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STANDARD FOR FIRE PROTECTION AND LIFE SAFETY

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DOCUMENT HISTORY LOG

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Baseline	Change 3	12-19-2000	Initial Release With Change 3
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Revision	A	11-19-2008	Various Updates and Reformatting
Revision	B	08-20-2020	Standard reformatted to match IBC with additions. Clarified where IBC applies, where NFPA 101 applies, and where both apply. Added definitions for qualified designers.
Change	1	02-24-2021	Replaced NPR 8715.3 reference with NPR 8715.1 for section 1.3.1, 1.3.2, 1.4.1, A.1.1, and B.1.2, which is now the authoritative directive for this standard and describes the process for requesting relief from Agency Institutional Safety Requirements

FOREWORD

This NASA Technical Standard provides uniform engineering and technical requirements for processes, procedures, practices, and methods that have been endorsed as standard for NASA facilities, programs, and projects, including requirements for the selection, application, and design criteria of an item.

This revision to the NASA Standard for Fire Protection and Life Safety represents a major change from the previous edition. This revision is aligned with and relies more on voluntary consensus standards than the previous edition. In particular, NASA incorporates by reference the International Building Code (IBC) and the NFPA 101, Life Safety Code. This revised Standard for Fire Protection and Life Safety provides requirements to be used in addition to, and in some cases, in place of, those published in the IBC and NFPA 101 to ensure fire protection and life safety at NASA facilities. The chapters of this revised standard match those of the IBC, but only include additional content and requirements to that in the IBC or to be used in lieu of the IBC.

This NASA standard was developed by the NASA Office of Safety and Mission Assurance (OSMA) and subject matter experts from each of the Centers and Component Facilities. Each Center, the NASA Office of Strategic Infrastructure, and the NASA Office of Protective Services have endorsed the content and use of this standard. Requests for information, corrections, or additions to this standard should be submitted to NASA OSMA by email to Agency-SMA-Policy-Feedback@mail.nasa.gov or via the “Email Feedback” link at <https://standards.nasa.gov>.



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NASA Chief, Safety and Mission Assurance

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Approval Date

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STANDARD FOR FIRE PROTECTION AND LIFE SAFETY

1. SCOPE AND ADMINISTRATION

1.1 Purpose

1.1.1 The purpose of this standard and the Center Fire Protection and Life Safety Programs is to protect human life, property, and the environment from the risk of fire-related hazards, through the application of codes, standards, and best practices, engineering analysis, fire prevention techniques, and public education and awareness of fire safety for NASA and contractor personnel.

1.1.2 This standard establishes requirements for life safety, fire prevention, detection, control, and suppression through engineering, inspection, training, and firefighting. A fire protection and life safety program consists of fire protection and life safety engineering (to minimize the occurrence of fire and fire loss through engineering designs and systems), fire prevention (to inspect for employee-created fire hazards and provide fire safety education and training), and a fire suppression force (to minimize losses in the event of a fire).

1.2 Applicability

1.2.1 This standard applies to NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers, and may be cited in contract, program, and other Agency documents as a technical requirement. This standard may also apply to the Jet Propulsion Laboratory or to other contractors, grant recipients, or parties to agreements to the extent specified or referenced in their contracts, grants, or agreements.

1.2.2 This standard applies to NASA-owned and NASA-operated, temporary and permanent, buildings, facilities, and installations, and to non-NASA-owned contractor or tenant buildings, facilities, and installations, operated on NASA property.

1.2.3 The International Building Code (IBC), 2018 Edition, the International Existing Building Code, 2018 Edition and the NFPA 101, Life Safety Code, 2018 Edition, are incorporated by reference. This NASA Standard for Fire Protection and Life Safety is a companion to these consensus standards and provides requirements to be used in addition to, and in some cases, in place of, those published in the IBC, IEBC and NFPA 101 to ensure fire protection and life safety at NASA facilities. The chapters of this revised standard match those of the IBC. Each chapter includes only additional content and requirements to that in the IBC or to be used in lieu of the IBC. Where there are conflicts between the requirements in the IBC and NFPA 101, use the more stringent requirement unless otherwise required by the AHJ.

1.2.4 This standard is not intended to be a substitute for Federal or applicable State and local government requirements. When conflicts exist between this document and voluntary consensus standards, this document takes precedence, except in those cases where the voluntary consensus standards are invoked by applicable Government regulation.

Note: Center level requirements in addition to, and that do not conflict with, those listed herein may be appropriate for inclusion in Center-specific fire protection and life safety policies and procedures to address unique applications and situations not covered by this document. For example, the AHJ may elect to adopt state and local building and fire codes provided they are not found to be in strict conflict with the requirements noted herein.

1.2.5 In this standard, "shall" denotes a mandatory requirement, "may" denotes a discretionary privilege or permission, "can" denotes statements of possibility or capability, "should" denotes a good practice, and "will" denotes an expected outcome.

1.2.6 In this standard, Appendices are considered required parts of this standard. They are separated into appendices for organizational purposes only.

