

d. Fuel-oil piping located underground must be UL971 listed, non-metallic flexible piping system constructed of a High-Density Polyethylene (HDPE) outer layer with Ethylene Vinyl Alcohol Copolymer (EVOH) resin liner and integral secondary leak containment. System joints must be electrofusion welded to create a seamless piping system. All fittings, transitions, etc. must be of the same manufacturer to ensure full compatibility with the piping system. Provide transition sumps with leak detection at building entry, underground fuel tank, and all low points in the underground piping system.

e. All fuel-oil systems must be compliant with NFPA Standard 31.

f. Provide any fuel-oil storage tanks with appropriate manholes and ladders for access. Provide all tanks with leak detection and monitoring systems and underground tanks with overfill protection devices. Provide appropriate venting for tanks.

g. Fuel-oil monitoring systems must have auxiliary contacts and a communications interface to be tied into the BAS for monitoring and alarms. Provide BACnet communications where available; MODBUS may be utilized where BACnet is not available.

23.3.2.2 Facility Natural Gas Piping:

a. Natural gas piping must be schedule 40 black steel with welded joints. Corrugated stainless steel tubing with polyethylene jacketing may be used for final connections to appliances within 1.5 m (5 ft) in areas where piping is not subject to damage.

b. All underground piping must be installed in vented conduit.

23.3.2.3 Facility Liquid Petroleum (LP) Gas Piping:

a. All LP systems must be compliant with NFPA Standard 58.

b. Provide shutoff valves for all LP piping branches and at each piece of LP equipment.

c. Provide pressure regulators as necessary for proper operation of equipment.

d. Provide direct-type direct-fired LP vaporizers.

e. LP piping must be schedule 40 black steel with welded joints.

23.3.3 Hydronic Water and Steam Piping:

a. Submit all ASME certificates for pressure vessels to the SI.

b. Pressure relief valves must be factory set. Do not alter relief valves after certification or perform any activities that would otherwise void the ASME rating.

23.3.3.1 Hydronic Piping:

a. Piping must be constructed of either ASTM B88, Type L copper or ASTM A53, Type E, Grade B black steel. Piping DN50 (2 in) and smaller must be copper; larger must be schedule 40 black steel.

b. Copper piping located below grade must be Type K.

c. Piping joints must be either soldered, brazed, or welded. Use of press-connect joints and grooved fittings is permitted in piping that is accessible in sizes DN300 (12 in) and less. Any inaccessible piping, including piping within shafts or above inaccessible ceilings, must be soldered, brazed, or welded.

d. Tees, nipples, and test plugs for pressure gages and thermometers must be schedule 80.

e. Project engineers must determine the appropriate piping system pressure class based on the characteristics of the system, including static pressure head and pump dead head pressure. Systems must be designed for a minimum of 860 kPa (125 psi).

23.3.3.2 Underground Hydronic Piping:

a. Underground piping systems must be either an insulated conduit system with black steel carrier pipe and non-metallic outer conduit, an insulated cased piping system constructed of PVC plastic carrier pipe with foam insulation in a PVC jacket, or Fiberglass Reinforced Plastic (FRP) carrier pipe with foam insulation in a PVC jacket. Project engineers must evaluate system temperatures and pressures to determine the best system for use.

b. Snow melting systems must utilize a propylene glycol mixture for freeze protection.

c. Snow-melt tubing must be a multi-layered system constructed of either crosslinked PEX or Ethylene Propylene Diene Monomer (EPDM) with an aluminum oxygen barrier. Oxygen penetration must not exceed 0.10 grams/m3 per day at 104° F.

d. Manifolds must be constructed of stainless steel with branch isolation/balancing valves, branch flow indicators, main trunk air vent, drain, and isolation valves with temperature gauges.

23.3.3.3 Ground-Loop Heat-Pump Piping:

a. Ground-source piping must be high-density polyethylene with minimum 11,000 kPa (1,600 psi) hydrostatic design.

b. Material must have a cell classification as required by local regulations with UV stabilizer of C, D, or E as specified in ASTM D-3350-10A. Material must exhibit zero failures when tested for 192 hours or more under ASTM D-1693-08, condition C.

c. All piping must have a minimum Standard Dimensional Ratio (SDR) of 9.0.

d. Vertical-loop piping must include a factory-installed u-bend with two (2) thermally fused joints and anti-buoyancy device. No other field or factory joints are permitted on the vertical piping run. All piping must be factory and field leak tested to minimum 690 kPa (100 psig) for a minimum of four hours with zero pressure loss.

e. Provide a thermally enhanced bentonite grouting material for the full vertical height of the well. Grout must be NSF/ANSI 60 listed and acceptable to the local authority.

23.3.3.4 Hydronic Pumps:

a. Chilled water, hot water, and condenser water pumps used on building systems must be flexible coupled, horizontal direct drive, end suction, or double suction centrifugal type. The pump must be mounted on either a cast iron or steel base and driven by an electric motor. Pumps must be aligned by the manufacturer representative in the field during startup.

b. Pumps must be constructed of the following materials:

Case wearing rings:	Bronze ASTM B144-3B
Casings:	Cast iron ASTM A48-56
Ball Bearings:	Steel
Seals:	Mechanical (carbon/ceramic)
Shaft sleeves:	Stainless steel
Impellers:	Bronze ASTM B144-3B
Shafts:	Carbon steel
Coupling guards:	Formed sheet steel

c. Constant or variable speed of pumps must not exceed 1800 nominal rpm.

d. Pump cases and components must be designed and manufactured to withstand hydrostatic pressure equal to a minimum of the pump dead head pressure plus the static head on the system at the zero flow condition for the installed impeller.

e. All pumps of the same type must be of the same manufacturer.

f. All pump sets must have the provision to measure the pressure drop across the pump and the temperature of the water. Pumps must have flange pressure ports on the inlet and outlet. Provide a single pressure gauge with copper tubing manifold with needle valves to permit measurement of inlet pressure, outlet pressure, pump differential pressure, and strainer differential pressure.

g. A manual air vent must be provided on all pump sets to eliminate trapped air in the pump.

h. Do not install balancing valves on pumps driven by a variable speed drive. On constant flow systems, butterfly valves must not be used for balancing valves; utilize calibrated balancing valves.

i. Provide isolation valves on both sides of the pump. Circuit-setter valves must not be used as isolation valves.

j. Provide condenser water pumps with external flushing lines with cyclone separators.

23.3.3.5 Steam and Condensate Heating Piping:

a. Pressure-reducing stations must utilize pilot-actuated valves with downstream pressure sensing.

b. Provide a pressure-relief valve on the discharge side of the station relieving to the outside in a safe location.

Terminate with exhaust head to prevent damage to building surfaces.

c. Provide a separator on incoming steam pipe when connecting to GSA steam.

d. Piping must be constructed of ASTM A53, Type S or E, Grade B black steel.

e. Piping joints must be either threaded (sizes DN50 and smaller) or welded. All welded fittings must be performed by a certified welder and all joints must be radiographically tested. Use of flanged fittings must be limited to the minimum quantity possible.

f. Use schedule 80 pipe for steam piping in sizes DN50 (2 in) and smaller and all steam condensate piping. Use schedule 40 piping elsewhere. All nipples must be schedule 80.

g. Steam piping utilizing De-Ionized (DI) water must use Type 316L stainless steel piping.

h. Provide float and thermostatic traps with stainless steel float, head, and seat for low-pressure service below 100 kPa (15 psi). Utilize thermodynamic traps with stainless steel body, disc, and seat for high-pressure service.

23.3.3.6 Steam Condensate Pumps:

a. All condensate pumps must include a redundant pump or trap. Electric pumps must alternate use to equalize run time.

b. Low pressure systems less than 100 kPa (15 psi) may use dual electric. Consider elevating the condensate receiver/pump, especially if the condensate temperature is high.

c. For high-pressure systems, the use of a steam-powered pump is recommended.

d. Provide a flash tank for all condensate systems operating above 100 kPa (15 psi).

23.3.3.7 Refrigerant Piping:

a. Refrigerant pipe must be designed and installed per manufacturer recommendations.

b. Refrigerant piping must be ASTM B280, ACR copper tubing, type K or L hard copper with brazed joints. Soft tubing may be used for final connections to equipment in sizes DN20 (3/4 in) and smaller.

23.3.3.8 HVAC Water Treatment:

a. The chemical treatment contractor must be an experienced service provider capable of analyzing water quality, installing water-treatment equipment, and applying water treatment to open- and closed-loop HVAC systems. The contractor must have a Certified Water Technologist (CWT) on staff. All chemicals must comply with the requirements of the local jurisdiction.

b. All systems must be provided with chemical treatment and disinfection to prevent from freezing, scale formation, corrosion, algae, bacteria, Legionella, and slime growth.

c. For open systems, the water treatment contractor must implement routine and continuous microbiological control practices as outlined in the Cooling Technology Institute (CTI) Guideline Best Practices for Control of Legionella to minimize the risk of Legionella growth. The service program must maintain Legionella count below detectable levels. Testing for Legionella is required to evaluate the effectiveness of the disinfection procedures and to identify whenever other factors external to those procedures may have contributed to a loss of microbiological control for an extended time period.

d. Where an existing water service contract exists, consider extending the existing contract to include new or revised systems. Coordinate contract requirements with the COTR.

e. The chemical treatment contractor must visit the site monthly to perform testing. A signed service card must be provided after each visit indicating which systems were serviced along with a full-service report.

f. All new piping systems and extensions of existing systems must be chemically cleaned in accordance with water treatment contractor recommendations.

g. Provide a corrosion coupon rack with sight glass on all piping systems.

h. Provide a side stream centrifugal solids separator on all open-loop systems.

i. Provide all open systems with a chemical treatment controller and automatic feeding equipment. The controller must include conductivity and pH controls, chemical and biocide feed controls. Provide with BACnet interface to the BAS.

j. Open systems must include make-up and blow-down totalizing meters.

k. Vessels must be 304 stainless steel made to ASME Div. I Section VIII and rated for 690 kPa (100 psi) service.

l. Treated water, including draw-off/blow-down water, must be discharged to a sanitary sewer or other treatment system (reference: 40 CFR 122.26).

m. All water treatment systems must have proper backflow prevention devices installed (reference: 40 CFR 141, AWWA Manual 14: Backflow Prevention and Cross-Contamination Control and ASHRAE handbook topic Valves).

23.3.4 Ductwork and Fans:

23.3.4.1 Metal Ducts:

a. Duct construction must comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) HVAC Duct Construction Standards – Metal and Flexible, latest edition, except as indicated herein.

b. Kitchen and dishwasher hood exhaust must, at a minimum, meet design guidelines specified in the American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation – A Manual of Recommended Practices for Design.

c. All ductwork must be constructed of minimum 24-gauge thickness.

d. General supply, return, and exhaust ductwork must be constructed of ASTM A653 G90 galvanized steel or ASTM B209 aluminum, except as noted herein.

e. Exhaust ductwork for laundry and shower areas or other moisture-laden exhausts must be ASTM B209 aluminum.

f. Outside air intake ductwork within 16 km (10 miles) of a saltwater source must be ASTM B209 aluminum.

g. Dishwasher exhaust must be ASTM480 Type 304 stainless steel with welded joints.

h. Grease exhaust must be UL listed grease duct, ASTM A366 carbon steel or ASTM A480 Type 304 stainless steel. All exposed grease ducts indoors and all outdoor ductwork must be stainless steel. All grease duct joints must be welded.

i. Chemistry laboratory exhaust from hoods must be ASTM480 stainless steel, Type 316 as dictated by the chemicals used. Plastic-coated steel may be used where appropriate.

j. Ductwork transverse joints must be a prefabricated slide-on joint or formed-on flange equivalent to SMACNA Type T-24 or T-25. Flat drive joints are only permitted on low-pressure systems where specifically approved by the design engineer due to clearance limitations.

k. Ductwork longitudinal joints must be Pittsburgh lock with polymer sealant.

l. All ducts must be sealed to achieve seal Class A, leakage Class 6 for rectangular duct and leakage Class 3 for round duct. All sealants must be water-based.

m. Use double-wall insulated ductwork for collections areas.

n. Interior sound lining is not permitted except at transfer air ducts.

23.3.4.2 Non-metal Ducts:

a. All ductwork must be constructed of sheet metal. Use of fiberglass ductwork is not acceptable.

b. Use of flexible air duct connectors conforming with NFPA 90A and listed under UL-181, Class 1 are acceptable for final connection of supply air devices to ductwork. Flexible ductwork must be self-supporting with a spring wire helix and insulation with outer moisture barrier. Run-out lengths must be limited to 2 m (6 ft).

c. Install flexible connectors at all vibrating equipment. Connectors must be constructed of glass fabric with either neoprene, synthetic rubber, or a chemical-resistant coating based on use.

23.3.4.3 Air Duct Accessories:

a. Provide dynamic fire dampers and electric fire/smoke dampers where required by code. Fire dampers must be designed for out-of-airstream applications. Fire/smoke dampers and fire dampers located within the airstream must have airfoil blades to minimize pressure drop.

Provide all fire/smoke dampers with integral status feedback contact for remote monitoring by the BAS.

23.3.4.4 Centrifugal HVAC Fans:

a. Utilize backward inclined or airfoil fan blades. Forward curved fans are only permitted for smaller fans less than 745 W (1 hp) or where backward inclined or airfoil fan blades are not available.

b. Provide direct-drive or ECM motors with speed controllers where available.

23.3.4.5 HVAC Power Ventilators:

a. Power roof ventilators must have a spun-aluminum dome top housing with hinged subbase for access to the throat-mounted damper.

b. Provide direct drive or ECM motors with speed controllers where available.

23.3.4.6 Air Curtains:

a. Air curtains must be hydronic or electric as appropriate for the project. Provide with door switch and thermostat. For hydronic units, provide two-position automatic isolation valve to automatically isolate when heating is not required.

23.3.4.7 Air Terminal Units:

a. Terminal units must be single duct type with reheat coils. All terminal units located in areas with collections/artifacts must be provided with electric heating coils.

b. Air terminal units must include thermal insulation with a foil-faced liner. Provide an insulated access door in the bottom of the box for access to the damper and upstream side of the reheat coil. Provide access panel in downstream ductwork for access to temperature sensor and downstream side of the reheat coil.

23.3.4.8 HVAC Gravity Ventilators:

a. Gravity ventilators will not be used unless absolutely necessary.

23.3.4.9 Commercial Kitchen Hoods:

a. Ductwork construction must comply with NFPA 96 and the IMC and must be reinforced and supported per SMACNA duct construction standards and installed per SMACNA.

b. Kitchen exhaust ductwork may be a UL 1978 listed, prefabricated system or a field-constructed system.

c. On vertical runs, provide access on every floor. In no case will access interval exceed 6 m (20 ft).

d. Kitchen exhaust ductwork must undergo both leakage and light tests in accordance with the IMC prior to the installation of any exterior insulation.

23.3.5 Air Filtration:

23.3.5.1 Particulate Air Filtration:

a. Provide all systems with pre-filters located upstream of coils. Pre-filters must be UL listed, Class I or II, and MERV 8 rated in accordance with ASHRAE 52.2. Provide 50 mm (2 in) or 100 mm (4 in) pleated type filters.

23.3.5.2 High Efficiency Particulate Air Filtration:

a. Provide all systems with high efficiency, final filters downstream of the pre-filter. Final filters must be UL listed, Class II, and MERV 13 or 14 as required by use, bag type rated in accordance with ASHRAE 52.2.

23.3.5.3 Gas-Phase Air Filtration:

a. Gas-phase filtration must be an activated carbon or hybrid media specifically formulated to target pollutants identified in the outdoor air sampling test. Provide removable filter trays and quantity of stages as required to meet design criteria.

b. Install MERV 8 filters downstream of gas-phase filtration system.

23.3.6 Hot Water/Steam Generation:

23.3.6.1 Breechings, Chimneys, and Stacks:

a. All breechings, chimneys, and stacks must be double-wall construction and insulated to limit exterior surface temperature to a maximum of 27.7° C (50° F) above ambient temperature.

b. For condensing boilers, the boiler flue system must be a double-wall, prefabricated, positive pressure type with stainless steel or AL29-4C super ferritic stainless steel inner liner as dictated by the appliance manufacturer. When located outside of the building, both the interior liner and exterior shell must be constructed of stainless steel. The flue system must be pre-insulated to limit exterior surface temperature to a maximum of (27.7° C) 50° F above ambient temperature.

23.3.6.2 Condensing Boilers:

a. Boilers must be condensing type, stainless steel fire tube design, with integral burner and burner controls. Burners must be fired by natural gas, fully modulating. Burner design must assure low NOx emissions of 20 ppm or less throughout entire firing range when operating with natural gas.

b. Boilers must be provided with a control panel with the manufacturer's standard controls and safety circuits.

c. Heat exchangers must be constructed of stainless-steel fire tubes and tube sheets, with a one-pass combustion gas flow design.

23.3.6.3 Water-Tube Boilers:

a. Boilers must be flexible water tube type designed to resist thermal shock.

b. Provide with steel water tubes with multiple passes, removable and replaceable without welding or rolling.

c. Select burner for low NOx emissions of 30 ppm or less throughout entire firing range when operating on natural gas.

23.3.6.4 Fire-Tube Boilers:

a. Boilers must be fire-tube boilers in either a wet back or dry back configuration.

b. Provide with steel fire tubes and shell with multiple passes.

c. Select burner for low NOx emissions of 30 ppm or less throughout entire firing range when operating on natural gas.

23.3.6.5 Heat Exchangers for HVAC:

a. Heat exchangers for HVAC hot water generation must be shell and tube type. For applications using GSA steam, use cupro-nickel tubes; otherwise use No. 20 BWG seamless, hard drawn copper tubes.

b. Plate and frame heat exchangers with stainless steel plates and rubber gaskets may be utilized for waterside economizers. Enclose plates in a solid aluminum or stainless-steel shroud and externally insulate.

23.3.7 Chilled Water Generation:

a. A refrigerant monitoring system must be provided in all machinery rooms as required by code. Provide a minimum of two sensing points per chiller.

b. Include provisions for factory witness testing of all chillers by representatives from the SI or their appointed designees. Coordinate quantity of witnesses with the SI on a project-by-project basis.

c. Where a project utilizes more than one chiller of the same type and size, all chillers will be of the same manufacturer.

d. Equipment performance must be in accordance with ASHRAE 90.1, latest edition.

e. If removing or replacing an existing chiller, recycle refrigerant per ASHRAE Standard 15 and local codes.

f. The chiller control interface must be through a BACnet interface. All critical control points (temperature set point, enable/disable, alarm) must be available through hard wired points on the controller. The chiller on-board controls must provide total remote operations to start, stop, change all set points, obtain all chiller on-board monitored sensors, and read all alarms.

g. For systems utilizing refrigerants, do not use Ozone-Depleting Substances (ODS) or high Global Warming Potential (GWP) chemicals where the Environmental Protection Agency (EPA) Significant New Alternative Policy (SNAP) has identified acceptable substitutes.

h. Machines must be specified to deliver water at the design temperature assuming an evaporator fouling factor of 0.0001 and a condenser fouling factor of 0.0005.

i. A factory performance test must be specified and witnessed. A certified test report must be submitted to verify the design operating conditions.

j. Machine control systems must be electric. Safety controls must include a flow switch or differential pressure switch, and low temperature cut-off thermostat in the chilled water circuit.

k. Provide discharge and liquid line refrigerant isolation valves to allow isolation of the entire charge in the condenser while servicing the compressor. Check valves must not be accepted.

l. Machines must be installed in ground level or basement mechanical rooms with sufficient clearance provided to perform all necessary routine maintenance, repairs, and replacement of components.

m. Modular chillers may be used.

23.3.7.1 Packaged Compressor and Condenser Units:

a. Systems requiring turndown must be specified with staged compressors, digitally controlled compressors, or inverter compressors.

23.3.7.2 Centrifugal Water Chillers:

a. Electric motor-driven machines will be constant or variable speed type with motor shaft speed not exceeding 3600 rpm unless the chiller has a magnetic bearing compressor.

b. Compressors may be single or multiple stage or magnetic bearing. Evaporators may be flooded or direct expansion type.

23.3.7.3 Reciprocating Water Chillers:

a. Use for high lift or low temperature requirements as applicable.

23.3.7.4 Rotary-Screw Water Chillers:

a. Screw chillers may be specified based on the building load, lifecycle cost, and maintenance complexity. Screw chillers may be constant speed or variable speed based on lifecycle cost effectiveness.

23.3.7.5 Cooling Towers:

a. Cooling towers must be pretested or comply with CTI ATC-105.

b. All cooling towers will be mechanical draft and may be of metallic or non-metallic construction. Return water distribution may be deck or spray type.

c. The metallic tower walls, panels, and structure must be stainless steel, Type 304.

d. A standard guardrail meeting OSHA requirements is required for work surfaces with an unprotected side or edge that is 1.2 m (4 ft) or more above a lower level. Ladders over 3.6 m (12 ft) in length must have safety cages.

e. Towers must have FM approval and listing in the latest edition of FM's Approval Guide. Towers must be approved for use without an automatic sprinkler system and have successfully passed the full-scale fire test, static and cyclic wind pressure test, and FM structural design evaluation.

f. Inlet louvers must be wave form, heavy gauge G-235 hot-dipped galvanized steel spaced to minimize air resistance and prevent water splash-out.

g. Wet deck surface and drift eliminators must be formed from PVC; approved by FM and listed in the latest edition of FM’s Approval Guide; impervious to rot, decay, and fungus, or biological attack; with drift loss limited to not over 0.001 percent of water circulated

h. The elevation of tower basins, storage tank operating levels, and pump suctions must be indicated on contract drawings to assure pump operation free of cavitation. Horizontal shaft pumps must be installed inside buildings.

i. All cooling towers operating with outdoor wet basins must be provided with sump heaters.

j. All make-up and blow-down water for cooling towers must be metered. Where utility reduction credits for evaporation are available, coordinate meter requirements with the local water/sewer utility.

k. Include sound abatement features on cooling towers in accordance with acoustic consultant recommendations.

l. Cooling towers must include direct-driven fans with variable speed drives. Include vibration sensors and a vibration cutout switch on all cooling towers.

23.3.8 Air Handling Equipment:

a. Include provisions for factory witness testing of all energy recovery and custom air-handling units in sizes of 9,500 l/s (20,000 cfm) and larger by representatives from the SI or their appointed designees. Coordinate quantity of witnesses with the SI on a project-by-project basis.

23.3.8.1 Air-to-air Energy Recovery Equipment:

a. Enthalpy wheels must be capable of transferring both sensible and latent energy by using a matrix core coated in a desiccant material with a 3-angstrom molecular sieve. Wheel performance must be certified in accordance with AHRI 1060 with a minimum total heat transfer effectiveness of 75 percent at 700 ft/min face velocity at standard rating conditions.

23.3.8.2 Air Handling Units (AHUs):

a. Field-assembled, or factory-fabricated air units may be used as appropriate for the project.

b. Sheet metal walls and casing tops must be constructed in accordance with details based on the recommendations of SMACNA.

c. Curb anchoring must be detailed for plenums pressurized by Class II and Class III fans.

d. Air filtration must be provided in every air handling system. AHUs must have a disposable pre-filter and final filter. Filter racks must be designed to minimize the bypass of air around the filter media with a maximum bypass leakage of 0.5 percent. Filters must be sized at 2.5 m/s (500 fpm) maximum face velocity.

e. Differential pressure gauges and sensors must be placed across each filter bank to allow quick and accurate assessment of filter dust loading as reflected by air-pressure loss through the filter and sensors must be connected to the BAS.

f. The unit casing must be constructed of double-wall aluminum or galvanized panels with internal polyurethane foam insulation and solid inner liner. Interior lining at cooling coil and humidifier sections must be constructed of stainless steel. Insulation thickness must be adequate to prevent surface condensation but not less than 50 mm (2 in).

g. For custom units and in areas subject to condensation, casing must incorporate an integral thermal break system downstream of the cooling coil.

h. Casing must be constructed for a maximum deflection of L/240 at 125 percent of maximum fan shutoff static pressure. Maximum leakage must not exceed 1 percent of unit capacity at 125 percent design static pressure.

i. Floors must be constructed of 3.2 mm (1/8 in) aluminum diamond plate in custom units, 3.5 mm (10 gauge) galvanized steel elsewhere. Flooring below cooling coils and humidifiers must be constructed of stainless steel.

j. Indoor AHUs must rest on minimum 100 mm (4 in) high concrete pads and be sized and arranged to permit servicing and repair of fans and filters, and replacement of tube coils. Increase pad height as required to accommodate trap dimension.

k. Each chamber must be lighted and have an access door not smaller than 600 mm (24 in) by 1220 mm (48 in) unless limited by AHU size. Access doors must be provided with safety latches and be hinged to swing against plenum pressure. Provide test ports in all access doors. Provide view windows into all fan sections.

l. Provide fan shutdown switch on unit casing at fan section access door.

m. Cooling coils must be mounted vertically in a straight line with tubes perpendicular to air flow.

n. Coils must be independently supported structural frames of stainless steel for cooling coils, galvanized steel elsewhere. Individual finned tube coils should generally be between six and eight rows with a maximum fin density of 10 fins per 25 mm (10 fins per in) to ensure that the coils can be effectively and efficiently cleaned. Coils must be constructed with copper tubes with minimum 0.89 mm (0.035 in) tube thickness and aluminum fins. Provide with burst-proof construction.

o. Dehumidifying coils must be selected for no more than negligible water droplet carryover beyond the drain pan at design conditions. Equipment and other obstructions in the air stream must be located sufficiently downstream of the coil so that they will not come into contact with water droplet carryover. Cooling coils must be selected at or below 2.5 m/s face velocity (500 fpm) to minimize moisture carryover. Heating coils must be selected at or below 3.8 m/s face velocity (750 fpm).

p. Intermediate condensate drain pans must project no less than 300 mm (12 in) downstream of coil frames, be constructed of stainless steel, and be installed between each coiled section with vertical copper drain lines to carry condensate to the floor pan.

q. Block off sheets of 24-gauge stainless steel must be installed with caulking to prevent air bypass and leakage. Condensate drains must be trapped.

r. Ultraviolet emitters and fixtures, where utilized for surface decontamination, are to be installed in sufficient quantity and in such an arrangement to provide an equal distribution of UVC energy on the coil and in the drain pan. To maintain energy efficiency, the UVC energy produced must be of the lowest possible reflected and shadowed losses. The average UVC energy striking the leading edge of all the coil fins must not be less than 250 micro-watts per cm^2 in a 2 m/s (400 fpm) air stream at 7.2° C (45° F) with adjacent surface reflectivity of 57 percent. Minimum surface irradiance must be within 50 percent of design average irradiance. This sets the quantity of fixtures to be installed and their placement. The emitter tube must be of the high output, hot cathode, T5 [15 mm (2 in)] diameter and medium bi-pin type. They must produce 95 percent of their energy at 254 nm and be capable of producing the specified output at airflow velocities to 5.08 m/s (1000 fpm) at temperatures of 1.6-76.6° C (35-170° F). When tested in accordance with the general provisions of the Illuminating Engineering Society (IES) Lighting Handbook, 1981 Applications Volume, total output per mm (in) arc length must not be less than 10 micro-watts per cm2, at one meter, in a 2 m/s (400 fpm) airstream of 7.2° C (45° F). Applied fixtures/lamps must be specifically manufactured for this purpose. Safety interlocks/features must be provided to limit hazard to operating staff. Refer to SDS Design Guidelines, Chapter 11- Safety and Security Engineering Requirements in

Volume 1 for additional design guidance on UVGI systems for active biological control.

s. Plenums containing cooling coils must be wide enough to fully enclose coil end turns and heads and to provide clearance between coil surfaces and plenum insulation.

t. Piping risers must be offset from coils and be provided with unions to facilitate removal of coils. Bottoms of risers must have drain valves, tops, and manual vent valves.

u. Preferred fan type is direct drive with variable speed drive in a fan array configuration. Include gravity isolation dampers, air flow measuring stations, individual motor disconnects, and drive bypasses. Coordinate redundancy requirements and quantity of motors per drive with the SI.

v. All heating and cooling coils must have a pressure gauge and temperature gauge on the piping entering and leaving the coil.

23.3.8.3 Indirect-Fired Heating and Ventilating Units:

a. Indirect-fired heating and ventilating units may be used for kitchen hood or process makeup air.

23.3.9 Unitary Air Conditioning and Humidity Control Equipment:

23.3.9.1 Air Coils:

a. Where possible, provide drainable type.

b. Provide with air vent connection.

23.3.9.2 Convectors:

a. Use extra heavy covers in high usage areas.

23.3.9.3 Unit Heaters:

a. Provide calculations or chart to ensure air can reach the floor level.

23.3.9.4 Radiant-Heating Electric Cables:

a. Direction must be provided to ensure the cable will not be cut during installation; otherwise, this product should not be used.

b. Provide controls to eliminate overheating.

c. Coordinate installation with type of floor being used and specify any special installation requirements.

23.3.9.5 Radiant-Heating Hydronic Piping:

a. Radiant floor tubing must be a multi-layered system constructed of either crosslinked PEX or EPDM with an aluminum oxygen barrier. Oxygen penetration must not exceed 0.10 grams per m3 per day at 104° F.

b. Manifolds must be constructed of stainless steel with branch isolation/balancing valves, branch flow indicators, main trunk air vent, drain, and isolation valves with temperature gauge.

23.3.9.6 Humidifiers:

a. Humidifiers distributing clean steam from an RO source must be constructed of Type 316L stainless steel, including all valves, piping, and accessories.

26. DIVISION 26 – ELECTRICAL

26.1. Reference Codes, Standards, and Guidelines

26.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design.

26.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

26.2. Design Requirements

26.2.1. Any deviation from these SDS requires SI approval. The A/E will provide written justification for all deviations from these SDS. The justification will be included in the design narrative and will include, at a minimum:

26.2.1.1. Specific section deviation addresses

26.2.1.2. Title of deviation request

26.2.1.3. Brief reasoning for deviation request

26.2.1.4. Brief analysis of positive or negative impacts to the project based on deviation

26.2.2. Commissioning is required for all projects. Commissioning will be completed through an independent third-party commissioning agent unless directed otherwise. Refer to SI Construction Specification Section 01 91 13 *Commissioning*, in Volume 2 for additional requirements.

26.2.3. Power and utility usage will be monitored and budgeted on a yearly basis for comparison. As a result of this requirement, additional sub-metering and control is required. Reference and follow the Leadership in Energy and Environmental Design (LEED) Advanced Energy Metering Credit and Federal Advanced Metering Guidelines in addition to requirements indicated herein.

26.2.4. Division One (Supplementary Conditions for Construction) will be provided by the Contracting Officer's Technical Representative (COTR). This information includes specific building operations and when certain types of construction, demolition, welding times, deliveries, etc. can be accomplished.

26.2.5. All equipment electrical testing will be completed in accordance with the National Fire Protection Association (NFPA) 70B and American National Standards Institute (ANSI)/NETA publications.

26.2.6. The designer must provide an electrical systems design narrative and all calculations specified in the A/E special conditions at each submission. Calculations include, but are not limited to:

26.2.6.1. Electrical Load Calculations

26.2.6.2. Fire Pump Sizing Calculations

26.2.6.3. Lighting Calculations: illuminance calculations (lux/fc) will be submitted for all typical spaces and specialty areas in an 11x17 format for SI review. Refer to SDS Design Guidelines, Chapter 3- General Information in Volume 1 for additional requirements for egress lighting submissions.

a. Calculated areas will include light loss factors, point by point analysis, and summary data for average illuminance, max/min, and average/min ratios. For exhibit lighting, provide vertical illuminance calculation plane and summary data.

b. Provide lighting calculations for code-required emergency egress lighting.

26.2.6.4. Selective Coordination and Electrical Short Circuit Study:

a. A coordination study will be provided for all normal and emergency power equipment within the scope of the project, meeting National Electrical Code (NEC) requirements. Normal power overcurrent protective devices will be coordinated to 0.1 seconds.

b. Available fault current values will be obtained from SI or the utility.

c. For short circuit analysis, point to point method is not acceptable.

d. The short circuit study will be performed with the aid of a digital computer program, preferably SKM Powertools or ETAP software, and will be in accordance with the latest Institute of Electrical and Electronics Engineers (IEEE) and ANSI Standards.

26.2.6.5. Voltage Drop of Extended Length Feeders and Branch Circuits

26.2.6.6. Emergency Generator Sizing in Manufacturer Software

26.2.6.7. Arc Flash Study: Submit sample labels for each electrical distribution equipment with incident energy values in accordance with NFPA 70E.

26.2.6.8. Evaluation of Lightning Protection System (Additions/New Construction)

26.2.6.9. Photovoltaic Sizing Calculations (if applicable)

26.2.6.10. Product Cut Sheets:

a. Electrical Distribution Equipment: including, but not limited to: switchgear, switchboard, panelboards, transformers, generator, automatic transfer switches

b. Lighting Fixture Cut Sheets

c. Lighting Control Equipment

26.2.7. Feeder conductors will be sized in accordance with the 25 percent spare capacity provided for each panelboard.

26.3. <u>Specifications</u>

26.3.1. Conductors and Cables:

26.3.1.1. Common Work Results for Electrical:

a. All conductors and busses will be copper. List no more than five manufacturers for electrical equipment in specifications.

b. Refer to Specification Section 260500 security system supplement for security system distribution. A copy of this spec can be provided by the COTR.

c. Confirm acceptable manufacturers and requirements with each facility prior to selection.

26.3.1.2. Medium Voltage Cables:

a. Cables will be copper conductors, triplexed sized in accordance with calculations, rated 15 kv, MV-105 133 percent insulation level, with (1) #1/0 bare, stranded ground wire EPR insulation, manufactured and tested to the Insulated Cable Engineers Association (ICEA) S-93-639 / National Electrical Manufacturers Association (NEMA) NC 74.

b. Provide labels for all feeders in manholes.

c. Underground conduits for the medium voltage system will be concrete encased with warning tape installed 300 mm (1 ft) above the concrete.

d. Utilize busbars in lieu of medium voltage cables where applicable on a project. Review locations and application with SI on a project-by-project basis.

26.3.1.3. Low-Voltage Electrical Power Conductors and Cables:

a. Minimum wire size will be #12 AWG, THHN-2, THWN. All conductors will be copper.

b. Branch circuits rated 20 amperes, 120V, and exceed 75 circuit feet from panelboard swill be #10 AWG. Branch circuits rated 20 amperes, 277V, and exceed 150 circuit feed from panelboard will be #10 AWG.

i. 600V insulated cables, 90° C listed, cables #10 and smaller: solid copper, cables #8 and larger: stranded copper

ii. Cable Types: Provide conductor types for specific applications:

a) XHHW-2 for wet locations

b) Mineral Insulated (MI), metal sheathed cable): fire rated cable for emergency systems, emergency generator, fire pump in accordance with NEC requirements

c. As part of electrical renovations to existing systems, all wiring will be removed back to the source for all demolished or removed equipment. No wiring will be abandoned in place without the express consent of the SI.

d. Do not show more than a 3-phase circuit, or 3-phase conductors, a neutral conductor, and an equipment grounding conductor in a single conduit.

e. Provide dedicated neutrals for all single-phase circuits. Shared neutrals within a common conduit are not permitted.

f. The use of Metal Clad (MC) cable and/or flexible metal conduit for power and lighting branch circuits will be reviewed with SI for specific project requirements. The basis of design will include branch circuits run in Electrical Metallic Tubing (EMT) conduit, with a 1.8 m (6 ft) maximum whip length from junction box to lighting fixture position. MC cable for overall branch circuit length is not permitted.

26.3.1.4. Under-carpet electrical power cables will only be used with SI consent.

26.3.1.5. Control-Voltage Electrical Power Cables:

a. Coordinate requirements for fire alarm control conductors with the Smithsonian Fire Alarm Specification.

b. Refer to Appendix A- Security Design Criteria Matric in Volume 3 for requirements for security alarm control conductors.

c. Conduit color codes: Red for fire alarm; blue for controls.