1.3 Authority Having Jurisdiction

1.3.1 The term "Authority Having Jurisdiction" (AHJ) as used in this standard and referenced documents is the party fulfilling the responsibilities identified in NPR 8715.1, NASA Safety and Health Programs.

1.3.2 The terms "Fire Official" (FO) and "Building Official" as used in referenced documents is the party fulfilling the responsibilities for AHJ identified in NPR 8715.1.

1.3.3 The AHJ has responsibility for interpretation of this standard, and to make final determination of whether the provisions of this standard are met.

1.4 Request for Relief

1.4.1 The process for requesting relief from requirements in this standard is defined in NPR 8715.1.

1.5 Equivalency of Alternative Materials, Systems, Design, Methods, and Devices

1.5.1 Nothing in this standard is intended to prevent the use of alternative materials, systems, design, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard, provided technical documentation demonstrating equivalency is submitted to the AHJ and approved for the intended purpose.

1.5.2 The proposed alternative material, system, design, method, or device shall be evaluated for compliance with the standard, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this standard in quality, strength, effectiveness, fire resistance, durability and safety, and approved for the intended purpose by the AHJ before use.

1.5.3 Requests for equivalency shall include

- a. Technical documentation and supporting data demonstrating how the proposed alternative solution provides an equivalent level of fire protection and life safety.
- b. Hazard analysis, compensatory features, criteria used, and other pertinent data.

1.5.4 Approved equivalencies only apply to the specific situation and do not constitute approval for similar cases.

1.6 Issuance of Certificate of Occupancy

1.6.1 Issuance of a Certificate of Occupancy (CoO) shall be in accordance with the IBC.

1.6.2 Temporary Certificates of Occupancy shall be valid for no more than 180 days from the date of issuance.

1.6.3 The CoO shall be approved by the AHJ prior to issuance.

1.7 Facility Records

1.7.1 Facility records for fire protection and life safety systems shall be maintained in accordance with the IBC and NFPA 101, and other standards incorporated by reference.

1.8 Existing Facilities

1.8.1 Chapter 34 provides requirements for existing facilities.

1.9 Performance-Based Fire Protection and Life Safety Design

1.9.1 Performance-based fire safety design shall be in accordance with the procedures, provisions, and applicable requirements of Appendix D.

1.9.2 A Qualified Fire Protection Engineer (QFPE) shall perform the performance-based fire safety design.

1.10 Design Analysis

1.10.1 A fire protection design analysis shall be performed by a QFPE for new construction or rehabilitation projects to address the fire protection requirements.

1.10.2 Where designs warrant, the AHJ shall be permitted to omit the requirement of 1.10.1.

1.10.3 The fire protection design analysis shall be submitted with the first design submission separate from other disciplines.

1.10.4 The following fire protection provisions shall be addressed:

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- a. Building code analysis (e.g., type of construction, height and area limitations, and building separation or exposure protection).
- b. Life safety analysis (e.g. occupancy loads, travel distances, fire separations).
- c. Classification of occupancy and identification of hazardous areas.
- d. Compliance with this standard and referenced applicable codes and standards.
- e. Requirements for fire-rated walls, fire-rated doors, fire dampers with their fire-resistive ratings, smoke compartmentation, and smoke barriers.
- f. Analysis of automatic sprinkler and suppression systems and protected areas including analysis of required water demand.
- g. Water supplies, water distribution, location of fire hydrants.
- h. Smoke control methods and systems.
- i. Fire alarm and detection systems, including monitoring.
- j. Standpipe systems and fire extinguishers.
- k. Interior finish ratings.
- l. Coordination with security requirements.
- m. Coordination with Fire Department requirements.

1.10.5 A QFPE shall review the 100-percent design submission of plans and specifications and certify in writing that the design follows this standard and all applicable criteria.

1.10.6 The certification letter shall be submitted with the 100-percent submission.

1.10.7 The AHJ shall be permitted to accept a Qualified Design Professional in-lieu of a QFPE for projects involving design or modification of fire-rated construction, detection, and suppression and life safety systems not part of new construction or large renovation projects.

2. ACRONYMS AND DEFINITIONS

2.1 Acronyms, Abbreviations, and Notation

AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
ARFF	Aircraft Rescue and Fire Fighting
ASME	American Society of Mechanical Engineers

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CFR	Code of Federal Regulations
CoO	Certificate of Occupancy
FDC	Fire Department Connection
FM	Factory Mutual
FRT	Fire-Retardant Treated
IBC	International Building Code
IEBC	International Existing Building Code
IFSTA	International Fire Service Training Association
ITE	Information Technology Equipment
MCE	Mission Critical Equipment
MSI	Mission Support Infrastructure
NASA	National Aeronautics and Space Administration
NASA-STD	NASA Technical Standard
NCI	NASA Critical Infrastructure
NECA	National Electrical Contractors Association
NFPA	National Fire Protection Association
NMIS	NASA Mishap Information System
NPR	NASA Procedural Requirements
NPSH	Net Positive Suction Head
NRTL	Nationally Recognized Testing Laboratory
OSHA	Occupational Safety and Health Administration
OSMA	Office of Safety and Mission and Assurance
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QFPE	Qualified Fire Protection Engineer