26.3.1.6. Grounding and Bonding for Electrical Systems:

a. The A/E will coordinate all requirements with appropriate model codes and notify the COTR of any discrepancy for direction on how to proceed.

b. Grounding conductors for No.8 AWG and smaller will be solid and grounding conductors No.6 and larger will be stranded.

c. Install ground bars in all Telecommunications Rooms (TR) unless otherwise indicated. Coordinate ground bar installations with the Office of Safety, Health, and Environmental Management (OSHEM) and the Office of Chief Information Officer (OCIO).

d. Comply with IEEE C2 grounding requirements and UL 467 for grounding and bonding materials and equipment. Coordinate requirements with OSHEM and OCIO.

e. Ground Rod Requirements: Material: copper clad

f. Lightening protection will conform with the requirements of NFPA 780 and UL 96.

g. Provide separate grounding conductors of insulated wire or cable with all branch circuits and feeders. Size grounding conductors in accordance with NEC requirements.

h. Metal poles for outdoor lighting fixtures: Install grounding electrode and a separate insulated equipment grounding conductor for each lighting pole.

i. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 100 mm (4 in) will extend above the finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in the manhole wall. Protect ground rods passing through concrete floors with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 50 mm (2 in) above to 150 mm (6 in) below concrete. Seal floor opening with waterproof, nonshrink grout.

j. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to a ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by the manufacturer of splicing and termination kits.

k. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 150 mm (6 in) from the foundation. Where exterior equipment is owned by the electric utility, the design will meet utility company standards for grounding and installation.

l. Grounding and Bonding for Piping:

i. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductors on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

26.3.2. Raceways and Supports:

26.3.2.1. Hangers and Supports for Electrical Systems:

a. Conduits will be fastened with UL clips approved by the SI. Supporting of conduits with tie wires, perforated straps, or similar means will not be permitted. Resting conduit on structural steel is not an acceptable means of support. Supports will be designed with additional 25 percent capacity for future conduit and devices.

b. Review the use of metallic and non-metallic structural supports/hangers for each project and facility with the SI.

c. The A/E will detail connection requirements to existing or new structure for the contractor to reference when supporting system components.

26.3.2.2. Raceways and Boxes for Electrical Systems:

a. Minimum conduit size will be 21 mm (3/4 in). Conduits routed indoors will be EMT unless otherwise accepted by the COTR. Conduit routed underground will be Polyvinyl Chloride (PVC) Schedule 80. Conduit routed above ground exterior will be rigid galvanized steel. Contractors will provide a coordinated Mechanical/Electrical/Plumbing (MEP) conduit/duct/piping plan as part of the submittal process.

b. Utilize Rigid Galvanized Steel (RGS) conduit at exposed interior conditions, including utility spaces, below 3 m (10 ft).

c. Connectors will be steel set screw type unless required differently by codes or security requirements.

26.3.2.3. Cable Trays for Electrical Systems:

a. Where cable trays are routed exposed below ceilings, provide non-ventilated bottom trough type cable tray painted to match the wall color. Ladder type or basket type is acceptable above ceilings. Coordinate with the OCIO through the COTR for depth and width of trays. Provide 25 percent spare capacity for tray fill calculations.

26.3.2.4. Underfloor Raceways for Electrical Systems:

a. Where applicable, provide underfloor raceways below raised access flooring. Underfloor raceways will be comprised of conduit and junction boxes or underfloor bus track. Coordinate with SI representative for preference.

b. Raceways will be installed parallel or perpendicular to building walls and column grids.

c. Ground all underfloor raceway components.

d. Coordinate final locations of junction boxes with furniture plans.

e. Where applicable, route underfloor raceways for electrical systems perpendicular to underfloor raceways for telecommunications systems. Coordinate with the OCIO through the COTR.

f. Coordinate with the SI user group through the COTR for acceptable service fitting types and finishes

26.3.2.5. Underground Ducts and Raceways for Electrical Systems:

a. Duct banks will consist of parallel sets of Type I CSA-certified PVC conduit encased in concrete. Conduits shall be minimum 152 mm (6 in) and spaced three times the outside diameter of the conduit, or 76 mm (3 in) center-to-center, whichever is greater.

b. Provide minimum one spare duct in each duct bank.

c. Coordinate requirements of medium voltage duct bank with the guidelines of the local utility where the duct bank delivers primary feeders from the local utility substation/transformer/manhole to SI property.

26.3.2.6. Vibration and Seismic Controls for Electrical Systems:

a. Provide seismic restraints in accordance with International Building Code (IBC) requirements for the specific building type and site geographical location.

b. For new vibration generating equipment, such as emergency generators, the A/E team will provide vibration analysis with recommendations for isolation to meet project requirements.

26.3.2.7. Identification for Electrical Systems:

a. Provide screwed-on labels for all electrical equipment indicating panel name and voltage, equipment name, and panel from which the equipment is fed. Provide painted-on voltage labels identifying voltage every 6 m (20 ft) on conduit.

b. Provide labels on all receptacle devices indicating panelboard and circuit number. Coordinate with the SI COTR for project-specific requirements on label color, size, and location (front or back of device wall-plate).

c. The A/E will create panelboard schedules for new and/or altered existing panelboards on the project. Schedules will be produced in Excel and will indicate load location and type.

26.3.2.8. Electrical Systems Studies and Analysis:

a. Provide overcurrent protection device coordination studies and short circuit analyses in electronic format in accordance with SI A/E special conditions.

b. Devices will be fully rated for the available short circuit unless specifically discussed with the SI COTR for series rating requirements.

c. Include arc flash labeling of all new and altered electrical equipment, utilizing labeling requirements as indicated in NFPA 70E. Review sample label information with SI as part of the submittal process.

d. Comply with IEEE 242 and IEEE 399.

26.3.3. Power Monitoring and Lighting Control Systems:

26.3.3.1. Electric Power Monitoring and Control:

a. Provide electric power monitoring and control for the emergency distribution system. The electric power monitoring and control system will monitor and control the positions of all automatic transfer switches and provide real-time load information.

b. Review requirements for load shed software and sequencing for use with a permanent or temporary generator connection with SI as part of each project's requirements. For projects including new emergency distribution equipment (automatic transfer switches) in a facility with an existing load shed system, include programming/manufacturer time in the project to re-establish sequencing, test, and commission the system modifications. New components will be compatible with the existing monitoring system.

c. The electric power and monitoring system will be monitored at a central location as directed by the SI representative. Power monitoring components will match existing or be compatible with the existing system installed within the facility. Review additional project specific requirements with the SI.

d. Provide integral power monitor device connected to the network for all electrical distribution panels, switchboards, switchgear, and motor control centers. Review additional requirements for monitoring of appliance panels or individual circuits with SI as part of each project.

e. Provide testing and commissioning when new devices are added or removed from the system.

26.3.3.2. Lighting Control Devices:

a. Refer to current energy code requirements applicable for the project for baseline occupancy, vacancy, daylight harvesting, receptacle control, and time-clock-based lighting control requirements. Review additional project-specific requirements with the SI.

b. Utilize toggle switches in utility spaces such as electrical and mechanical rooms and telecommunication closets where automatic lighting control could risk the safety of building occupants.

c. The emergency lighting system will be either continuously in operation or will be capable of repeated automatic operation without manual intervention. Indicate areas where emergency lighting will be dimmed or shut off during normal operation. A UL924 listed override device will be provided such that when normal power is lost, all emergency lighting automatically turns on to full light output. Emergency lighting will also be turned on and to full output upon activation of the fire alarm system.

d. The system will be integrated with the building fire alarm and/or mass notification system for automatic override during an emergency.

e. Coordinate with the SI representative to establish preset scenes and identify lighting zones to be controlled together. All lighting control groups (commonly known as zones) will be determined during the design phase. The programming of presets/scenes and daily schedules will be completed during the construction phase and with the approval of the SI representative.

f. Coordinate locations of the master station and remote stations with the fixed furniture and equipment within the space and the SI representative.

g. Where applicable in multi-user occupancy spaces with moveable partitions, integrate the lighting controls with the partition positions, such that each configuration of the partition walls is a preset scene.

h. Occupancy Sensor Submittal and Optimization: Manufacturers will submit layout drawings with coverage patterns of proposed occupancy sensors as part of the shop drawing phase. In addition, the manufacturer will be required to visit the site after the space is occupied and all furniture is installed to adjust sensor sensitivity, final placement, etc. to ensure full coverage of spaces and to minimize false tripping.

26.3.3.3. Central Dimming Controls:

a. Where applicable, provide appropriate lighting controls for public exhibit spaces to control the exhibit lighting systems.

b. Coordinate with the SI representative for exhibit renovations to determine the building standard for dimming controls. Construction document specifications will include training for museum staff.

c. The system will be capable of interfacing with the audio-visual control system, fire alarm system, and Building Automation System (BAS).

d. All dimming and network lighting controls will follow all SI OCIO standards necessary that will allow the OCIO to maintain and control the system after installation.

    i. The contractor will meet OCIO standards for items including, but limited to:

        a) Quality of wire

        b) Type and manufacture of switches, routers, and associated network equipment

        c) Type of fiber and copper connections

        d) Lighting networks will be protected VLAN segments of the SI network.

e. Display Lighting Control: Where applicable and approved by the appropriate SI representatives, add occupancy sensor controlling dimmed circuits for all public spaces and displays.

    i. Devices will be programmed so the visitor experience is not compromised.

ii. To maximize sensor usefulness, the sensor locations must be carefully integrated into the exhibit and the museum program to allow the necessary granularity of control.

iii. Controls will be provided to re-program attributes of occupancy sensors including varying time-delay periods for when the museum is open or closed. Time-delay periods will be variable from 30 seconds to permanently on.

iv. All circuits in public spaces controlled by occupancy sensors will be placed on dimmers.

a) SI personnel will have the capability to set the following attributes without the need to call a factory representative:

1. Setting the rate of fade for each dimmed circuit or group of circuits
2. Grouping of control devices and applying schedules to control devices
3. Setting the length of time delay on sensors

26.3.3.4. Modular Dimming Controls:

a. Unless otherwise noted, modular dimming controls are for select non-public spaces.

b. Modular dimming controls for non-public spaces should be tied into the building's central lighting control system as determined by the SI representative.

c. The system will be capable of interfacing with the audio-visual control system and video teleconferencing system, if applicable.

d. Network lighting controls will follow all SI OCIO standards necessary that will allow the OCIO to maintain and control the system after installation.

   i. The contractor will meet OCIO standards for items including, but limited to:

      a) Quality of wire

      b) Type and manufacture of switches, routers, and associated network equipment

      c) Type of fiber and copper connections

      d) Lighting networks will be protected VLAN segments of the SI network.

e. System specifications will include training for end-users on the operation and maintenance of the system, including, but not limited to, how to set scenes and change the lighting zones.

26.3.3.5. Network Lighting Controls:

a. For new construction and where applicable for renovations, provide an Information Technology (IT) based network lighting control system capable of monitoring on-off status and performing on-off and dimming operations.

b. Manual switches, internal time clocks, or other control systems will be provided to send a signal to the network lighting controls to turn on or off a group of lighting loads. Coordinate with the SI representative for locations of manual switches.

i. Manual override switches will be included to provide control beyond scheduled hours.

ii. Override controls will be from a single point of contact without the necessity of using multiple lighting programs, multiple computers, or logging onto multiple processors.

c. The lighting control system will have the capacity to be programmed so overrides automatically time out at a user-defined time. Software will allow overrides to be scheduled 364 days in advance.

d. The lighting control software will allow SI personnel to have the following capabilities:

i. Ability for SI personnel to group circuits into user-defined zones

ii. Ability for SI personnel to apply schedules to zones

iii. Ability to turn the entire lighting system on and off from a single point of contact

iv. Ability to schedule the entire lighting system from a single point of contact

v. Ability to turn individual zones on and off throughout the facility without the need to log onto multiple processors, multiple computers, or multiple programs

vi. Multiple lighting control systems will be integrated into a common controller or set of switches.

e. Network lighting controls will interface with all local modular dimming controls for non-public multi-user spaces and central dimming controls for public exhibit spaces. Turning off lights will not impact preprogrammed lighting controls and cause the systems to be reset.

f. The network lighting controls will have a BAS interface. The design team will include an integration meeting to review connection of the lighting control system with other building systems (e.g., BAS, AV, fire alarm, security) to coordinate communication hardware and data programming and sequencing requirements.

g. Follow OCIO wiring standards for any fiber or copper connections.

h. Coordinate the integration of network lighting controls with audio visual and BAS.

26.3.4. Electrical Systems Above 600V:

26.3.4.1. Provide Secondary Unit Substations in accordance with NEC Article 490.III: *Equipment – Metal-Enclosed Power Switchgear and Industrial Control Assemblies.*

26.3.4.2. Medium-Voltage Transformers:

a. 13.8 KV Transformers (Indoor Use):

i. Transformers will be silicone oil liquid filled, sealed tank, self-cooled, type LNAN-LNAF, 2 winding, step down, with a temperature rise rated self-cooled load of 55c over ambient of 40c maximum and 30c average.

ii. The capacity of each transformer will be:

a) 100 percent kva at 55C rise without fans

b) 112 percent kva at 65C rise without fans, with no loss of transformer life

c) 133 percent kva at 65C rise with fans, with no loss of transformer life

d) Fans will be provided, including automatic controls and status indicating lights

iii. High voltage windings will be 13.8KV, delta connected, with four 2.5 percent rated kv taps, two above and two below nominal voltage.

iv. Low voltage windings will be as required, wye connected, with the wye connection solidly grounded outside the tank.

v. The basic impulse insulation level will be 95kv.

vi. Transformers will meet Department of Energy (DOE) energy efficiency standards (DOE 10 CFR Part 431 Energy Conservation Standards). Provide DOE established efficiency levels at 50 percent load).

vii. The impedance will be between 5.5 percent and 6.3 percent including all tolerances.

viii. Transformers will be complete with all standard accessories, including, but not limited to, the following:

a) Off load circuit tap changer operable from ground level by a single external wheel, with provisions for padlocking in any position

b) Tap position indicator

c) High internal tank pressure-relief device

d) Hermetically sealed dial type oil temperature thermometer, three stage, with trip, fan start, and alarm contacts

e) Liquid level gauge with alarm contact, bottom drain valve, and sampling device

f) Two tank grounding studs for No. 4/0 AWG conductor

g) Lifting eyes, welded bottom corner jacking steps, and provisions for skidding

h) Diagrammatic nameplate of non-corroding material

i) Sudden gas pressure relay with trip and alarm contacts. Seal-in or lockout relays will operate on 125v DC.

ix. All alarm contacts will be wired out to a control enclosure.

x. Windings and all current-carrying conductors will be copper.

b. 4160V Transformers (Indoor Use):

i. Transformers will be high efficiency, low impedance type in accordance with NEMA TP 1-2002.

ii. Transformers will be power type AFA indoor, air-cooled, dry type with continuous capacity.

iii. Transformers will be three-phase delta primary, wye secondary. Insulation will be Class H.

iv. Transformers will have four 2.5 percent full capacity primary taps, two above and two below normal voltage. Provide off load tap changer.

v. Maximum sound level at AFA rating will be 60db. Transformers will have 50kv Basic Impulse Insulation Level (BIL) rating. Transformers will be equipped with fans to increase capacity to 133 percent nameplate rating.

c. Provide network protectors with external access to fuses. The basis of design for network protectors is Eaton.

d. All transformer vaults for new construction must have dual means of egress. One egress will be onto the exterior ground and the other into a corridor. Vaults will be temperature controlled with positive pressure (to aid in dissipation of heat generated by transformers).

26.3.4.3. Medium-Voltage Switchgear:

a. Coordinate with the local utility for minimum requirements for terminations and over-current protection.

b. The switchgear will be complete, metal-enclosed, factory-assembled, tested, and shipped ready for installation including main and tie circuit breakers, metering and power distribution section of required short circuit rating, and ampacity.

c. Provide electrical safety mats in front of switchgear with rating equivalent or greater than the rating of the associated switchgear.

d. Circuit breakers will be vacuum type.

e. Switchgear will be front accessible. Each switchgear section must be isolated by vertical steel barriers. Each switchgear section will have hinged doors.

f. Floor-mounted switchgear will be mounted on 100 mm (4 in) high equipment pads. Equipment pads will be at least 100 mm larger than the equipment on all sides.

g. Switchgear will be provided with means or equipment for the removal and installation of all breakers from the enclosure.

h. The contractor will provide full functional test sets for protective relays and for breakers testing on any electrical distribution. The contractor will provide infrared testing of all major equipment.

i. Vaults will include egress requirements based on ampacity and distances within the space in accordance with NEC requirements.

j. All equipment will include final third-party testing and inspection to confirm functionality, device settings, etc. as part of start-up services. Testing will be witnessed by the commissioning agent where included on a project.

26.3.5. Electrical Systems 600V and Below:

26.3.5.1. Low-Voltage Transformers:

a. Dry type transformers will be NEMA TP1 compliant.

b. Dry type transformers will be indoor, air cooled, dry type of the size, rating, and capacities to suit.

c. All windings and terminations will be copper.

d. Transformers will be of the 1.2kv class, standard BIL, with Class 220 insulation.

e. Locate transformers in spaces such that sound level is not increased by sound reflection. The spaces will be adequately ventilated to prevent temperature rise from exceeding the transformer rating.

f. Transformers will be mounted such that vibrations are not transmitted to the surrounding structure.

g. Floor-mounted transformers will be mounted on 100 mm (4 in) high equipment pads. Equipment pads will be at least 100 mm (4 in) larger than the equipment on all sides. All transformers will be floor-mounted. Where trapeze mounting is required based on field conditions, the application will be reviewed with SI on a project-by-project basis.

26.3.5.2. Low-Voltage Switchgear:

a. The switchgear will be complete, metal-enclosed, factory-assembled, tested, and shipped ready for installation including main and tie breakers, metering and power distribution section of required short circuit rating, and ampacity.

b. Provide a main circuit breaker for each service entrance section. Provide ground fault protection on service entrance feeders in accordance with NEC requirements.

c. Buses will be high strength, high conductivity, tin-plated copper, 100 percent rated neutral bus. Provisions will be made for extending the buses to future cubicles at each end of the switchgear. Buses will be joined together with a minimum of two bolted connections. Bus joint hardware will be noncorroding. A continuous copper ground bus will be run near the bottom, for the full length of the switchgear.

d. The metal frames of all components will be connected to the ground bus. Provide a plug for connecting to the external ground conductors at each end of the bus. The momentary rating of the ground bus will be equal to or greater than that of the apparatus in the assembly. The minimum size shall be 7 x 50 mm. Provide bus transition sections where required, with bolted access panels.

e. Provide a minimum of two spares and two prepared spaces in all new switchgear. Provide spare breakers, one for each frame size. Locate gutter on the bottom of the switchgear. Switchgear will have draw-out breakers with adjustable breaker settings. Breaker settings will be adjusted in accordance with the short circuit and coordination study required by the SI A/E special conditions.

f. Provide switchgear elevations showing all dimensions on construction documents. Provide enlarged electrical room plans illustrating all physical dimensions of electrical equipment.

g. Third-party testing of switchgear is required if there are in-field modifications.

h. Provide a label on each switchgear cube to identify the load served.

i. For renovations, new equipment must be compatible with existing power monitoring and control systems of the facility. Test equipment will be provided if new switchgear is of a different manufacturer than the previous switchgear.

j. Floor-mounted switchgear will be mounted on 100 mm (4 in) high equipment pads. Equipment pads will be at least 100 mm (4 in) larger than the equipment on all sides.

k. Switchgear will be provided with means or equipment for the removal and installation of all breakers from the enclosure.

l. The contractor will provide third-party full functional test sets for protective relays and for breakers testing on any electrical distribution. The contractor will provide infrared testing of all major equipment. Testing will be witnessed by the commissioning agent where included on a project.