SFPE	Society of Fire Protection Engineers
UL	Underwriters Laboratories

2.2 Definitions

2.2.1 The definitions contained in this section apply to the words and terms used in this standard. Where terms are not defined in this standard and are defined in the NFPA Glossary of Terms or the IBC, such terms have the meaning ascribed to them in those documents. Where terms are not defined through these means, such terms have their ordinarily accepted meanings within the context they are used, and Merriam-Webster's Collegiate Dictionary is the source for the ordinarily accepted meaning.

Adequate. When referring to fire protection or life safety, the safeguards necessary to provide facilities and their occupants with a reasonable degree of safety as determined by the AHJ.

Alternative. A system, condition, arrangement, material, or equipment submitted to the AHJ as a substitute for a requirement in a standard.

Approved. Acceptable to the Authority Having Jurisdiction. (See AHJ.)

Authority Having Jurisdiction. The individual, designated by the Center Director, responsible for enforcing the requirements of this standard (including those adopted by reference) and for approving equipment, materials, an installation, or a procedure. The AHJ enforces the requirements of the International Code Council model codes (adopted by reference) functioning as the Building Official.

Combustible Liquid. Any liquid having a flashpoint at or above 37.8 °C (100 °F).

Cost Benefit Analysis. A procedure in which the present value of future expenditures associated with the installation and maintenance of a fire or life safety system or device is related to the economic benefits of the facility or portion thereof that it is designed to protect. The technique is intended to determine the practicality of the installation and is applied only to those situations where the possibility of loss of human life and risk to mission success is low.

Design Fire. An engineering description of the development and spread of fire for use in a design fire scenario. Design fire curves may be described in terms of heat release rate versus time.

Design Fire Scenario. A set of conditions that defines the fire development and spread of fire within and through areas and describes factors such as ventilation conditions, ignition sources, arrangement, and quantity of combustible materials and fire load accounting for the effects of fire detection, fire protection, fire control and suppression, and fire mitigation measures.

Equivalent/Equivalency. An alternative means of providing an equal or greater degree of safety than that afforded by strict conformance to prescribed codes and standards.

Facility. A building, structure, or other real property improvements including utilities and collateral equipment.

Fire Barrier. A fire-resistance-rated wall assembly of materials designed to restrict the spread of fire in which continuity is maintained.

Fire Official. See Authority Having Jurisdiction (AHJ).

Fire Partition. A vertical assembly of materials, with protected openings, designed to restrict the spread of fire.

Fire-Resistive. A broad range of structural systems capable of withstanding maximum intensity and duration of fire without failure. Common fire-resistive components include masonry load-bearing walls, reinforced concrete or protected steel columns, and poured or pre-cast concrete floors and roofs.

Fire Safety Goals. Refers to the overall intent or purpose of the fire safety regulations.

Fire Wall. A fire-resistance-rated wall having protected openings, which restricts the spread of fire and extends continuously from the foundation to or through the roof, with sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of the wall.

Flammable Liquid. Any liquid that has a closed-cup flash point below 37.8 °C (100 °F), and a Reid vapor pressure that does not exceed an absolute pressure of 276 kPa (40 psi) at 37.8 °C (100 °F).

Fuel Load. Expected maximum quantity of combustible material in a given fire area; in normal facilities, it is the combustible structural elements and the combustible contents contained within that area. Fire load is usually expressed as weight of combustible material/ft.² of area.

High bays. Any space with a ceiling height of 9.1 m or more (30 ft or more).

Note: These spaces represent fire protection challenges resulting from the heat and smoke dispersion over the potentially large distances, compounded by the unique and sometimes large fuel loads associated with the aerospace industry.

Information Technology Equipment. Computer servers, switches, automatic data processing equipment, and command and control systems. ITE can be classified as “essential” or “incidental.”

Essential Information Technology Equipment. A facility’s equipment, located in specific areas, that includes, but is not limited to, data and communication center

equipment, command and control systems, and mission support equipment. Electronic equipment areas are areas containing telecommunication equipment that serves more than one facility, a portion of a Center, or the entire Center. This section does not apply to the room in a facility that contains the incoming telecommunications service for that specific facility or Incidental Electronic Equipment rooms.

Incidental Information Technology Equipment. Word processing stations, printers, and systems—desk top computers; office automation systems; individual data output stations (i.e., printers, etc.); individual computer work stations; telephones; communication equipment; video conferencing equipment; administrative telephones; reproduction equipment; and similar equipment. Incidental Information Technology Equipment includes building only or building-wide communication/telephone/LAN equipment typically found in communication, data, or telephone rooms that do not serve an essential mission or purpose for mission support. This includes the room in a facility that contains the incoming telecommunications service for that specific facility.