26.3.5.3. Paralleling Low-Voltage Switchgear:

a. Provide a minimum of two spares and two prepared spaces in all new switchgear. Provide spare breakers, one for each frame size.

b. Locate gutter on the bottom of the switchgear.

c. Switchgear will have draw-out breakers with adjustable breaker settings. Breaker settings will be adjusted in accordance with the short circuit and coordination study required by the SI A/E special conditions.

d. As part of the construction documents, provide switchgear elevations showing all dimensions on construction documents. Provide enlarged electrical room plans illustrating all physical dimensions of electrical equipment.

e. Third-party testing of switchgear is required if there are in-field modifications.

f. For renovations, new equipment must be compatible with existing power monitoring and control systems of the facility.

g. Floor-mounted switchgear will be mounted on 100 mm (4 in) high equipment pads. Equipment pads will be at least 100 mm (4 in) larger than the equipment on all sides.

h. Switchgear will be provided with means or equipment for the removal and installation of all breakers from the enclosure.

26.3.5.4. Switchboards:

a. Switchboards will be complete, metal-enclosed, factory-assembled, tested, and shipped ready for installation including main and tie breakers, metering and power distribution section of required short circuit rating, and ampacity.

b. Review of the use of switchgear vs. switchboard construction for electrical distribution will be completed with SI on a project-by-project basis.

c. Indicate available fault current at each bus on the switchboard one-line diagram. Indicate settings of adjustable breakers on the one-line diagram.

d. Provide a main circuit breaker for each service entrance section. Provide ground fault protection on service entrance feeders.

e. Provide appropriate warning labels indicating flash hazard boundary, hazard risk category, and Personal Protective Equipment (PPE) level required to service the equipment.

f. Breakers in switchboards will be bolt-on type.

g. Third-party testing of switchboards is required if there are in-field modifications. The contractor will provide infrared testing for switchboards.

h. Provide gutter on bottom of the switchboard.

i. Provide a minimum of two spares and two prepared spaces in all new switchboards. Provide spare breakers, one for each frame size.

j. Provide switchboard elevations showing all dimensions on construction documents. Provide enlarged electrical room plans illustrating all physical dimensions of electrical equipment.

k. Switchboards will be mounted on 100 mm (4 in) high equipment pads. Equipment pads will be at least 100 mm (4 in) larger than the equipment on all sides.

l. Cascade type Transient Voltage Surge Suppression (TVSS) devices will be installed in switchboards serving computers or laboratory equipment. Oversized neutral conductors will be provided for feeders supplying laboratory receptacle panelboards and computer receptacle panelboards

m. The contractor will provide third-party full functional test sets for protective relays and for breakers testing on any electrical distribution. The contractor will provide infrared testing of all major equipment. Testing will be witnessed by the commissioning agent where included on a project.

26.3.5.5. Panelboards:

a. Bussing in every panel will be copper and will extend the full length of the panel. Circuit breakers will be current limiting molded case type, 100 percent rated neutral. Provide a minimum 25 percent spare capacity in panel (6 prepared spaces, 4 prepared spares, feeder ampacity to include an additional 25 percent capacity). Coordinate with the SI representative if 25 percent spare is not achieved.

b. Provide an enclosure with a hinged door in hinged cover construction. The panelboard will have tool-less entry for easy maintenance. Panels will have a maximum of 42 poles.

c. Panelboards will be mounted such that the top of the panel enclosure is 2 m above the finished floor.

d. Indicate homeruns for all circuits on the drawings.

e. Panelboards that are not within sight of the circuit breaker serving the respective feeder will be provided with main circuit breakers.

f. Panelboards will be fully rated for the fault current available. Series rated panelboards will not be used.

g. Laboratory panelboards will be rated for 100 amperes minimum and will be provided with main circuit breakers.

h. Twenty ampere branch circuits for lighting and receptacles will be limited as follows:

    i. Each 120 volt branch circuit will be limited to 1600 VA of load.

    ii. Each 277 volt branch circuit will be limited to 3600 VA of load.

i. Cascade type TVSS devices will be installed in panelboards serving computers or laboratory equipment. Oversized neutral conductors will be provided for feeders supplying laboratory receptacle panelboards and computer receptacle panelboards.

j. Provide enclosure ratings listed below:

    i. General indoor dry environment: NEMA 1

    ii. Kitchen/wash-down areas: NEMA 250/4X

    iii. Outdoor: NEMA 250/3R

    iv. High-humidity/corrosive outdoor environments: NEMA 4X/316 stainless steel or a separate protective enclosure rated for the application.

26.3.5.6. Motor-Control Centers:

a. As part of the project design, the A/E team will review the quantity of motors requiring starters, Variable Frequency Drives (VFDs), etc. and review with the SI to determine if a motor control center or distributed control devices are appropriate for the project.

b. Motor control centers will be Class I, Type B at a minimum.

c. Motor control centers will have tinned copper main buses and tinned copper vertical buses in each section, and fully rated equipment for the available fault current.

d. Enclosures will be full-height barriers to isolate the vertical buses from the starters. Each starter will be provided with an engraved nameplate identifying load served.

e. Cable lugs or bus duct terminals will be provided as required. The main bus will be adequately sized to match the feeder size.

f. Individual 120V control transformers with fused primary will be supplied for each starter shown. A ground bus will be provided for the full length of each MCC.

g. Each MCC will have a minimum of one spare section for the full height of the MCC to house automatic temperature control relays, fire alarm shut down relays, smoke evacuation wiring terminals, and accessories. The spare sections will be fitted with a suitable stiffened hinged access door for the full height of the section.

26.3.5.7. Enclosed Bus Assemblies:

a. The use of bus duct for electrical distribution will be considered in lieu of traditional conduit and wire installation where applicable. The A/E will review potential use with the SI on a project-by-project basis.

b. Install bus duct in accessible areas. Coordinate routing of bus duct with the SI representative. Bus duct will have copper bus with 100 percent ground.

c. Plug-in style bus duct will include fuse or circuit breaker bus duct plug assemblies.

d. Install a 101 mm (4 in) equipment curb around all floor penetrations.

26.3.5.8. Power Distribution Units (PDUs):

a. Provide PDUs for large data centers and telecommunication rooms with data racks.

b. Where applicable, provide in-row PDUs with the data racks.

c. If floor-mounted cabinet power distribution units are provided, the cabinet will be front-accessible with top or bottom cable entry.

d. PDUs will have provisions for dual-feed electrical service.

e. Each PDU will have 200 percent rated neutral bus.

26.3.5.9. Electricity Metering:

a. Provide electric meters at panels that provide power to equipment that serves Smithsonian Enterprises (SE) activities or other for-profit exhibits. Meters will record KWh.

b. All metering will include data collection by way off SI ethernet. Coordinate with the OCIO for SI ethernet drop and static IP address through the COTR.

c. Standalone metering or analog dial-up metering is not permitted.

d. Electrical metering will include dynamic trending data of phase voltage, phase-to-phase voltage, current, phase angle, power factor, KW, KVA, and KVAR. Data storage capability of this data is also required.

e. Power consumption data (kWh) will be stored at least three months in 15-minute increments. Provide interval data on at least a daily basis.

f. Automated data analysis and data level notification/alarm systems are desirable.

g. Acceptable meters: Siemens BAS, E-Mon Energy, and Electro Industries / Gauge

h. Unacceptable meters: Quad Logic

i. Standalone metering is not acceptable.

j. For any meter that is connected to the BAS, the BAS will be set up to show continuous running total, running daily total, running monthly total, past month's total, generate monthly total report, trend every 15 minutes, and trend daily total.

k. A monitoring system will be provided from a single manufacturer platform for all meters, communication components, and server equipment. Multiple separate manufacturers or vendors are not acceptable.

l. Review electrical and mechanical equipment to include meters on a project-by-project basis with the SI.

m. At a minimum, the following systems must be sub-metered within the project scope:

   i. Total electrical energy

   ii. Interior lighting

   iii. Exterior lighting

   iv. Plug loads (receptacle circuits)

n. Coordinate additional load type sub-metering requirements with Division 23- HVAC, Energy Management section in Volume 1

o. Comply with DOE Advanced Metering Guidelines.

26.3.5.10. Wiring Devices:

a. Wiring devices will be specification grade unless otherwise noted.

b. Coordinate the color of faceplate and devices with exhibit and/or interior design of the space.

c. General purpose receptacles will be 20A 120V, 2-wire, grounding, NEMA 5-20R. Coordinate NEMA ratings of receptacles larger than 20 amps with individual equipment being connected. Locate general purpose receptacles at 6 in on center along walls. The A/E will review these requirements with the SI for confirmation on a project-by-project basis.

d. Receptacles on emergency power will be red.

e. Isolated ground receptacles will be orange.

f. A maximum of six duplex general-purpose receptacles will be connected to a 20 ampere, 120 volt branch circuit.

g. Provide all pendant-cord devices within strain relief.

h. Confirm with the SI representative for the use of surface-mounted raceway.

i. Install receptacles with the ground-pin in the upward position.

j. Wall plates in finished spaces will be brushed stainless steel as a basis of design and will be reviewed with the SI on a project-by-project basis. Back-of-house wall plates will be galvanized steel type.

k. For exterior power requirements in gardens and courtyards, coordinate specific electrical equipment requirements for events, vendor equipment, and/or general use with the COTR on a project-by-project basis.

26.3.6. Motor Controls and Disconnects:

26.3.6.1. Fuses:

a. Fuses will be fast-acting type. Deviations will be reviewed with the SI and be in accordance with manufacturer recommendations.

b. Unless specifically reviewed with the design team, the use of fuses is limited to enclosed switches and controllers. Fuses will not be used for feeder and branch circuits over current protection within panelboards, switchboards, or switchgear.

c. Coordinate fuse selection for elevator controllers with Division 14- Conveying Systems in Volume 1.

26.3.6.2. Enclosed Switches and Circuit Breakers:

a. Circuit breaker switches will be current limiting molded case circuit breakers.

i. Fuse type enclosed switches will be fast-acting type unless otherwise noted.

b. Fuses will be cartridge type.

c. Provide enclosure ratings listed below:

v. General indoor dry environment: NEMA 1

vi. Kitchen/wash-down areas: NEMA 250/4X

vii. Outdoor: NEMA 250/3R

viii. High-humidity/corrosive outdoor environments: NEMA 4X/316 stainless steel or a separate protective enclosure rated for the application.

26.3.6.3. Enclosed Controllers:

a. Coordinate selection of motor controllers with motors provided for compatibility.

b. Controllers will have integral disconnecting means.

c. Provide enclosure ratings listed below:

ix. General indoor dry environments: NEMA 1

x. Kitchen/wash-down area: NEMA 250/4X

xi. Outdoor: NEMA 250/3R

xii. High-humidity/corrosive outdoor environments: NEMA 4X/316 stainless steel or a separate protective enclosure rated for the application.

26.3.6.4. Variable-Frequency Controllers:

a. Coordinate selection of VFDs with mechanical engineers. Review preference for VFD type, harmonic filters, etc. with the SI to determine the appropriate solution on a project-by-project basis.

b. VFDs will be provided for all motors that require adjustable-speed operation.

c. Any motor controlled by a VFD requires bearing protection to prevent damage from harmful shaft currents.

d. Include harmonic distortion analysis as part of the design as an initial determination of drive types, and the contractor will be required to complete an analysis and submit for SI and A/E review as part of the construction process. This should include drives provided by other divisions (fire pump, chillers, etc.). Use IEEE 519 as the guideline for harmonic analysis/computation of Total Harmonic Distortion (THD) and Total Demand Distortion (TDD).

e. Design documentation will include a VFD schedule with Division 22, 23, and 26 drawing packages indicating equipment to include VFDs, VFD types, by-pass potions, multi-motor drive arrangements, etc.

26.3.7. Emergency and Standby Systems:

26.3.7.1. Engine Generators:

a. Generators will not be located on the roofs of existing or new construction buildings. Generators will be located away from loading docks, entrances, and parking. More secure locations include protected grade level and protected interior areas. The A/E will review specific site requirements with the SI on a project-by-project basis.

b. Where diesel generators are used, specify ultra-low sulfur content fuel.

c. Fuel tanks will be mounted near the generator, given the same protection as the generator, and sized to store fuel to allow for 48 hours of continuous generator operation with re-fueling.

d. If natural gas is available on site and it is a reliable source (as determined appropriate by a SI representative), a natural gas generator may be provided for emergencies (NEC Article 700 loads).

e. Coordinate with Homeland Security shelter-in-place emergency generator run-time requirements.

f. Provide a permanent load bank to test at 100 percent of load.

g. As a minimum, the following loads will be placed on emergency power, in addition to those required by code:

i. Fire pumps/jockey pumps, where applicable for the project

ii. Sump pumps

iii. Head-end communication systems

iv. Security systems

v. Security UPS

vi. Security Operations Center (SOC / Unit Control Room (UCR)

vii. Security Server Room

viii. Security LAN Closets

ix. OPS Suite

x. Guard Booths

xi. Vehicle Gates

xii. Active Vehicle Barriers

xiii. Radio System

xiv. BAS to operate mechanical equipment connected to emergency power. Review with the SI on a project-by-project basis.

xv. Telephones in electrical rooms

xvi. Coordinate with local building representative from SI for any additional user-requested emergency loads (optional loads include those for protection of property).

xvii. Refer to additional elevator equipment requirements in Division 14- Conveying Systems in Volume 1.

xviii. Refer to additional security equipment requirements in SDS Design Guidelines Chapter 3- Safety and Security Engineering Requirements in Volume 1.

h. Provide an exterior connection for a portable generator, equal in capacity to the building generator.

i. Provide double-ended emergency switchboard/switchgear to allow for connections to both the stationary emergency generator and portable generator. Incoming sections will have kirk-key interlock to prevent simultaneous use. If tertiary power is required, other methods include generators and feeders from alternate substations. Requirements will be reviewed on a project-by-project basis.

j. Confirm the noise level requirement of the generator with the local SI representative.

26.3.7.2. Central Battery Equipment:

a. Do not use valve-regulated lead acid batteries. Provide sealed batteries for UPS systems.

b. Batteries within computer rooms will be NiCad or lead acid type. Alternate battery technologies will be reviewed with OSHEM/SI on a project-specific basis.

26.3.7.3. Static Uninterruptible Power Supply:

a. Provide uninterruptible power supply for telecommunication racks and related equipment. Coordinate with the SI representative for other load types.

b. Coordinate requirements with OCIO standards.

26.3.7.4. Transfer Switches:

a. All three-phase automatic transfer switches will be four-pole and all single-phase automatic transfer switches will be three-pole.

b. Provide automatic transfer switches with maintenance by-pass to allow for maintenance and repair without requiring shutdown of the associated system. Equipment will include Withstand and Closing Rating (WCR) and short time rating for protection of short arc faults.

c. Automatic closed-transition transfer switches will include the following functions and characteristics.

   i. Fully automatic make-before-break operation

   ii. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms

   iii. Initiation of no-interruption transfer controlled by in-phase monitor and sensors confirming both sources are present and acceptable

      a) Initiation occurs without active control of generator.

      b) Controls ensure that closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.

d. Failure of power source serving load initiates automatic break-before-make transfer.

26.3.8. Lightning Protection, Cathodic Protection, Surge Protection Devices:

26.3.8.1. Lightning Protection Systems:

a. Perform a lightning risk assessment and provide a lightning protection system in accordance with NFPA 780 and an inspected and certified master label per UL 96.

b. Coordinate placement of air terminals and down conductors to minimize visibility.

26.3.8.2. Cathodic Protection:

a. Provide cathodic protection for metal conduits that are direct-buried in the earth.

26.3.8.3. Surge Protective Devices for Low-Voltage Electrical Power Circuits:

a. Provide surge protective devices on service entrance switchgear, distribution panels, and appliance panels within the electrical distribution system.

b. Provide surge suppression for distribution panels serving computer and communication centers.

26.3.9. Interior Lighting Systems:

26.3.9.1. Interior Lighting:

a. General requirements for all space types:

i. Utilize energy efficient LED lighting fixtures and sources. Review with the SI all site-specific requirements where alternate fixture types may be required.

ii. Review minimum lighting levels with security camera requirements within all public and non-public spaces.

iii. Limit the quantity of luminaire/lamp types to the furthest extent possible to minimize variations in attic stock.

iv. Lamps will be TCLP compliant.

v. Luminaires will have field-replaceable light engines and drivers; full replacement of a fixture due to failure is not acceptable.

vi. Exit signs will be LED type and connected to an emergency panel. Unless otherwise noted, battery-powered exit signs are not allowed.

vii. All LED fixtures and systems will include a minimum five (5) year warranty.

viii. Provide wire guards for fixtures located in mechanical and electrical rooms.

ix. Lighting within transformer vaults, switchgear rooms, electrical closets/rooms, and generator rooms will be connected to emergency power.

b. Public Spaces:

i. Lighting for exhibit areas will include emergency egress lighting and house lighting.

ii. Lamps for collections areas will be provided with UV filters, or data of the LED UV spectrum will be provided for review with the SI.

iii. Refer to SI zoo guidelines for specific lighting requirements for animal care areas.

iv. Emergency egress lighting in exhibit areas will be normally off. Provide UL-list emergency override relays for emergency lighting to turn on upon loss of normal power.

v. Emergency lighting will be provided in restrooms.

vi. Coordinate lamp types with SI exhibit designers during the design.

vii. Lighting Track:

a) Lighting track will have separate neutrals for each phase conductor.

b) All lighting track will be two-circuit track unless otherwise indicated by SI exhibit designers.

c) The A/E will include language in the construction documents for the contractor to test all two-circuit track segments for correct wiring and functionality after installation and prior to space turn-over. Contractor will provide a report of testing to the SI and A/E for review.

d) Track Lighting Fixtures:

e) Will accept a minimum of two accessories, including, but not limited to, ultra-violet lenses, light reduction screens, and spread lenses

f) Will contain glare-reducing snoots and louvers to maintain a 45-degree cutoff from the viewer's perspective

viii. Lenses and Filters:

a) Lens manufacturers will publish optically measured transmission rate for glass. Lenses will be optically clear unless otherwise indicated.

b) UV lenses will be included on all lighting fixtures illuminating displays and artifact storage areas for lighting sources including, but not limited to, metal halide, High Intensity Discharge

(HID), and fluorescent. The A/E will contact the appropriate SI personnel to determine the necessity of installing filters on halogen, incandescent, and LED luminaries.

c) Samples will be provided for lighting fixtures and lighting track that include, but are not limited to:

1. Lighting track with associated lighting track hardware
2. Lighting fixtures
3. All lighting accessories such as lenses and louvers
4. All retail spaces will have lighting specified to the same lamp temperature. A minimum lamp temperature of 3500 Kelvin is required.