Interior Finish. Exposed material comprising walls, ceilings, wainscoting, and other interior building surfaces. It includes interior surfacing materials (such as paneling, carpeting, and wall coverings) applied directly to the walls, floors, and ceilings. Exposed insulating and acoustical materials are interior finishes.

Laboratory. A building or portion of a building that provides controlled conditions in which scientific research, experiments, or measurements are performed.

Note: May refer to any number of occupancies. Thus, care should be taken when classifying the occupancy of laboratories. Laboratories could refer to an electronics lab that would more closely resemble a business occupancy, a chemical lab that would meet a factory or industrial occupancy, or another occupancy.

Listed. When referring to a material or device used in conjunction with fire protection and life safety, a product that has been tested by a recognized and independent research laboratory (e.g., Underwriters Laboratories [UL] and Factory Mutual) in accordance with generally accepted and standardized test methods and verified that it will perform adequately and dependably under adverse conditions.

Maximum Allowable Quantity Per Control Area. A threshold quantity of hazardous material in a specific area.

Note: Once threshold exceeded, may require the application of additional administrative procedures, construction features, or engineering controls.

Means of Egress. A continuous and unobstructed way of travel from any point in a building or structure to a public way. A means of egress comprises the vertical and horizontal travel and includes intervening room spaces, doorways, hallways, corridors, passageways, balconies, ramps, stairs, enclosures, lobbies, escalators, horizontal exits, courts, and yards.

Mission Critical Equipment. Equipment whose function has a direct impact on mission capabilities, including equipment integral to mission assets or used in direct control of these assets.

Note: Mission critical equipment should be so designated by the Program. To provide optimum protection for this equipment, it should be located in an information technology equipment facility or room, or treated as NCI.

Mission Support Infrastructure. Any asset that an NCI is dependent on; NASA or other agency owned or operated that the NCI uses to perform its mission (e.g. power, communications, facility, and the like.) that if destroyed or otherwise interrupted could adversely impact the continued viability of the NCI asset.

NASA Critical Infrastructure. See NPR 1600.1.

Nationally Recognized Testing Laboratory. A laboratory that performs testing per nationally recognized standards and certifies products as stipulated in the Code of Federal Regulations and is recognized by the United States Occupational Safety and Health Administration (OSHA).

Ordinance. See definition in NASA-STD 8719.12.

Performance Criteria. Measurable quantities stated in engineering terms to be used to judge the adequacy of proposed designs.

Proposed Design. Used in performance-based design to identify a design that deviates from the prescriptive regulatory requirements of this standard.

Qualified Design Professional. An individual licensed to perform engineering or architectural design by a state authority or by one of the following: (1) Certified by a nationally recognized certification organization, or (2) Factory trained and certified for fire alarm and fire suppression system design, emergency communications system design of the specific type and brand of system.

Qualified Fire Protection Engineer. An individual meeting one of the following conditions: (1) A registered professional engineer who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys, or (2) A registered professional engineer in a related engineering discipline with a minimum of 5 years of verified experience, dedicated to fire protection engineering. The QFPE is intended to be a member of the design team or a third-party reviewer, and should not be the person having enforcement responsibilities for the project as part of the AHJ staff.

Sensitivity Analysis. An analysis to determine the effect of changes in individual input parameters on the results of a given model or calculation method.

Telecommunications (Telecom) Equipment. Signal processing equipment and main distribution areas where telecom services are rendered to the Center. Telecom service for a specific building is not considered telecom equipment.

Temporary (Electrical). Electrical service in use or in place for a period of 90 consecutive calendar days.

Temporary (Operational). Indicates a time period of 180 calendar days or less where describing storage or use of equipment, materials, or processes that impose a fire, health, or safety hazard that is not otherwise normally present within the building, facility, or location of storage or use.

3. OCCUPANCY CLASSIFICATION AND USE

3.1 General

3.1.1 Classification of occupancy shall be determined in accordance with NFPA 101 as it relates to fire and smoke resistance rating of interior non-load bearing partitions (other than occupancy separation), means of egress, interior finish, features of fire protection (including vertical openings) and associated requirements.

3.1.2 Where there is a conflict between NFPA 101 and the IBC for occupancy construction requirements, NFPA 101 shall take precedence.

Note: There is no intent to supersede other standards or requirements that may be more stringent. For purposes of this standard, NFPA 101 is intended to be used to determine occupancy-specific construction requirements.

3.2 Hazardous Materials

3.2.1 The maximum allowable quantities (exempt amounts) of hazardous materials, for the purpose of occupancy classification, shall be in accordance with IBC.

4. SPECIAL DETAILED REQUIREMENTS BASED ON OCCUPANCY AND USE

4.1 Aircraft Hangars and Maintenance Areas

4.1.1 NASA aircraft hangars and hangars that house NASA Program aircraft (including leased facilities) shall be constructed and protected in accordance with NFPA 409, Standard on Aircraft Hangars 2016 Edition and the following additional requirements:

4.1.1.1 Hangar foam system release valves, where utilized, shall be of the flow control type capable of having flow stopped with continuous depression of an interrupt switch (“dead-man” switch).