5) Refer to SDS, Design Guidelines Chapter 3-General Information in Volume 1 for additional requirements for egress lighting.

26.3.9.2. Theatrical Lighting:

a. Theatrical lighting components are permitted for use as part of exhibit and/or special event lighting systems.

b. Plug connectors for theatrical fixtures will be NEMA type L5-20R, twist-locking type.

c. Plug connectors for theatrical lighting will include labeling of the circuit/control zone at each connection point.

d. Electrical distribution for theatrical fixtures will include DMX ports for connecting luminaires to a head-end dimmer board and lighting control system.

e. The design team will evaluate specific DMX connectivity and equipment requirements for theatrical lighting on a project-by-project basis with the SI.

f. Theatrical luminaires will be LED type as a basis of design, with dimming as a minimum control function.

g. Products to be mounted to theatrical pipe will be provided with C-clamps with a minimum 1.5 in diameter mounting connection.

h. For installations where theatrical lighting is provided as part of a future fit-out, a minimum of one fixture will be specified in order to test all power distribution and plug connector components.

26.3.10. Exterior Lighting Systems:

26.3.10.1. Exterior Lighting:

a. Coordinate selection of fixtures with local the SI representative and any local jurisdiction requirements for aesthetics.

b. Exterior lighting will include the path to exit discharge for life safety and will be on an emergency circuit.

c. Utilize energy efficient LED lighting fixtures and sources. Review all site-specific requirements with the SI where alternate fixture types may be required.

d. Luminaires will have field-replaceable light engines and drivers; full replacement of a fixture due to failure is not acceptable.

e. All LED fixtures and systems will include a minimum five (5) year warranty.

f. Site lighting will be coordinated with the security video system on the property. Review security lighting level requirements on a project-by-project basis. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for additional security requirements for exterior lighting.

27. COMMUNICATIONS

27.1. Reference Codes, Standards, and Guidelines

27.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 27-specific requirements:

27.1.1.1. National Fire Protection Association (NFPA) 70: National Electrical Code (NEC), latest edition or edition referenced in the scope of work

27.1.1.2. SI Office of Chief Information Officer (OCIO) Technical Note IT-960-TN14 January 2017

27.1.1.3. SI Office of Engineering Design and Construction Specifications

27.1.1.4. TIA-526-7 Revision A: *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*

27.1.1.5. TIA-526-14 Revision C: *Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant*

27.1.1.6. TIA-568.C.2 Revision C: *Balanced Twisted-Pair Telecommunications Cabling and Components Standards*

27.1.1.7. TIA-568.C.3 Revision C: *Optical Fiber Cabling Components Standard*

27.1.1.8. TIA-568.C.4 Revision C: *Broadband Coaxial Cabling and Components Standard*

27.1.1.9. TIA-568.0.D Revision D: *Generic Telecommunications Cabling for Customer Standard*

27.1.1.10. TIA-568.1.D Revision D: *Commercial Building Telecommunications Infrastructure Standard*

27.1.1.11. TIA-569 Revision D: *Telecommunications Pathways and Spaces*

27.1.1.12. TIA-506 Revision B: *Administrative Standard for Telecommunications Infrastructure*

27.1.1.13. TIA-607 Revision B: *Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises*

27.1.1.14. TIA-758 Revision B: *Customer-Owned Outside Plant Telecommunications Infrastructure Standard*

27.1.1.15. Building Information Consulting Service International (BICSI) Telecommunications Distribution Design Manual, 13th Edition

27.1.2. Refer to SDS Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

27.2. Design Requirements

27.2.1. Any deviation from these standards requires the approval of Smithsonian Facilities (SF) and SI OCIO Network Management Division (NMD).

27.2.2. The design will be in accordance with OCIO Technical Note IT-960-TN14. Where a conflict occurs between the OCIO Technical Note and the SDS, SI OCIO NMD will be notified for conflict resolution.

27.2.3. Division One (Supplementary Conditions for Construction) is available on the SF website. This information includes specific building operations and when certain types of construction, demolition, welding times, deliveries, etc. can be accomplished.

27.2.4. The designer must provide a telecommunications systems design narrative. This narrative will describe the telecommunications pathways, backbone, and horizontal cabling design. Pathway fill calculations will be done including sleeve and cable tray fills.

27.2.5. The designer will provide a separate “T” series set of telecommunications drawings. The following types of drawings are required:

27.2.5.1. T0- Legend, Notes, Symbols, and Index of Drawings

27.2.5.2. T1- Telecom Floorplan showing the location of outlets, cable pathways, and the location of the Telecom Rooms (TR)

27.2.5.3. T3- Room Layout drawings showing the layout of all TRs including racks/cabinets, cable tray, wall fields, grounding busbar, core holes, and sleeves

27.2.5.4. T4- Elevation Drawings showing rack/cabinet and wall elevations

27.2.5.5. T5- Telecom Riser One-Line diagrams showing all fiber, copper, and coaxial counts to and from each TR including the Main Distribution Frame (MDF), Intermediate Distribution Frames (IDFs), and Demarks.

27.2.5.6. T6- Telecom Details showing faceplates with labeling and other details

27.3. Specifications

27.3.1. Common Work Results for Communications:

27.3.1.1. Designer will be a Registered Communications Distribution Designer® (RCDD) and have at least ten (10) years of design work and have done projects of similar scope.

27.3.1.2. Installer will have BICSI and manufacturer-trained technicians or will have ten (10) years or more of experience doing installations for the SI.

27.3.1.3. At least a 20-year manufacturer’s parts and application warranty will be provided.

27.3.1.4. TRs will be turned over to OCIO per the following requirements:

a. TRs will be completed of all work and free of dust and construction.

b. Ts will have SI card reader access with only Office of Protection Services (OPS) and OCIO holding access-programmed badges.

c. The area surrounding the TRs will be free of construction work being done that could contaminate the TR.

d. There will be no requirement for any additional work in or affecting the TRs once they are turned over.

27.3.1.5. Utilities not serving the TR will not transit the TR, including plumbing, fire sprinkler, HVAC, and electrical mains.

27.3.2. Grounding/Bonding of Telecommunications Systems:

27.3.2.1. Design will follow TIA 607.

27.3.2.2. Connections:

a. Exothermic Weld

b. Compression: Two-Hold Lug

27.3.3. Pathways for Communications Services:

27.3.3.1. Conduits:

a. Fill ratio will not exceed 40 percent.

b. A pull box is required for every two (2) 90-degree bends, straight lengths of 30.4 m (100 ft), or a U-shaped bend in the conduit.

c. Pull boxes will not be used to change the direction of conduits or cabling.

d. If drywall ceilings are present, conduit will be installed from the outlet location to the nearest accessible area in the ceiling.

27.3.3.2. Cable tray in the common area installed above the drop tile ceilings will be basket type tray. Cable tray below the ceiling will be non-ventilated bottom trough type cable tray painted to match the wall color. Paint will not be sprayed onto any telecommunications cabling.

a. Fill ratio will not exceed 50 percent.

b. Cable tray will be installed for the main cable pathways with the usage of J hooks or Electrical Metallic Tubing (EMT) conduit for the conveyance from the cable tray to the outlets.

c. Cable tray will be installed in hallways and common areas. Access to the cable tray will be in the hallways and common areas and not in the offices.

d. Cable tray will have clear space of at least 75 mm (3 in) from the ceiling tile and 200 mm (8 in) above the cable tray to the nearest blocking object.

e. Cable tray will be properly bonded per the manufacturer's specifications.

27.3.4. Communications Equipment Room Fittings:

27.3.4.1. Provide two post equipment racks for IDFs.

a. 2.1 m high x 482 mm wide (7 ft high x 19 in wide) with marked and numbered 45U spaces

b. UL classified and EIA-310 compliant

c. Posts will be 6 in deep.

27.3.4.2. Provide four post equipment racks for MDF.

a. 2.1 m high x 482 mm wide (7 ft high x 19 in wide) with marked and numbered 45U spaces

b. UL classified and EIA-310 compliant

c. Depth from front posts to rear posts should be at least 762 mm (30 in).

27.3.4.3. Provide ladder rack for routing of cables inside of MDFs and IDFs.

a. All parts will be UL classified.

b. Rungs will be tubular in design.

c. Ladder rack will be black.

d. All sweeps and turns will be factory manufactured.

e. Waterfalls will be used for cables leaving the cable tray.

27.3.4.4. Provide vertical cable managers on each side of the rack:

a. Double-sided

b. Trough 152.4 mm (6 in) wide

27.3.4.5. Provide 2U front only horizontal cable managers that will have a ring depth of 101.6 mm (4 in).

27.3.5. Communications Backbone Cabling:

27.3.5.1. Multi-Mode Fiber:

a. Outdoor:

I. 50 micron OM3 12-strand fiber

II. Overfilled modal bandwidth 1500/500 MHz.km

III. Indoor/outdoor

IV. Tight buffer or loose tube

V. Armored sheath

VI. SC connectors; do not fusion splice

VII. 6 duplex SC coupler panels

b. Indoor:

i. 50 micron OM3 12-strand fiber

ii. Overfilled modal bandwidth 1500/500 MHz.km

iii. Tight buffer

iv. Armored sheath

v. SC connectors; do not fusion splice

vi. 6 duplex SC coupler panels

27.3.5.2. Single-Mode Fiber:

a. Outdoor:

I. 8.2/125 micron OS1/OS2 12-strand fiber

II. Indoor/outdoor

III. Tight buffer

IV. Armored sheath

V. SC connectors; do not fusion splice

VI. 6 duplex SC coupler panels

a. Indoor:

I. 8.2/125 micron OS1/OS2 12-strand fiber

II. Tight buffer

III. Armored sheath

IV. SC connectors; do not fusion splice

V. 6 duplex SC coupler panels

27.3.5.3. Copper Cable:

a. 25-pair Category 3 plenum cable

b. Terminated one pair per port on 24-port patch panel on each end

27.3.6. Communications Horizontal Cabling:

27.3.6.1. Category 6A plenum rated cable

27.3.6.2. Category 6A 8-position/8-pin RJ45 outlets

27.3.6.3. Category 6A patch panel with 110 IDC terminations on back; provide cable strain relief bar for each patch panel.

27.3.6.4. Provide ring/D-ring type horizontal wire management.

27.3.6.5. All cables will be tested with a Level III tester. Test results will be given to the SI. No star passes or failed tests will be accepted.

27.3.6.6. Standard Work Area Outlet (WAO) is a Category 6A duplex outlet.

28. ELECTRONIC SAFETY AND SECURITY

28.1. Reference Codes, Standards, and Guidelines

28.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design.

28.1.2. Refer to SDS, Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

28.2. Design Requirements: Fire Alarm Systems

28.2.1. Special Requirements:

28.2.1.1. Where multiple fire alarm control panels are provided, they will be interconnected in a Class A or Class X network arrangement.

COMMENTARY: Due to the complexity of some SI facilities, multiple networked fire alarm panels may be needed. The importance of a fire alarm system for detection and evacuation requires a reliable network. A Class A circuit (looped circuit) allows continuous operation of the fire alarm system despite a single break in the circuit. A Class X circuit (looped circuit) allows continuous operation of the fire alarm system despite a single break or short circuit.

28.2.1.2. All fire alarm systems will be monitored by a SI proprietary supervising station or a central supervising station that meets the requirements of the National Fire Protection Association (NFPA) 72.

28.2.1.3. Provide a fire alarm workstation on a separate desk in the Security Operations Center (SOC) / Unit Control Room (UCR).

28.2.1.4. Fire alarm panels are not allowed in the Security Operations Center (SOC) / Unit Control Room (UCR).

28.2.1.5. In facilities where OFEO/OSHEM staff is the sole Authority Having Jurisdiction (AHJ), provide two manual pull-stations, one RED and one BLUE, in the Security Operations Center (SOC) / Unit Control Room (UCR). The RED pull-station will provide manual activation of all notification appliances throughout the facility (i.e., “ALL EVAC”), and will drop power to field relays controlling any powered door locks through egress pathways (e.g., delayed-egress doors and select card reader doors in the egress path). The BLUE pull-station is for a ‘silent evac’ and will drop power to field relays controlling any powered door locks through egress pathways, but NOT activate any notification appliances. On a case-by-case basis, OSHEM and OPS shall determine if this will be the only means of activating notification appliances in the facility. In facilities where SI is not the AHJ, OSHEM and OPS will work with the local authority to determine an acceptable manner of notification activation. Typically, this will be automatic or pre-signal (as defined in IBC or Life Safety Code).

28.2.1.6. All fire alarm circuits will be installed in conduit: Electrical Metallic Tubing (EMT), Intermediate Metal Tubing (IMT), or rigid).

COMMENTARY: Fire alarm circuits installed in conduits minimize the risk of damage or accidental cutting of the circuits. In addition to minimizing the risk, conduits also facilitate repairs and future modifications, for instance, ease of pulling new wire or adding to an existing system. Limited use of metal-clad cable can be considered on a case-by-case basis, depending on the condition of the contract area.

28.2.1.7. Signaling line, initiating circuits, notification appliances, and power circuits will each be in a separate conduit.

COMMENTARY: Installing Signaling Line Circuit (SLC), initiating circuits, notification appliances, and power circuits in separate conduits allows survivability of each circuit independently. Physical separation of circuits by type reduces the extent of potential disruption to critical fire alarm system functions during the frequent construction and repair activities that occur throughout the SI.

28.2.2. Public Address Systems:

28.2.2.1. Public address systems used for mass notification will comply with NFPA 72 and the Smithsonian Specification *283111-Addressable Fire Alarm System* included in Volume 2.

COMMENTARY: This requires coordination between the Office of Safety, Health, and Environmental Management (OSHEM), the Office of Protection Services (OPS), and the SI facility. Public address systems are typically utilized for facilities where fire alarm systems cannot achieve the intelligibility sound levels needed to communicate emergency information to the public and staff.

28.3. Design Requirements: Electronic Security

28.3.1. The measures presented here are not all-inclusive, and additional technical information for implementation can be found in the referenced documents.

28.3.2. Standards

28.3.2.1. Design electronic security systems with a minimum of 20% expansion beyond the base project including requirements for exhibits. This includes servers, network switches, and security panels.

28.3.2.2. Consult with the OPS Project Manager for any Guard Tour requirements.

28.3.3. Electronic Security Network

28.3.3.1. The standard infrastructure design provides network resiliency via redundant physically separated pathways. Redundant pathways from Security LAN Closets to the Security Server Room (SSR) ensures operability in the event of device failure or loss of connection. Connections from Security LAN Closets to the Security Server Room (SSR) must utilize a minimum of 12-strand single-mode (OS2) fiber optic cabling. These connections will be redundant SFP+ (10GB) connections.

28.3.3.2. Use fiber optic cabling for communications outside the building envelope to prevent transient voltage surge suppression issues. Connections to locations such as emergency call boxes, camera poles, and vehicle gates must utilize a minimum of 6-strands of either single-mode fiber (OS2) or multimode fiber (OM4). These connections will be SFP (1GB) connections.

28.3.3.3. Utilize redundant fiber switches as the core switches in the Security Server Rooms (SSR) to connect Security LAN Closets throughout the building. Exceptions may be made for small buildings on a case-by case basis; consult OPS for approval.

28.3.4. Physical Access Control

28.3.4.1. Utilize card readers for areas where an audit trail of access is required and high throughput locations to reduce the issuance of conventional keys. Card readers should not be used on personnel offices unless the office is a high security area.

28.3.4.2. Life Safety.

a. All security locking arrangements on doors used for egress must comply with requirements of the National Fire Protection Association (NFPA) 101, Life Safety Code.

b. Each security power supply supporting a locking device shall have a UL approved relay that releases power to locking devices upon activation of the local fire alarm panel.

28.3.4.3. ADA Requirements. Design and mount all access control components requiring interaction with staff or public users in accordance with ADA height requirements, 1066 mm (42 in) above finished floor (AFF), on the lockset side of the door. Base final locations of the card readers on door swing and safe door opening operation.

28.3.4.4. Keyed cylinders. Provide card access control doors with Schlage or Medco full size cylinders on the unprotected side to permit bypass of inoperative card readers for emergency purposes. The use of the keys to open a door shall result in a forced open alarm.

28.3.4.5. Request to Exit Devices

a. The preferred method is an exit shunt mounted in the handle of the door hardware. If electrified cylindrical locks are required for retrofit applications, a PIR Rex must be used.

b. PIR Rex will only momentarily shunt the door position switch. When used with doors with electrified lockset, the PIR Rex will not unlock the door.

28.3.4.6. Door closers. All access-controlled doors require door closures.

28.3.4.7. Provide a RM-4E enclosure and reader module on the secure side of each access-controlled door.

28.3.4.8. Local Sounders. Install local sounders on all card reader doors. Utilize chime models with a minimum 92 dB chime measured at 3.0 m (10-ft) from the device. Mount them on the secure side of the door. The preference is to ceiling mount the device, if this is not feasible, mount the devices as high as possible up to 10 feet above finished floor.

28.3.4.9. Lock Power Supply

a. Provide UL listed power supplies with one (1) hour of battery back-up when powered from an emergency power generator circuit or eight (8) hours of battery back-up when not powered from an emergency power source.

b. Provide separate UL listed power supplies for delayed egress doors with one hour of battery back-up.

28.3.4.10. Electric Locks

a. The preferred lock is an electrified lockset with integrated REX wired to be normally closed. The secondary choice is an electric strike. All locks will be 24VDC and fail-secure, unless prohibited by code.

b. Magnetic locks are only to be used in extreme circumstances with written OPS approval. When they must be used, only UL listed magnetic lock and egress devices configurations with PIR Rex. Provide emergency release buttons meeting ADA requirements according to IBC. The push-to-exit button will be double pull to drop power and signal the access control system as a valid exit. Magnetic locks must drop primary power through the Fire Alarm Relay in the lock power supply.

c. High-current locks are not allowed.

28.3.4.11. Emergency Exits (Delayed Egress Devices)

a. Only UL listed magnetic lock and egress device configurations with touch sensitive bar or switch in the hardware are allowed.

b. Delayed egress devices must drop primary power through a relay connection to the fire alarm system.

c. Emergency exit doors must remain latched from the exterior when the fire alarm system and egress hardware is in emergency exit mode. Emergency exit doors shall not be provided with pull hardware on the exterior side.

d. Delay time for delayed egress hardware is 30 seconds. Set nuisance delay time for three seconds.

e. When in fail-safe mode for egress, the hardware should maintain the doors in a fail-secure mode from the outside.

f. A Light Emitting Diode (LED) countdown device should be provided on the latch side of the door at ADA height. Equipment is to be fail-safe for egress.

g. Provide video surveillance capturing individuals exiting through the door at ‘forensic detail’.

h. Delayed egress hardware will provide status indication through the access control system, not via separate control panels in the security control room.

i. Where delayed egress is required, but local codes may prohibit it, the following shall be substituted: door contact, local sounder, recorded video of individuals and objects being removed, and appropriate signage. Suggested signage is: “Alarm will sound when exiting. Under video surveillance.”

28.3.5. Intrusion Detection

28.3.5.1. Configuration

a. Zone intrusion devices of different technologies (i.e., motion detection, glass break, or magnetic contacts) separately.

b. Wire motion sensors together, not to exceed three (3) devices, within the confines of clear physical barriers and not to exceed 15.25 m (50 ft).

c. Motion sensors shall not be wired together in Collection Storage areas.

d. Wire vibration sensors together, not to exceed three (3) devices protecting a wall.

e. Program devices in the same physical location providing the same purpose in alarm groups to support the Intrusion Zone concept.

28.3.5.2. Applications. The following are examples of typical application of IDS on intentional openings:

a. Doors: Typically protected with door position switches with PIR motion sensors as a back-up system if necessary.

b. Windows / Glazed Openings: Typically protected with position switches and glass break sensors with PIR motion sensors as a back-up system if necessary. Blast resistant windows with interior glazing that exceeds 0.25 inches (e.g., two 1/8" panes laminated together with a 1/16" interlayer) cannot be protected with acoustic glass break sensors.

c. Archways: Typically protected with a PIR curtain motion sensor.

d. Vents / Ducts

i. A duct is considered an intentional opening and part of the boundary layer. Protection is required for any vent/duct where the wall requires protection.

ii. Whenever possible, vents / ducts should be designed to be smaller than man-passable (a clear cross section area of 619 square cm (96 square in) or more with the smallest dimension exceeding 15.2 cm (6 in)). If penetrations cannot be designed to prevent intrusion, then apply duct detection.

iii. Design and mount sensors on the secure side of an opening to detect intrusion. Detection may be provided by one or a combination of motion detection, contacts or barrier bars, tension wires, or pressure mats within the duct. The designer may submit alternative detection methods to OPS for approval. The designer is responsible for selecting the appropriate sensor technology based upon the project conditions.

28.3.5.3. Sensor Line Supervision

a. All sensors are to be tampered, reporting trouble regardless of the state of the sensor (on or active, vs. a non-reporting status). Wire tamper alarms to the PACS as a line supervision error alarm zone. Wire each tamper in the sensor circuit to provide a tamper / supervision error.

b. Use end-of-line resistors located at the last device in the circuit for the supervision of all alarm devices.

c. End-of-line resistors shall be a prepackaged unit and resistor networks shall meet manufacturers specifications. Resistor quality shall be standard tolerance of 1% or maximum of 1/4 Watt.

28.3.5.4. Mounting Heights. Show the mounting heights of all detectors on the drawings, in the model, or in a detail. All motion detectors, glass break sensors and cameras are to be mounted above reach, no less than 2745 mm (9 ft) Above Finished Floor (AFF), if ceiling height permits, to minimize performance degradation through vandalism.

28.3.5.5. Intrusion Zone (Arm/Disarm) Card Readers. Provide Intrusion Zone (Arm/Disarm) card readers in each intrusion zone adjacent to the primary entrance. The control device shall be configured for an adjustable entry /exit delay. Do not include perimeter IDS sensors in the Intrusion Zone, only volumetric IDS devices.

28.3.5.6. Position Switches (Door Position Switches or Balanced Magnetic Switches)

a. Mount the position switches on the latch edge of the door or opening within 152 mm (6 in) of the latch edge if mounted in the top of the door. On double doors, each door will have a separate contact. Where doors are controlled by entry control devices, intrusion detection shall be coordinated with authorized accesses to preclude nuisance alarms for authorized entries and exits. When surface mounting is required, provide armored cabling from the sensor to the junction box.

b. All operable perimeter windows within 4 m (18 ft) of exterior ground surface or within 3 m (12 ft) directly or diagonally opposite a window, structure, fire escape, or roof shall be protected with contact sensors. The sensors shall be individually wired and always armed. Exceptions may be granted from OPS if the windows have burglar bars meeting SI criteria. An alternative means of protection may be recommended by the security consultant.

c. Provide roll-up doors and other doors not a standard size or configuration with position switches suitable for the application. Position switches shall be mounted on both the left and right of the protected side of roll-up doors wider than 2 m (6.6 ft).

28.3.5.7. Volumetric Motion Sensors. The number, spacing, and placement of devices shall be in accordance with the manufacturer’s specifications to provide 100% coverage of the area to be protected.

28.3.5.8. Vibration and Ultrasonic Sensors (Wall/Safes Penetrations)

a. The number, spacing, and placement of devices shall be in accordance with the manufacturer’s specifications to provide 100% coverage of the boundary or object to be protected. The area of coverage of each device shall be shown on the drawings. The designer is responsible for selecting the appropriate sensor technology based upon the project conditions.

b. All wall mounted shock/vibration sensors should be provided with LEDs to indicate activation, latch upon activation, and be mounted to always provide a clear view of the LEDs to responding security officers.

c. Sensors must be wired to provide LED resetting from the console via the DGPs’ output relays. The DGP relays are utilized to interrupt device power.

d. Except for unusually small areas, smaller than 3 x 3 m (10 x 10 ft), sensors zoned together shall not cover more than one wall.

e. Sensors placed on concrete or concrete masonry unit (CMU) walls need to be placed directly on the concrete or CMU block and wired into an adjacent junction box and conduit system. Sensors should not be mounted within the conduit system's Junction boxes, due to conduit vibration transmission and Junction boxes fastening uncertainties. Use sensors specifically recommended by a manufacturer for use on the wall material.

f. Sensors placed on expanded metal over steel studding, shall be secured to the steel studding to maximize the transfer of vibration via the expanded metal to the studding.

g. Only vibration/shock sensors along a particular wall can be zoned together, and the average number of sensors per zone should not exceed ten (10).

28.3.5.9. Glass-Breakage Sensors

a. The number, spacing, and placement of devices shall be in accordance with the manufacturer's specifications to provide 100% coverage of the boundary to be protected. The area of coverage of each device shall be shown on the drawings.

b. Acoustic glass break sensors or shock sensors shall be provided for the protection of glass panels that exceed 240 square cm (37.2 square in) with any dimension greater than 200 mm (8 in).

28.3.5.10. Wireless Alarm Systems

a. The Wireless alarm system shall be an Echo Stream 900MHz spread spectrum, 900 MHz system with field repeaters as necessary. It should be provided with sufficient zoning to handle anticipated use and a minimum of 192-point wireless panels are the system of choice, mounted in Security Closets at 1500 mm (59 in) AFF. Repeaters may be required to achieve a minimal signal test level of “10” with the test kit.

28.3.5.11. Receivers

a. Receivers must have a relay output to the PACS for each zone, and the preferred unit should accommodate 16 zones (at a minimum) with 192 transmitters.

b. All receivers, whether single or multiple zones, shall be field programmable (as opposed to factory setting).

c. Receivers must be contained within alarmed Security Closets and mounted on cover of enclosures to permit conduit to be run from the enclosure. Wiring is to be routed in a protected manner, out the rear of the receiver into the enclosure.

d. Each receiver is to be given its own house code, from a master list maintained by OPS. The house code is to be permanently displayed on the cover of the mounting enclosure.

e. Repeaters

i. The placement of repeaters is critical. Signal strength tests are required to determine their need and placement.

ii. In determining the need for a repeater, the installation contractor during installation, must conduct field strength tests with the appropriate test kit. (Testing during construction is imperative because local field conditions may have change with the introduction of steel.) A radio frequency signal indicator reading below 10 between the transmitter in the field and the receiver is unacceptable.

iii. Repeaters mounted in accessible locations must be wired with an external tamper alarm switch inside the plastic cover and wired to the “external terminal”. Power repeaters from the DGP power supply at the nearest Security LAN Closet. Under this situation, battery back-up is not needed in the repeater housing. Repeaters shall not be mounted lower than 2745 mm (9 ft) AFF.

f. Wireless Receivers. The preferred method for exhibit security wiring is to hardwire the alarm devices to the monitoring system. Hardwired devices are considered more reliable and dependable than wireless alarms. Plan wireless receivers for exhibit areas to accommodate gallery exhibits not accessible by conduit systems.

28.3.5.12. Video Analytics. Video analytics may be used in lieu of other identified detection technologies. OPS shall be consulted prior to planning to use video analytics.

28.3.6. Video Assessment and Surveillance

28.3.6.1. Resolution

a. General Surveillance Detail. This video provides a minimum of 40 pixels per foot. This level of detail is for live viewing where the detail is not necessary on recorded video. For instance, looking to see what a crowd is doing without needing to recognize faces. Or only needing to detect when someone is in a restricted area.

b. Forensic Detail. This video provides a minimum of 80 pixels per foot. This level of detail is necessary when, recording, and recognizing images like license plates and faces. This allows the video to be referenced after an incident to determine exactly what happened and provide forensic evidence.

28.3.6.2. High Detail. This video provides a minimum of 120 pixels per foot. This level of detail is applicable in a retail or banking context where there is a need to clearly see the customer's and employee's faces as well as identify the currency in their hands.

28.3.6.3. Assessment Video. Assessment cameras shall be alarm actuated by either intrusion detection sensors or access control devices.

28.3.6.4. Cameras

a. Fixed. Fixed cameras shall be specified for applications requiring continuous video capture.

b. Multi sensor. Utilize multi-sensor cameras when possible, to reduce quantities of cameras and camera licensing.

c. Pan-tilt-zoom (PTZ). PTZ’s are only allowed when integrated into a single housing unit with a multi-sensor camera and only for use for rooftop parapet mount locations.

d. All cameras shall be color day/night. All interior cameras shall have dome enclosures. All exterior cameras will be housed in environmentally controlled domes unless operational requirements make a dome unnecessary; in that instance, an environmentally controlled enclosure may be utilized.

e. The mounting heights of all cameras shall be shown on the drawings or in a detail. All cameras are to be mounted above reach, no less than 2745 mm (9 ft) above finished floor if ceiling height permits. This minimizes performance degradation through vandalism.

28.3.7. Intercommunications

28.3.7.1. Intercom Call Stations. Intercom stations, or some other form of communication, are required at select staff entrances to call the Security Operations Center (SOC) / Unit Control Room (UCR).

28.3.7.2. Elevators. Intercoms or emergency phones meeting SI & ADA requirements are required to allow cab occupants to contact the security control room or other monitoring agencies.

28.3.7.3. Area of Rescue Assistance (ARA). Intercoms SI ADA requirements are required at ARA locations to allow building occupants to contact the Security Operations Center (SOC) / Unit Control Room (UCR).

28.3.7.4. Intercoms are required at vehicle access control points adjacent to card readers and should have dual-height pedestals for truck access points.

28.3.8. Detection and Screening Equipment

28.3.8.1. All facilities require screening of personnel per ISC requirements. Consult with OPS for project specific requirements.

28.3.9. Pathways

28.3.9.1. All security related conductors and cabling will be in shared cable tray or conduit. Connections for EMT (electric metallic tubing) will be steel compression fittings. Exterior conduits shall be RIGID or schedule 80 PVC. All exterior buried conduits will be PVC.

28.3.9.2. Conduits

a. Mark conduits between fire panels and security data gathering panels with red and blue tape every 10 m (32.8 ft).

b. Backbone fiber and raceways will be in conduit unless within Security LAN Closets or Security Server Room.

c. Electrical Metallic Tubing (EMT) may be used at any point in the system within a building.

d. Flexible Metal Conduit must be limited to short connections and requires approval from OPS.

28.3.9.3. Shared Cable Tray

a. Security cabling may be run in a common tray with non-security cabling.

b. Coordinate with the Telecom designer to provide 6” wide dedicated security space in the shared tray.

28.3.10. Enclosure

28.3.10.1. All security field equipment shall be housed in approved enclosures. For general interior use NEMA 12 rated enclosures. Exterior enclosures use NEMA 4 rated polycarbonate construction. All enclosures shall be hinged with lock knockouts.

28.3.10.2. A large enclosure assembly may be used to consolidate space in closets. Large enclosures consolidate security equipment (Data Gathering Panel, Field termination board, such as, I-8 and R-8 boards) and provide for improved wire management.

28.3.10.3. OPS’s standard enclosures are the Life Safety Power E8 enclosure for the power supply and DGP. Additional I-8 and R-8 boards should be in a standard 16-inch wide by 24-inch-tall enclosure.

28.3.11. Security Zone Distribution Box (ZDB)

28.3.11.1. A Security ZDB is a patch point within an area (typically a Gallery) to allow renovations, moves, adds, and changes within a gallery to be done without disturbing any space or activities outside the gallery. The cabling should come from the nearest Security LAN Closet and associated network switches and data gathering panels.

28.3.11.2. Size the Security ZDB per the gallery it is covering. The minimum quantities of terminations include (24) CAT6 cables terminated on a CAT6 patch panel, a combination of (6) I-8 and R-8 modules, and (2) of D8 12VDC power distribution modules.

28.3.11.3. Provide vertical pathways to the shared cable tray (20 feet on center) in the black-box gallery ceiling.

28.3.11.4. The Security ZDB must be within a working height while standing on the floor.

28.3.11.5. The Security ZDB must be a locked enclosure with a tamper.

31. DIVISION 31 – EARTHWORK

31.1. Reference Codes, Standards, and Guidelines

31.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design.

31.1.2. Local Jurisdiction Requirements:

31.1.2.1. The A/E will be responsible for the coordination with local utility authorities.

a. For projects in Washington, D.C., that includes, but is not limited to: Washington Gas, DC Water, Pepco, the Washington Metropolitan Area Transportation Authority (WMATA), Miss Utility, District of Columbia Department of Transportation, General Services Administration (GSA) (steam tunnels). Projects on the National Mall must also take into consideration adjacent property owners and stakeholders (i.e., Secret Service, Department of Homeland Security, National Park Service (NPS), etc.).

31.1.2.2. The A/E will be responsible for identifying and obtaining all required design approvals and permits from federal, state, and local jurisdictions having authority over the project site.

a. For projects in Washington, D.C., that includes, but is not limited to: erosion and sediment control and stormwater management approval (DC Department of Health), public space permit (DC Department of Transportation), and building permit (DC Department of Consumer and Regulatory Affairs).

31.1.2.3. Local agency design criteria should be used to the extent possible.

a. For projects in Washington, D.C., that includes, but is not limited to: District of Columbia Department of Transportation Standard Specifications for Highways and Structures, NPS Streetscape Manual – Interagency Initiative for National Mall Road Improvement Program, National Capital Planning Commission requirements, District of Columbia Historic Preservation Office requirements, and U.S. Commission of Fine Arts requirements.

31.1.3. Smithsonian Requirements:

31.1.3.1. When 464 sq m (5,000 sq ft) of land is disturbed, D.C. stormwater management regulations and additional specific requirements kick into effect. (DC-specific). Smithsonian Gardens (SG) must be involved in the discussion and approach to design.

31.1.4. Refer to SDS, Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

31.2. <u>Design Requirements</u>

31.2.1. Existing natural features such as trees, slopes, and drainage characteristics must be preserved and protected, whenever possible.

31.2.1.1. Identify, assess, and protect existing vegetation of aesthetic, historic, and ecological value. Preserve existing onsite vegetation and its stormwater management, air quality, and microclimate benefits.

31.2.1.2. Minimize soil disturbance whenever possible to preserve and protect soil resources from damage by limiting the area of site disturbance, controlling erosion, and compaction during construction. This is a critical step to preserving soil structure and maintaining infiltration and groundwater recharge.

31.2.1.3. The A/E must coordinate with the SI arborist to verify areas and methods for tree protection to be used for all trees within the limit of disturbance.

31.2.1.4. Earthwork cut and fill quantities should be balanced to the extent possible.

31.2.1.5. Use of pneumatic equipment is recommended for excavation work near existing trees and plants to be preserved.

31.2.1.6. Identify and assess the historic implications and need for preservation within gardens. While not many gardens are historic, they contribute to the historic character of the Mall.

31.2.1.7. Trees within gardens are considered accessioned collection items and are part of the SI tree collection.

31.2.1.8. Gardens will be treated as exhibits.

31.2.1.9. Alert the A/E to the above conditions and include in documentation.

31.2.2. All grades adjacent to buildings will maintain a positive slope to allow for drainage away from the structure.

31.2.3. The extent of the existing irrigation system will be investigated and clearly identified on the plans. The plans will clearly indicate that the existing irrigation system will be protected at all times during site clearing and earthwork operations and that any damage to the existing irrigation system as a result of the site clearing and earthwork operations will be repaired at the contractor's expense. SG has as-built drawings available. The A/E is responsible for verifying existing conditions. Coordinate through the Contracting Officer's Technical Representative (COTR).

31.2.4. Coordinate earthwork specifications with specific soil placement, settlement, and compaction requirements specified in Division 32 for planting soil and landscaping work.

31.3. <u>Specifications</u>

31.3.1. Site Clearing:

31.3.1.1. Selective Tree and Shrub Removal and Trimming:

a. All tree removal requires prior approval by the SI project manager.

b. Tree removal will meet local standards.

c. Refer to Division 32- Exterior Improvements, Section 32.2.6.6 in the Volume 1 for additional language regarding approvals for tree removal. Trees on the SG campus on the Mall and on Gallery Place are all accessioned SI collections items. The design team should make every effort to preserve and protect trees. Any necessary tree removal must comply with National Capital Planning Commission (NCPC) tree preservation and replacement policies.