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4.1.1.2 Optical fire detection commensurate with the hazard shall be provided for complete coverage in all aircraft servicing areas.

4.1.1.3 Existing aircraft hangars shall be in accordance with Chapter 34 of this standard.

4.1.2 Changes in aircraft being housed or serviced in NASA hangars shall have an evaluation performed by a QFPE to identify required modifications prior to use by the incoming aircraft.

4.2 Essential Information Technology Equipment

4.2.1 Automatic Sprinkler Protection

4.2.1.1 Essential Information Technology Equipment shall be equipped with wet-pipe automatic sprinklers installed in accordance with this standard, NFPA 13, Standard for the Installation of Sprinkler Systems 2016 Edition and NFPA 75, Standard for the Fire Protection of Information Technology Equipment 2017 Edition.

4.2.1.1.1 The sprinkler system shall be valved independently from other sprinkler systems.

4.2.1.1.2 The zone valve shall be equipped with electrical supervision.

4.2.1.1.3 Where approved by the AHJ, a preaction sprinkler system with quick response heads shall be permitted to be used in lieu of a wet-pipe sprinkler system.

4.2.1.1.4 Supplemental fire suppression systems, clean agent or water mist deluge, are permitted in addition to wet-pipe automatic sprinklers.

4.2.2 Automatic Smoke Detection

4.2.2.1 Under floor smoke detection shall be provided below all raised floors.

4.2.2.2 Above ceiling smoke detection shall be provided if above ceiling area is used as a plenum.

4.2.2.3 Aspirating smoke detection of the early warning type shall be installed throughout.

4.2.2.4 Each installation shall be engineered for the specific area to be protected in accordance with NFPA 72, National Fire Alarm and Signaling Code 2016 Edition.

4.2.3 Construction Materials

4.2.3.1 Construction of Essential Information Technology Equipment (ITE) areas shall be in accordance with the requirements of NFPA 75.

4.2.3.2 Areas housing ITE shall be separated from the remainder of the facility by a minimum 1-hr fire barrier.

4.2.3.3 Power cables in under floor spaces shall be either type Mineral Insulated Metal Sheathed cable, Metal Clad cable, or Armored Cable cables or installed in approved conduit or metallic tubing. Polyvinyl chloride (PVC) and similar conduit coverings are not permitted.

4.2.3.4 Communication, data, and interconnecting cables shall be installed in approved conduit or metallic tubing not coated with PVC or similar material or listed as approved for use in air plenums.

4.2.3.5 All construction below floors and above ceilings shall be of non-combustible material, including any ramps or stairs. Use of fire-retardant treated plywood is not acceptable.

4.3 Cooling Towers

4.3.1 Cooling towers shall be constructed and operated in accordance with NFPA 214 (2016 Edition).

4.3.2 Cooling towers with fiberglass or PVC-type fill are considered combustible and shall be protected by sprinklers, unless the fill is listed or approved for use as non-combustible by a Nationally Recognized Testing Laboratory (NRTL).

4.4 Transformer Locations

4.4.1 Transformers shall be installed in accordance with Factory Mutual Global Property Loss Prevention Data Sheet 5-4, Transformers.

4.5 Trailers and Modular Construction

4.5.1 All trailers and modular units shall meet the appropriate construction, mechanical system, and electrical system installation requirements of NFPA 501, Standard on Manufactured Housing 2017 Edition and Manufactured Home Construction and Safety Standards, 24 CFR pt. 3280.

4.5.2 Trailers, modular units, sheds, and the like, shall be located at least 7.62 m (25 ft.) from permanent buildings and at least 7.62 m (25 ft.) from each other unless joined to form a single complex.

4.5.3 Trailers, sheds, and modular units shall be constructed wholly of non-combustible materials and meet all requirements for permanent structures listed in this standard, the IBC, and NFPA 80A (2017 Edition).

4.5.4 Trailers and modular units forming a single fire area exceeding 464.5 m² (5000 ft²) shall be equipped with an automatic wet-pipe sprinkler system in accordance with Section 9.2.3.

4.6 Tunneled Walkways

4.6.1 Tunneled walkways shall be constructed in accordance with IBC, Chapter 34, and the following.

4.6.2 Tunneled walkways shall be constructed and protected in such a manner as to prevent smoke, heat, and flame from being conveyed through the tunnel into occupied areas of a building by one of the following methods:

- a. Water spray systems at all unprotected building openings in accordance with NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection 2017 Edition.
- b. A fire suppression installed throughout the tunnel in accordance with Chapter 9 of this standard.
- c. A 2-hr-rated fire barrier provided at each end of the tunnel.

4.6.3 Tunnels shall not be utilized as office or storage space.

4.7 Anechoic Chambers

4.7.1 Anechoic chambers shall be protected in accordance with Factory Mutual Global Property Loss Prevention Data Sheet 1-53, Anechoic Chambers.

4.7.2 Fixed extinguishing systems shall comply with at least one of the following:

- a. Automatic wet-pipe sprinkler protection controlled by separate listed indicating control valves.
- b. A total-flooding, automatic-acting primary suppression system with a backup automatic reserve system, both activated by a detection system integral to the suppression component of the system.

4.7.3 Control rooms shall be separated from the chamber by a minimum 1-hr fire barrier.

4.7.4 Vision panels in walls separating the control room from the chamber shall be fire-rated glazing in steel frames of no more than 0.836 m² (9 ft²).

4.7.5 Air conditioning systems or other chamber ducting shall be independent of main facility systems.

4.7.6 Chambers shall be equipped with an air-sampling smoke detection system.

4.7.7 Egress from control rooms shall not be through the anechoic chamber.

4.8 High Bays

4.8.1 Spaces with ceiling heights of 9.14 m to 18.28 m (30 ft to 60 ft) shall be designed in accordance with Chapter 9.

4.8.2 Spaces with ceiling heights in excess of 18.28 m (60 ft) shall be in accordance with Section 1.5.

4.9 Explosive or Propellant Operations

4.9.1 Buildings, structures, and areas that store, use, or handle explosive and/or propellant operations exceeding the maximum allowable quantities of hazardous materials listed in Chapter 3 of the IBC shall comply with Section 4.9.

4.9.2 Ordnance facilities or areas shall be classified as high hazard occupancies.

4.9.3 Facilities that contain or are exposed to explosive or propellant storage or operations, the siting distances shall be as prescribed in NASA-STD-8719.12, NASA Safety Standard for Explosives, Propellants, and Pyrotechnics.

4.9.4 Ensure facilities used for the storage of explosives comply with the provisions of Explosives and Blasting Agents, 29 CFR § 1910.109(c).

4.9.5 Sprinkler protection in dedicated earth covered storage bunkers is not required.

4.9.6 Where required by the AHJ, automatic sprinkler systems in facilities housing ordnance shall be protected in accordance with NFPA 13, “Piping Where Subject to Earthquakes,” regardless of seismic design category.

4.9.7 Water supply infrastructure such as pumps and storage tanks shall be located at not less than intraline distance (ILD) from operating buildings.

4.9.8 Portable fire extinguishers with UL rating 10A:80B:C shall be distributed for use by employees, so that the travel distance from any location where explosives are being stored or handled to any extinguisher is 30 feet or less.

4.9.9 Buildings or areas within buildings housing/handling explosive shall be classified as extra hazard occupancy per NFPA 101 for determining egress requirements, except as modified by 4.9.10.

4.9.10 Where operating bays that have substantially constructed walls on three sides and where personnel limits are limited to three persons, a single exit that does not exceed the permitted common path of travel is permitted.

4.9.11 Water spray systems shall be provided in the following hazardous areas:

- a. Transfer areas containing hydrazine-based fuels.

- b. Transfer areas containing nitrogen tetroxide propellant oxidizer.
- c. Locations where fuel separation of propellants occur.
- d. Hazardous spacecraft systems test facilities, such as those containing cryogenic fluid, hypergolic propellant, and environmental systems, designed to provide protection from the most severe hazard anticipated during normal test operations.
- e. Liquid propellant transition joints and transfer control manifolds located adjacent to launch vehicles designed for fire control.
- f. Cryogenic or gaseous oxygen and hydrogen storage containers, grouped piping, and pumps where a fire hazard exists.
- g. Solid propellant inspection areas where grains are exposed for visual, optical, or mechanical examination.
- h. Solid propellant manufacturing areas.
- i. Solid propellant handling, assembly, or transfer areas.

5. GENERAL BUILDING HEIGHTS AND AREAS

- 5.1.1 For General Building Heights and Areas, IBC, Chapter 5 shall apply.

6. TYPES OF CONSTRUCTION

6.1 Type of Construction

- 6.1.1 Construction type shall be in accordance with the more stringent of the IBC and NFPA 101.

6.2 Separation Between Buildings

- 6.2.1 Separation distances between buildings shall be in accordance with the IBC, except as modified by this standard.

7. FIRE AND SMOKE PROTECTION FEATURES

7.1 General

- 7.1.1 Marking and identification of all horizontal and vertical fire and smoke barriers or any other barrier required to have protected openings shall be in accordance with the IBC.

7.2 Segregation of Hazards

- 7.2.1 Where a room or area within a facility presents a greater hazard to the facility or its occupants than the occupancy hazard classification for the overall facility, such rooms or areas

shall be separated from the remainder of the structure by fire barriers and/or suppression system according to the following:

7.2.1.1 Where the room or area is one severity level above that of the overall facility, the area shall be separated by a minimum 1-hr fire barrier or automatic sprinkler protection.

Note: For instance, an Ordinary Hazard Occupancy (Group 2) library in an Ordinary Hazard (Group 1) office building requires separation in accordance with IBC 6.3.1.1.