31.3.1.2. Earth Stripping and Stockpiling:

a. All suitable topsoil will be stockpiled (best practice) for smaller projects only. Coordinate and confirm with SG through the COTR.

b. Excavated material will be stored within the limits of disturbance.

c. SG integrates an effective green waste management strategy into its daily operations by properly treating and disposing of all biodegradable wastes rather than sending them to a landfill.

   i. Strip and stockpile in areas where compaction or disturbance will occur or is anticipated.

   ii. Separate topsoil horizons O and A from sub soil horizon B.

   iii. Segregate topsoil types.

   iv. The optimal size of stockpiles is 1.8 m (6 ft) maximum height for sandy soils, and 1.2 m (4 ft) maximum height for clay loam soils to minimize crush loading. The larger the piles and the longer the storage time, the longer it will take to reactivate the soil biology properties.

v. Do not cover topsoil stockpiles with impervious materials. Doing so will reduce air penetration and increase soil temperature, killing critical biological organisms within the soil. However, erosion and sedimentation control procedures will be implemented.

vi. Select soil types to meet the specific needs they are intended to support. To ensure a successful, sustainable project, match soil characteristics and types with planting and stormwater management goals and anticipated levels of use and compaction.

vii. Test topsoil after stockpiling to determine the type and amount of amendments needed to reactivate biological properties and handle drainage needs.

a) Consider the use of compost as an amendment since it is often the most effective way to rebuild structure, improve drainage, and support biological activity without overloading nutrient content or increasing salinity levels, which may happen with inorganic fertilizer amendments.

b) Adjust soil pH and fertility as indicated by testing. A qualified consultant is required to determine soil composition. The consultant will propose a strategy for SG approval.

31.3.2. Earth Moving:

31.3.2.1. Excavation and Fill:

a. The design and preparation of the subgrade should be considered in coordination with the soil placement plan, and with planting and stormwater objectives.

b. Below planting bed and lawn areas, subgrades should be prepared in a manner that supports healthy rooting conditions. Specify performance requirements for compaction and infiltration rates and provide frequency of testing to ensure contractor compliance with the requirements.

   i. Provide subsurface drainage in planting areas where subsurface conditions do not provide sufficient infiltration.

c. In areas where green infrastructure Best Management Practices (BMPs) are designed to promote infiltration, specify performance requirements for compaction and infiltration rates and provide frequency of testing to ensure contractor compliance with the requirements.

   i. In the design process, provide specific site investigation testing including borings and infiltration tests in proposed infiltration BMP locations to ensure viability with design intent.

32. DIVISION 32 – EXTERIOR IMPROVEMENTS

32.1. Reference Codes, Standards, and Guidelines

32.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design.

32.1.2. All projects on the National Mall (the Mall) will incorporate approved precinct studies and criteria developed by/for the SI into building and site design. Any future projects that do not follow approved precinct studies/criteria may require approval and the National Environmental Policy Act (NEPA), Section 106.

32.1.2.1. These include but are not limited to: site security – SI Security Design Criteria, SI Exterior Signage Master Plan, SI Water Reclamation Study, Mall Streetscape Manual, Monumental Core Framework Plan, SI master plans, and SI Mall-Wide Perimeter Security Master Plan. Reference the upcoming Monumental Core Streetscape Guidelines that will supersede the Mall Streetscape Manual when released.

32.1.2.2. Projects on the National Mall require coordination with the National Park Service (NPS) and District of Columbia to verify "ownership" of the sidewalks.

32.1.3. Local Jurisdiction Requirements:

32.1.3.1. The A/E will be responsible for coordination with local utility authorities.

a. For projects in Washington, D.C., that includes, but is not limited to: Washington Gas, DC Water, Pepco, Washington Metropolitan Area Transportation Authority (WMATA), Miss Utility, District of Columbia Department of Transportation, General Services Administration (GSA) (steam tunnels). Projects on the

National Mall must also take into consideration adjacent property owners and stakeholders (i.e., Secret Service, Department of Homeland Security, NPS, etc.).

32.1.3.2. The A/E will be responsible for identifying and obtaining all required design approvals and permits from federal, state, and local jurisdictions having authority over the project site.

a. For projects in Washington, D.C., that includes, but is not limited to: erosion and sediment control and stormwater management approval (DC Department of Health), public space permit (DC Department of Transportation), and building permit (DC Department of Consumer and Regulatory Affairs).

32.1.3.3. Local agency design criteria should be used to the extent possible.

a. For projects in Washington, D.C., that includes, but is not limited to: District of Columbia Department of Transportation Standard Specifications for Highways and Structures, NPS Streetscape Manual – Interagency Initiative for National Mall Road Improvement Program, National Capital Planning Commission requirements, District of Columbia Historic Preservation Office requirements, and U.S. Commission of Fine Arts requirements.

32.1.4. All projects must provide adequate accommodation for emergency access for fire, ambulance, police, and service vehicle, including access for policing the building perimeter and pedestrian paths.

32.1.5. Refer to SDS, Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

32.2. Design Requirements

32.2.1. This document is not intended to cover outdoor exhibits or collection gardens, nor is it intended to cover interior plants.

32.2.2. The Smithsonian Gardens (SG) campus on the Mall and Gallery Place includes highly maintained display gardens and garden exhibits that constitute an accredited museum maintained by SG. The trees on the SG campus are accessioned SI collections items that are managed as specimens.

32.2.3. Early collaboration between maintenance and design teams allows for thoughtful decision making that increases the probability that projects will be maintained properly that operational knowledge will be incorporated into the design, and that maintenance personnel will be more vested in the project.

32.2.3.1. The project will be designed to survive for a life span established by the SI project manager.

32.2.3.2. It is recommended to request a 35 percent submission review by the Office of Facilities Management and Reliability (OFMR), which includes building maintenance. In addition, SG should also provide a formal review at 35 percent; however, they should be brought in for input as soon as possible during design development.

32.2.3.3. Pedestrian paving must be sized to receive service vehicle and emergency vehicle loads, for example, snowplowing and façade maintenance lifts.

32.2.3.4. Plazas and entrances will have adequate power and water supplies for ease of maintenance and versatility of spatial use for both daily and event uses. These requirements are project-specific and will be determined by the A/E.

32.2.3.5. Planting locations will accommodate cleaning and maintenance activities, which may include the need for lifts to access façades.

32.2.3.6. Refrain from using raised planters next to buildings. To decrease the possibility of waterproofing issues, the use of raised planters requiring waterproofing attached to or above buildings is not recommended and requires approval of the SI project manager.

32.2.3.7. To the greatest extent possible, create an 18 in wide non-vegetated sanitary zone at building walls.

32.2.4. Soil characteristics play a major role in the health of vegetation and in water management. It is essential to determine soil conditions early in the design process and is critical to achieving a high-performance landscape.

32.2.4.1. Soils must be accurately assessed to gain a thorough understanding of soil quality, contamination, percolation, and bearing capacity. This analysis should determine protection efforts, drainage rates, and amendment requirements. The amount of soil testing needed is based less on-site size than on site complexity. Utilize visual inspection, site history and context, and interviews to determine amount and type of testing needs.

a. Coordinate earthwork specifications with specific soil placement, and settlement and compaction requirements specified in Division 31 for planting soil and landscaping work.

b. Test for geotechnical characteristics.

32.2.4.2. If soil testing reveals that the existing soils are not healthy or if there is limited space for storing, it is recommended that existing soils be removed and replaced with new soils with characteristics that match the intended planting, stormwater management goals, and anticipated levels of use and compaction.

32.2.4.3. If soil testing determines that the existing soils are healthy and there is sufficient room for storing soils on site, consult with the design manager to determine if soil preservation is recommended and if a soil management plan should be created to outline the soil preservation process to take place on site. This plan should delineate the limit of disturbance, ensure soil restoration/rejuvenation, define the boundaries of vegetation and soil protection zones, and define soil preservation locations.

32.2.4.4. Test soil after stockpiling to determine the type and number of amendments needed to reactivate biological properties and handle drainage needs. Consider the use of compost as an amendment since it is often the most effective way to rebuild structure and improve drainage and biological activity without overloading nutrient content or increasing salinity levels, which may happen with inorganic fertilizer amendments. Adjust soil pH and fertility as indicated by testing.

32.2.4.5. Consider the use of engineered soils when naturally occurring soils are not well-suited to the programmatic use or are unable to withstand urban stresses and conditions.

32.2.4.6. Coordinate soil and subsoil requirements with Division 31: Earthwork requirements to ensure proper handling, placement, settlement, and performance testing during construction.

32.2.5. Provide adequate soil volumes and depths (as deep as practical) to allow trees, shrubs, and plants to achieve mature size. However, factors such as soil type, plant selection, maintenance expectations, exposure, underdrainage requirements, and available irrigation will determine the appropriate soil depth required. SG recommends the following depths:

32.2.5.1. Lawns: 304 mm (12 in) of topsoil

32.2.5.2. Shrubs and perennials: 609 mm (24 in)

32.2.5.3. Trees: depth of root ball, but no less than 914 (36 in)

32.2.5.4. The following are the minimum soil volumes for viable planting/root of trees:

a. Shade trees: 28 m3 (1000 cu ft)

b. Ornamental trees: 11 m3 (400 cu ft)

32.2.5.5. Increase soil volumes when using sand-based or stone-based structural soils to compensate for depleted soil resources within the structural soil matrix.

32.2.5.6. When possible, use linear trenches to allow connections between soils volumes and pits. Utilize suspended pavement systems or structural soil systems to provide viable horticultural performance of soils below pavement areas.

a. Coordinate with weight load requirements.

b. Ensure sufficient volume.

32.2.6. Promote plant survival through plant selection and placement. Consider associating plant needs with water sources, soil types, and levels of care. Plants that are not adapted to the local environment require more inputs than well-suited selections. SG prefers native plant species.

32.2.6.1. New plant material will be non-invasive and appropriate for site conditions, climate, and design intent, preferably native or adapted non-invasive species, obtained locally. Plants not adapted to the local environment require more input than well-suited selections. Use plants that can be adapted to the local environment.

32.2.6.2. Recognize that landscapes are based on growth and change over time. Establish goals for periods of time: 5 years, 10 years, 25 years, and 100 years. Develop long-term management plans that require monitoring over time and anticipate changes to the plan, but plant for current conditions.

32.2.6.3. Recommended planting schedule:

a. Spring: March 1 through May 15

b. Fall: September 15 through December 1

32.2.6.4. Plant selections for projects on the National Mall and National Zoological Park (NZP) require coordination with SI staff.

a. For projects on the Mall, plant selections are to be coordinated with SG: The Living Collections Objectives.

Plantings are required to be located in Geographic Information System (GIS) (by SI) to meet American Association of Museum standards.

b. For projects at the NZP, plant selections are to be coordinated with the Contracting Officer's Technical Representative (COTR).

c. SG provides guidance for plant selections for projects for the Mall, Anacostia Community Museum, Donald W. Reynolds Center, and the Suitland Campus.

32.2.6.5. Develop and implement a plan for the control and management of known existing invasive plants to limit damage to local ecosystems – before, during, and after construction.

32.2.6.6. Develop a plan for tree and vegetation removal and transplantation.

a. Tree removal requires approval by SG.

b. Tree removals to be undertaken by a certified arborist. Coordinate with the COTR and SI arborist.

c. Tree removal must comply with National Capital Planning Commission (NCPC) tree preservation and replacement policies.

d. Plant material removed for reuse will be balled, bagged, and protected in accordance with instructions prepared by SG.

e. Trees on the SG campus on the Mall and Gallery Place are all accessioned collections items. The design team should make every effort to preserve and protect trees.

32.2.6.7. Avoid utility conflicts. Plan and coordinate utility locations and installation with proposed planting and soil designs to avoid long-term maintenance conflicts. Since utility improvements often significantly precede planting operations during construction, provide utility corridor location plans with coordinates or other layout controls within contract documents to ensure contractor compliance with indicated utility locations to prevent conflicts.

32.2.6.8. Reduce turfgrass wherever feasible, specifically in tree boxes and areas directly under trees. Use ground cover in lieu of grass to reduce water consumption and minimize the need for pesticides and fertilizers. This significantly reduces chemical and nutrient loading of groundwater and surface water; eliminates the need for regular mowing; and reduces maintenance cost, energy consumption, and air and noise pollution.

32.2.6.9. All projects should include a 12-month warranty for all installed plants. Plants that are more than 25 percent dead or in an otherwise unhealthy condition should be replaced immediately or planted in the succeeding planting season.

32.2.7. Exterior materials and finishes and furnishings will be coordinated with local jurisdiction requirements, SDS, with consideration of matching existing materials on site and within the context of the project.

32.2.7.1. Paving and metalwork, such as railings and guards, will be specified to match, or designed to match, the existing metalwork materials, finishes, and treatments. Exceptions must be approved by the SI project manager.

32.2.7.2. Hardscape and structural materials will be of local, natural materials wherever possible. Consider using recycled materials such as glass, rubber, or crushed concrete for base courses and aggregates when possible, especially when recycled from on-site materials.

32.2.7.3. Special elements and landscape features and structures will be designed in accordance with any historic or preservation standards or expectations when appropriate and applicable.

32.2.8. Integrate security considerations into the site planning and landscape design using Crime Prevention Through Environmental Design techniques.

32.2.8.1. Coordinate with COTR and OPS early in the design process to identify the security requirements for the site.

32.2.8.2. Select and locate plantings that will not obstruct view for security personnel or video surveillance over time as plants mature. Additionally, do not create hiding places for assailants.

32.2.8.3. Design the perimeter, vehicle, and pedestrian circulations areas with safety and security as a built-in feature. Incorporate barriers into the design so they are as inconspicuous as possible.

32.2.8.4. Bollards may be acceptable when integrated into the building or landscape design. Automated or manual bollards should be utilized where vehicular or equipment access is required.

32.2.9. Translation of interior exhibits into the programming and design of the landscape in coordination with SG is encouraged where applicable and appropriate.

32.2.10. Coordinate hardscape and planting areas with subsurface utility and infrastructure design.

32.2.10.1. Utility manholes must be traffic-rated with anti-slip, ADA-compliant grates/lids.

a. ADA-compliant is the baseline for opening types and sizes in grates.

32.2.10.2. Use of coordinated utility corridors to reduce site disturbance and planting conflicts is recommended.

32.2.11. Tree preservation should be a priority for all projects.

32.2.11.1. Any project in the landscape should include a tree inventory (e.g., location, size, health, structure, significance, and condition) for any tree potentially impacted by the project.

32.2.11.2. Early in the process, the project should map the trees' Critical Root Zones (CRZ) as defined in SG site protection specifications. The design team should then review potential impacts to the trees and should make every effort to preserve and protect the trees. Only if tree preservation is not possible should replacement be considered to establish equal or higher quality trees.

32.2.11.3. Even relatively minor construction activities have the potential to significantly damage tree health and safety, although those impacts are often not visible for years. Often, minor design changes and simple tree protection measures can solve tree protection challenges. SG should be consulted early in the design process to assist with these design considerations.

32.2.11.4. Construction documents should include a tree protection plan that defines:

a. Fenced tree protection zone

b. Absence of construction impacts in preserved trees' structural root plates

c. Conservation of a high percentage of CRZs for all preserved trees (absolute minimum: 70 percent conservation; minimum may be higher depending on health and significance of the tree)

d. Any other necessary tree protection measures

32.3. <u>Specifications</u>

32.3.1. Bases, Ballasts, and Paving:

32.3.1.1. Subgrade modifications will be designed in accordance with the recommendations of a licensed geotechnical engineer with knowledge of the local site conditions.

32.3.1.2. Subbase course material and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.1.3. Aggregate base course material and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.1.4. Asphaltic base course material and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.1.5. Lime-treated base course material and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.1.6. Cement-treated base course material and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.1.7. Concrete base course material and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.2. Flexible Paving:

32.3.2.1. Preparatory tack and prime coats for flexible paving will be in accordance with the local Department of Transportation standards and requirements.

32.3.2.2. Asphalt paving mix designs and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.2.3. Asphalt paving wearing course mix designs and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.2.4. Flexible paving surface treatments are prohibited.

32.3.2.5. Seal coat materials and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.2.6. Porous Flexible Paving:

a. Porous Flexible Paving is permitted for use in tree pit permeable pavements only. Other uses/applications are prohibited.

b. Porous flexible paving mix designs and installation will be in accordance with the local Department of Transportation standards and requirements.

   i. Coordinate the use of porous flexible paving with designed base courses to encourage stormwater infiltration, storage, and disposal.

   ii. Verify subgrade conditions by testing to determine infiltration viability.

   iii. If infiltration is proposed as part of the porous flexible paving systems, specify type and frequency of performance testing to ensure contractor compliance. Coordinate requirements with Division 31: Earthwork in Volume 1.

   iv. Design porous flexible paving systems in accordance with the recommendations of the National Asphalt Pavement Association's Porous Asphalt Pavement for Stormwater Management (latest edition) for the specification of pavers, base courses, installation, and maintenance.

c. If porous pavement is to be used as a Low Impact Development (LID) measure, regular maintenance (sweeping/vacuuming) of the pavement will be critical to ensure the pavement maintains its porosity. If regular maintenance cannot be assured, other LID measures may be more appropriate.

32.3.2.7. Asphalt paving joint sealants and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.3. Rigid Paving:

32.3.3.1. Concrete paving mix design and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.3.2. Exposed Aggregate Concrete Paving:

a. Aggregate to be supplied by a single approved gravel pit for the duration of the project. There will be no shale in the aggregate mix.

b. All sidewalk improvements or modifications on the Mall to be coordinated with the NPS, and the exposed aggregate concrete to match sample, which is currently located adjacent to the National Gallery, for aggregate size and color.

c. A mock-up to ensure match is required for all projects.

32.3.3.3. The use of pervious concrete paving is not permitted.

32.3.3.4. Concrete Paving Joint Sealants:

a. Concrete paving joint sealants and installation will be in accordance with the local Department of Transportation standards and requirements.

b. Ensure that the type of joint sealant specified is appropriate for the expected use of the pavement. For example, fuel resistant joint sealants should be specified in areas subject to fuel spillage.