7.2.1.2 Where the room or area is two or more severity levels above that of the overall facility, the area shall be separated by a minimum 2-hr fire barrier or 1-hr fire and automatic sprinkler protection.

Note: For instance, an Extra Hazard Occupancy (Group 1) chemical laboratory in an Ordinary Hazard Occupancy (Group 1), office building requires separation in accordance with IBC 6.3.1.2.

7.2.1.3 Where the room or area contains ITE, NCI, MCE, or is the location of a critically important operation, the room or area shall be separated by a minimum 1-hr fire barrier and automatic sprinkler protection.

7.3 Fire-Rated Partitions and Barriers

7.3.1 Fire-rated partitions and barriers shall be in accordance with NFPA 221, Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls 2018 Edition.

7.3.2 Fire barriers shall be of non-combustible material.

7.3.3 Fire partitions and barriers shall extend from the structural floor to the structural floor, rated ceiling assembly, or roof above the area involved.

7.4 Opening Protection and Fire Stopping

7.4.1 Fire stopping penetrations shall be indicated on as-built drawings with the respective listed assembly number identified for each individual penetration.

7.4.2 Fire door and window assemblies shall be installed in accordance with the requirements of NFPA 80 (2019 Edition).

7.5 Fire walls

7.5.1 Construction of fire walls shall be in accordance with NFPA 221.

7.5.2 Every firewall shall be of non-combustible material.

7.6 Application of Fire-Resistant Materials

7.6.1 All fire-resistant materials shall be installed according to the manufacturer's instructions and the listing of the product.

7.6.2 Where the specification for a fire-resistant material is given as an average thickness, the average thickness shall be used as a minimum.

7.7 Insulation

7.7.1 Insulating materials and their installation shall be in accordance with IBC Section 720 and this section. Exposed insulation in concealed spaces of sprinkled buildings shall have a flame spread of 25 or less and a smoke developed rating of 50 or less (including paper covering).

7.7.2 Where insulation meets any of the following criteria, there is no limit on the smoke developed rating, and the flame spread rating shall be less than 100.

- a. Insulation installed above poured concrete or poured gypsum roof decks, nominal 50.8 mm (2 in.) thick tongue-and-groove wood plank roof decks, or precast roof deck panels or planks that are approved by an NRTL as non-combustible roof deck construction.
- b. Insulation installed above roof decks where the entire roof construction assembly, including the insulation, is UL-listed as Fire Classified, or FM-approved for Class I roof deck construction or equal listing or classification by an NRTL.
- c. Insulation contained entirely within panels, where the entire panel assembly used in the construction application meets the cited flame spread and smoke developed limitations.
- d. Insulation isolated from the interior of the building by masonry walls, masonry cavity walls, insulation encased in masonry cores, or concrete floors.
- e. Insulation installed over concrete floor slabs and completely covered by wood tongue-and-groove flooring without creating air spaces within the flooring system.
- f. Insulation completely enclosed in hollow metal doors.
- g. Insulation installed between new exterior siding materials and existing exterior siding or wood board, plywood, fiberboard, or gypsum exterior wall sheathing.

8. INTERIOR FINISHES

8.1 General

8.1.1 Interior finish shall be installed and maintained in accordance with NFPA 101.

8.1.2 Drop-out ceiling panels, as defined in NFPA 13, shall be prohibited.

9. FIRE PROTECTION AND LIFE SAFETY SYSTEMS

9.1 General

9.1.1 All fire protection and life safety equipment/systems shall be listed by an NRTL for the intended purpose.

9.1.2 Required Acceptance Inspection and Tests of Fire Protection and Life Safety Systems.

9.1.2.1 A written statement certifying that the system has been installed and performs in accordance with design drawings and specifications shall be provided to the AHJ prior to the final acceptance test.

9.1.2.2 The final acceptance test shall be witnessed by the AHJ or designee.

9.2 Fire Suppression Criteria

9.2.1 Standpipe Systems

9.2.1.1 The design, installation, and maintenance of standpipe and hose systems shall be in accordance with NFPA 14, Standard for the Installation of Standpipe and Hose Systems 2016 Edition, NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems 2017 Edition, Standpipe and Hose Systems, 29 CFR § 1910.158, and State and local government codes.

9.2.1.2 Standpipes shall be installed in facilities and areas meeting any of the following criteria:

- a. Three or more stories in height or having a level that is 15.24 m (50 ft.) or more above grade.
- b. Windowless or underground buildings or facilities where the dimensions are such that all areas cannot be reached by hose lengths of 91.44 m (300 ft).
- c. Where the interior partition arrangement prevents access to all areas within the building using 91.44 m (300 ft) of fire hose lines.

9.2.1.3 Standpipes shall be Class 1 Wet type systems as defined in NFPA 14, where not subject to freezing conditions.

9.2.1.4 Standpipes and sprinkler systems shall be interconnected, so that each Fire Department Connection (FDC) serves all fire protection needs simultaneously.