32.3.4. Unit Paving:

32.3.4.1. Stone paving surfaces should be slip resistant, i.e., flamed finish.

32.3.4.2. Porous Unit Paving:

a. Porous paving will be of durable design with low-maintenance requirements

b. Paving selection requires approval of the SI project manager.

c. Coordinate the use of pervious concrete paving with designed base courses to encourage stormwater infiltration, storage, and disposal.

d. Verify subgrade conditions by testing to determine infiltration viability.

e. If infiltration is proposed as part of the pervious concrete paving systems, specify type and frequency of performance testing to ensure contractor compliance. Coordinate requirements with Division 31- Earthwork in Volume 1.

f. Design porous paving systems in accordance with recommendations of the Interlocking Concrete Pavement Institute (ICPI) for the specification of pavers, base courses, installation, and maintenance.

32.3.5. Curbs, Gutters, Sidewalks, and Driveways:

32.3.5.1. Curb and gutter materials and installation will be in accordance with the local Department of Transportation standards and requirements.

32.3.5.2. Driveways:

a. Driveways will be designed to accommodate the largest vehicles expected to utilize the facility.

b. Special consideration will be given for large/oversize vehicles related to weight limitations and driveways/dock access, etc.

32.3.6. Paving Specialties:

32.3.6.1. Paving specialties: by regulation

32.3.6.2. Pavement marking materials and installation will be in accordance with the local Department of Transportation standards and requirements, and the latest edition of the Federal Highway Administration Manual on Uniform Traffic Control Devices (MUTCD).

32.3.6.3. Pavement Snow Melting Systems:

a. The use of magnesium chloride, and corn-based or other materials not toxic to plants, water life, and animals, is preferred in lieu of mechanical systems.

b. The use of sectionalized systems is preferred.

i. If mats are used, systems will be sectionalized systems for continuous operation and ease of maintenance. Consider sleeving for replacement. Consider overall energy use and maintenance access.

32.3.7. Athletic and Recreational Surfacing:

32.3.7.1. Playground protective surfacing will be approved by the SI project manager.

32.3.8. Chain Link Fences

32.3.8.1. Requires approval from COTR and OPS.

32.3.8.2. Security fence fabric is 9-gauge steel or aluminum wire woven in 2-inch diamond mesh. It can be coated in polyvinyl for different color options. The finish must be maintenance free.

32.3.8.3. Unless otherwise directed all security and perimeter fencing must have a minimum fence fabric height of 7 feet (2.13m), excluding the top guard. Fence height including outriggers must be a minimum of 8 feet (2.44m). The typical configuration is an 18-inch outrigger set at a 45-degree outward angle with three strands of barbed wire. The fencing fabric must be extended to within 2 inches (51 mm) of firm ground.

32.3.8.4. Locate all posts, rails, bracing and tension wires on the secure/protected side, i.e., inner side, of the fencing fabric. Select the framework components and material from ASTM F626, ASTM F1043, and ASTM F1083.

32.3.9. Decorative Metal Fences

32.3.9.1. Selection requires approval by SI Project Manager and OPS.

32.3.9.2. Structural components consist of tubular steel ornamental pickets and rails. Pickets have a minimum cross-sectional area of 1 sq in and a minimum wall thickness of 14 gauge. Provide pickets with spear-pointed tips extending a minimum of 6 in above the top rail of the fence. Mount pickets to a top and bottom rail spaced a maximum 80 inches apart. Space pickets along rails with a maximum gap not to exceed 2.25 inches. Secure pickets to rails by welding or inaccessible, tamper-proof fasteners.

32.3.9.3. It can be powder-coated for different color options.

32.3.10. Retaining Walls:

32.3.10.1. Retaining walls are to be of durable design with a low-maintenance finish.

32.3.10.2. All retaining walls must be approved by the SI project manager.

32.3.10.3. Perimeter walls and stair elements should be designed at a comfortable height and depth for seating.

32.3.11. Manufactured Site Specialties:

32.3.11.1. Manufactured Metal Bollards:

a. Reference Division 34 for Anti-ram Vehicle Barriers requirements as needed.

b. Bollards, when use is permitted, will have a maintenance-free finish.

c. All operable bollards must have positive drainage and/or underdrainage.

d. Coordinate the location of and access to bollard controls.

e. Manufactured metal bollards are permitted only where use is approved by the SI. Coordinate the use and location with the COTR.

f. Refrain from using bollards along the Mall to the greatest extent possible. Use of bollards requires SI approval.

g. The designer will consider alternatives to bollards, including but not limited to, landscape elements, planters, stones, etc.

32.3.12. Irrigation:

32.3.12.1. Planting Irrigation:

a. Match existing and/or specific system. Irrigation equipment will be Rain Bird MAXICOM2 or compatible to be consistent with the existing centrally controlled irrigation system that monitors flows and quantity of water use.

b. Rain Bird training and certification is required for employees operating irrigation systems. A training and operational/maintenance manual is required for new system commissioning.

c. Irrigation plans will be designed by a certified irrigation designer. A design-build approach to irrigation design is prohibited.

d. Irrigation design is to include full design including main line layout, controller locations, and head layout, and to be coordinated with other trades. It must connect to the central control MAXICOM system, which requires coordination with SG.

e. Some portion of the water budget will be apportioned for landscape maintenance, and the irrigation design will adhere to the approved water budget. The SI will consider irrigation systems that are fed from an alternate source of water, such as harvested rainwater or condensate whenever possible. However, if domestic water must be used for irrigation systems, it will be metered separately.

f. Water sources will be tested in advance to verify that the water quality supports plant health.

g. Irrigation systems are to be metered, separate from the domestic water source, to monitor water use per the recommendations in the water reclamation study.

   i. The A/E will coordinate with plumbing requirements for metering as well as ties into the stormwater retention system.

   ii. The use of stormwater retention is strongly recommended and encouraged where feasible.

h. Mainline piping will be Schedule 40 PVC, at a minimum. Consider the use of High-Density Polyethylene (HDPE) piping instead of Polyvinyl Chloride (PVC), due to the recyclability, re-use, and toxicity. It is also stronger and less susceptible to freeze damage.

i. Placement of trace wires during installation and repair of irrigation systems is required to facilitate detection of pipes later.

j. Irrigation systems are to be considered a utility for any ground-disturbing activities and are required on civil utility drawings.

k. Irrigation systems are to be designed and sized to handle anticipated pressure and allow for expansion of area and flow rate.

l. The typical irrigation system will utilize a computer-operated control system with a weather station.

m. All irrigation pipes must be sized to receive vehicular loads whether under walks or in planting beds. Irrigation sleeves are to be included wherever irrigation pipes are located below pavement.

n. Exercise caution to avoid disturbing existing plant materials and root systems.

    i. Depths of bury:

        a) Mainlines: 406 mm (16 in) to 508mm (20 in)

        b) Laterals: 356 mm (14 in) to 406 mm (16 in)

    ii. Within planters: at base of soil fill

    iii. When necessary, the design team will consult with an arborist where irrigation needs to be installed in the CRZ of existing trees.

o. Zone irrigation systems by planting types to reduce irrigation demand.

32.3.12.2. The use of drip irrigation systems is prohibited.

32.3.13. Planting Preparation:

32.3.13.1. SG through the COTR must approve the requirements for soil preparation. Refer to SG Soil Preparation Specification in Volume 2.

32.3.13.2. Landscape Grading and Compaction:

a. Soil compaction requirements are project- and site-specific and should be developed by a qualified designer.

b. Finish Grading:

i. Match soil type for smaller projects.

ii. Provide soil specific to type of planting, location, and drainage requirements for larger projects.

c. Before planting, seeding, or sodding, obtain the SI project manager's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

32.3.14. Turf and Grasses:

32.3.14.1. Seeding:

a. SG approval is required to utilize seeding.

b. Seeding is not permitted on the Mall.

c. In general, refrain from seeding at all Washington, D.C., locations.

32.3.14.2. For sodding, refer to the SG Specification *329200 Lawns and Grasses* included in Volume 2.

32.3.14.3. Reinforced Turf:

a. The use of reinforced turf will only be considered when installed for infrequently used vehicular applications such as maintenance drives.

b. The use of reinforced turf must be approved by SG.

c. Reinforced turf is acceptable in fire lanes but must be approved by the COTR.

32.3.15. Planting Accessories:

32.3.15.1. Landscape edging within SI properties will be metal. All others will be as approved by the SI project manager.

32.3.15.2. Tree Grates:

a. Refrain from using tree grates to the greatest extent possible.

b. Where approved, tree grates to have frames and be split capable for center opening enlargement to accommodate tree growth.

33. DIVISION 33 – UTILITIES

33.1. Reference Codes, Standards, and Guidelines

33.1.1. The Architect/Engineer (A/E) is responsible for the research of all codes, standards, and regulations, including federal, state, and local, which are applicable to the project design. Refer to the Smithsonian Design Standards (SDS), Design Guidelines Chapter 3- General Information in Volume 1 for a general list of applicable codes, standards, and regulations. All design work will comply with the requirements of the latest edition of codes and regulations in use at the time of design. Below are additional Division 33-specific requirements:

33.1.1.1. Local Jurisdictional Requirements: Water and Sewer Piping and Structures:

a. DC Water and Sewer Authority (DCWASA) requirements

b. Washington Suburban Sanitary Commission (WSSC) requirements

33.1.1.2. Local Jurisdictional Requirements: Storm Drainage Piping and Structures:

a. District of Columbia Department of Transportation Standard Specifications for Highways and Structures

b. Maryland Department of Transportation Standard Specifications for Construction and Materials

c. Virginia Department of Transportation Road and Bridge Specifications

33.1.1.3. Local Jurisdictional Requirements: Electric Utilities

a. Pepco requirements

b. Dominion Power requirements

33.1.1.4. SI Mall-Wide Water Reclamation Initiatives, National Museum of Natural History, final report

33.1.2. Refer to SDS, Design Guidelines Chapter 11- Safety and Security Engineering Requirements in Volume 1 for design recommendations specific to critical building infrastructure and security threats.

33.2. Design Requirements

33.2.1. Miss Utility does not locate utility lines within SI properties. SI contracts with private utility-locating companies for this service. Coordinate the gathering of this information with the Contracting Officer's Technical Representative (COTR).

33.2.2. Irrigation systems are to be considered a utility for any ground-disturbing activities and are required to be indicated on civil utility drawings.

33.2.3. Plazas and entrances will have adequate power and water supplies for ease of maintenance and versatility of spatial use for both daily and event uses. These requirements are project-specific and will be developed by the A/E.

33.2.4. Systems will be metered to monitor water use, per the recommendations in the water reclamation study.

33.2.5. Utility elements will provide convenient access and be integrated with building and landscape design.

33.2.6. Create combined utility drawings as part of the design process to indicate utility locations for all engineering design and disciplines to identify realistic utility corridor locations, conflicts, and construction impacts.

33.2.6.1. Coordinate combined utility drawings with proposed tree-protection plans, soil preparation and placement plans, and planting plans.

33.2.6.2. For projects with critical protection of existing trees or vegetation, provide utility corridor plans with coordinates or other surface layout controls to ensure protection of Critical Root Zones (CRZ).

a. Cross-coordinate utility corridor requirements with tree protection specifications.

b. Consider the use of pneumatic soil excavation in areas of proximity to CRZs as a way of mitigating damage.

33.3. Specifications

33.3.1. Operation and Maintenance of Utilities:

33.3.1.1. Operation and maintenance of site water, steam, natural gas, chilled water, and all other applicable water utilities will be in accordance with the local water Authority Having Jurisdiction (AHJ) over the project site.

33.3.1.2. Operation and maintenance of site sewer utilities will be in accordance with the local sewer AHJ over the project site.

33.3.1.3. Operation and maintenance of site electrical utilities will be in accordance with the local electrical company having jurisdiction over the project site.

33.3.1.4. Operation and maintenance of site telecommunication utilities will be in accordance with the local telecommunications company having jurisdiction over the project site.

33.3.1.5. Operation and Maintenance of Geothermal Utilities will be in accordance with the local geothermal company having jurisdiction over the project site.

33.3.2. Common Work Results for Utilities:

33.3.2.1. Manholes and Structures:

a. Manholes and structures will meet the requirements of the local agencies (water/sewer authority, Department of Transportation, etc.) having jurisdiction over the project site.

b. Manholes and structures located within areas subject to vehicular traffic will be designed to withstand loading from the heaviest vehicle expected to impact that structure. At a minimum, the design will meet American

Association of State Highway and Transportation Officials (AASHTO) HS-20 loading.

c. Manholes and structures located in areas not normally subject to vehicular traffic but that could be impacted by occasional maintenance vehicles will be designed to meet AASHTO HS-20 loading.

d. All structures must meet the requirements of all applicable codes.

33.3.2.2. Utility Structures:

a. Utility structures will meet the requirements of the local agencies (water/sewer authority, Department of Transportation, electric utility company, etc.) having jurisdiction over the project site.

b. Utility structures located within areas subject to vehicular traffic will be designed to withstand loading from the heaviest vehicle expected to impact that structure. At a minimum, the design will meet AASHTO HS-20 loading.

c. Utility structures located in areas not normally subject to vehicular traffic but that could be impacted by occasional maintenance vehicles will be designed to meet AASHTO HS-20 loading.

33.3.2.3. Detectable warning tape or trace wire will be installed above all below-grade utilities as a utility identification best practice.

33.3.2.4. Instrumentation and control for utilities will meet the requirements of the local utility companies having jurisdiction over the project site.

33.3.3. Water Utilities:

33.3.3.1. Water Utility Distribution Piping:

a. Water utility distribution piping will meet the requirements of the local water authority, health department, and fire marshal office having jurisdiction over the project site.

b. The water supply for fire protection will meet the requirements of the Office of Safety, Health and Environmental Management (OSHEM) identified in the SDS Design Guidelines Chapter 8, Section 8.4 of Volume 1. Specifically, private service mains will conform to National Fire Protection Association (NFPA) 24; private distribution mains must be no smaller than 12 in diameter; and building/facility water distribution loops must be 8 in diameter or larger.

33.3.3.2. Water utility distribution equipment will meet the requirements of the local water authority and the local fire marshal office having jurisdiction over the project site.

33.3.3.3. Disinfection of water utility distribution piping will meet the requirements of the local water authority, health department, and fire marshal office having jurisdiction over the project site.

33.3.4. Wells:

33.3.4.1. Existing groundwater monitoring wells that are impacted by construction activities will be reset, relocated, or abandoned in accordance with the federal, state, or local AHJ.

33.3.5. Sanitary Sewerage Utilities:

33.3.5.1. Sanitary utility sewerage piping will meet the requirements of the local sewer AHJ over the project site.

33.3.5.2. Low pressure utility sewerage will meet the requirements of the local sewer AHJ over the project site.

33.3.5.3. Sanitary utility sewerage force mains will meet the requirements of the local sewer AHJ over the project site.

33.3.5.4. Sanitary utility sewerage structures will meet the requirements of the local sewer AHJ over the project site.

33.3.6. Storm Drainage Utilities:

33.3.6.1. Storm drainage utility piping will meet the requirements of the local Department of Transportation or other AHJ over the project site.

33.3.6.2. Culverts will meet the requirements of the local Department of Transportation having authority over the project site.

33.3.6.3. Storm utility water drains will meet the requirements of the local Department of Transportation having authority over the project site.

33.3.6.4. Stormwater management ponds and reservoirs will be designed and constructed in accordance with the local AHJ over the project site.

33.3.6.5. Storm Drainage Structures:

a. Storm drainage structures will meet the requirements of the local Department of Transportation or other AHJ over the project site.

b. Storm drainage structures will meet the requirements of the DCWASA.

34. DIVISION 34 – TRANSPORTATION

34.1. Reference Codes, Standards, and Guidelines

34.1.1. Anti-Ram Barriers must be certified to meet performance requirements for vehicle size and speed specific to the facility under ASTM F 2656, Standard Test Method for Crash Testing of Vehicle Security Barriers.

34.1.2. OPS will provide the Design Basis Threat (DBT) for vehicle size and type to determine the minimum crash rating necessary for protection.

34.2. Design Requirements

34.2.1. Active or passive vehicle barriers must be selected based on the appropriateness of the architecture of the facility and the specifics of the site and natural environment.

34.2.2. Anti-ram vehicle barriers are used to protect a facility against vehicle born improvised explosive devices (VBIED) and vehicle ramming attacks.

34.2.3. Barriers may not stop a vehicle instantaneously and the attack vehicle may travel a significant distance before stopping, thus still presenting a significant hazard to people. It is important to choose the right type and appropriate location of barrier to ensure that effective protection is achieved. For barriers/obstacles where the penetration distance is large, the risks can be reduced by:

34.2.3.1. Keeping an appropriate amount of separation between barrier and crowd/personnel; and/or

34.2.3.2. Placing the barrier in a location where the path of the attack vehicle is not aligned to the crowd – i.e., by introducing standoff between the path of the vehicle and the crowd.

34.2.4. Greater standoff may also provide more time for people to identify and react to an attack.

34.2.5. Measures designed to slow the approach speeds of vehicles will typically reduce the penetration distance of a vehicle and therefore reduce the risk to people behind a barrier. It may also serve as a visual deterrent to conducting the attack and/or obstruct the view of the attacker.

34.2.6. Anti-ram vehicle barriers must be located at main entrances due to a history of vehicle strikes at these locations. Anti-ram vehicle barriers must be located at lobby entrances cafeterias, child-care play yards, and other gathering areas when at risk from vehicle strikes.

34.2.7. Anti-ram vehicle barriers must be located at utility connections, emergency power supplies, hazardous-materials storage, HVAC, and external critical telecom and IT resources when at risk from vehicle strikes.

34.2.8. Active anti-ram rated vehicle barriers must be located at required access points that permit vehicles within the minimum standoff distance around the facility. This includes gated access to the loading dock, emergency lanes for first responders, and maintenance access.

34.2.9. Coordinate locations of passive barriers, such as bollards, with accessibility requirements when placed adjacent to or across a path of pedestrian travel.

34.3. Specifications

34.3.1. Performance of anti-ram element must be demonstrated by means of impact testing or detailed finite element analysis of the vehicle impact; testing is to be performed in accordance with the latest edition of ASTM F2656, ASTM F3016, or DOS SD-STD-02.01.

34.3.2. Types of active barriers must be anti-ram rated electric wedges, plate, beam, catch cable system, or retractable bollards recessed into the pavement for a flush condition when not deployed.

34.3.3. Permanently install active barriers.

34.3.4. Passive barriers must be walls, stationary bollards, cables, or combination of landscape and hardscape that achieves the required anti-ram resistance.