9.2.1.5 All standpipe hose stations shall have not less than 1.2 m (48 in) of clearance maintained from all obstructions.

9.2.2 Fire Pumps

9.2.2.1 Fire pumps shall be designed and installed in accordance with NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection 2016 Edition.

9.2.2.2 Where fire pumps are required within NCI and occupancies where hazards are in excess of that allowed under 3.2 of this standard, pumps shall meet the following:

- a. Fire pumps shall be provided with a redundant pump of the same size, if the water supply cannot support 50% of the sprinklers in the most hydraulically remote area with the primary fire pump out-of-service.
- b. Where the fire pump provides supply to a water spray or deluge system, a redundant pump of the same size shall be provided.

9.2.3 Sprinkler Systems

9.2.3.1 All building and facility construction shall be provided with automatic sprinkler protection.

9.2.3.2 Where approved by the AHJ, automatic sprinkler protection shall be permitted to be omitted from facilities 232 m² (2,500 ft²) or less that do not contain NCI, MSI, ITE, or hazardous materials or conditions.

9.2.3.3 Automatic sprinklers shall be provided when additions, renovations, or modernization projects of unprotected facilities meet any of the following criteria, unless otherwise required by the AHJ:

- a. For Level 2 and Level 3 Alterations as prescribed by the International Existing Buildings Code.
- b. Where required, due to changes of use or occupancy.
- c. In facilities involving NCI, MSI, or ITE, where required by the AHJ.

9.2.3.4 The design density of Light and Ordinary (Group 1) occupancies, as defined by NFPA 13, shall be increased by one occupancy classification.

Note: For example, an Ordinary Hazard (Group 1) NASA Facility should use the NFPA 13 water supply density requirements specified for Ordinary Hazard (Group 2).

9.2.3.5 At least one FDC shall be provided for each facility with a sprinkler system or standpipe system.

9.2.3.5.1 The FDC shall serve the sprinkler system and interior standpipe system in buildings equipped with both.

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9.2.3.5.2 Facilities classified with high-hazard contents shall be provided with a remotely located FDC.

Note: Location to be determined by AHJ during design phase.

9.2.3.5.3 Each FDC shall be unobstructed and located within 30.48 m (100 ft) of hose lay from a fire hydrant.

9.2.3.6 Water flow alarms shall be provided for each floor level protected by the automatic sprinkler system.

9.2.3.7 Dry pipe and pre-action sprinkler systems shall be equipped with an automatic air or inert gas maintenance device and high/low air pressure alarms.

9.2.3.8 Control valves on connections to water supplies and on supply pipes to sprinklers shall be of the indicating type and one of the following:

- a. Be electronically supervised.
- b. Be secured with a chain and lock, when located in areas where the installation of tamper switches is impractical.

9.2.3.9 Control valves shall be maintained in a ready condition in accordance with NFPA 25.

9.2.3.10 Floor drains in NCI and ITE areas shall be sized to contain the anticipated accumulation of sprinkler system and hose stream discharge.

9.2.3.11 Inspector test connections shall comply with all of the following:

- a. Be located in the most hydraulically remote area from the flow or pressure switch, unless otherwise approved by the AHJ.
- b. Be located so as to test individual flow/pressure switches indicating floor level.
- c. Be accessible within 2.133 m (7 ft) of the finished floor.
- d. Discharge to an exterior location.

9.2.4 Water Distribution System Criteria

9.2.4.1 Water distribution systems shall be designed in accordance with NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances 2016 Edition.

9.2.4.2 Water distribution systems shall be designed to minimize the impact to fire suppression operations of a single electrical or mechanical failure, obstruction, mishap, or another event.

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9.2.4.3 The installation of "dead-end" water mains is prohibited unless approved by the AHJ.

9.2.4.4 Sectional control valves shall be installed and maintained to allow isolation of fire systems and water supplies without shutting off other systems.

9.2.4.5 Where meters are installed in firewater distribution systems, they shall be listed as fire flow meters.

9.2.4.6 When approved for installation, all flow meters shall be listed for fire service use.

9.2.5 Special Systems

9.2.5.1 Fire extinguishing systems that may function by displacing oxygen shall not be installed in occupied areas.

9.2.6 Water Mist Systems

9.2.6.1 Water mist systems shall be designed and installed in accordance with NFPA 750, Standard on Water Mist Fire Protection Systems 2015 Edition.

9.2.7 Water Spray

9.2.7.1 Water spray systems shall be designed and installed in accordance with NFPA 15 and this standard.

9.2.7.2 Water spray systems shall be one of the following types:

- a. Pre-primed, high-speed systems.
- b. Deluge valve and open spray nozzle type.

Note: Water spray systems are provided to protect defined hazardous equipment and areas, and are not intended for complete facility protection.

9.2.7.3 Where required, water spray systems shall

9.2.7.3.1 Provide a water spray density of 20.35 L/min/m² (0.5 gal/min/ft²) where fuel propellant transfer occurs.

9.2.7.3.2 Provide a water spray density of 20.35 L/min/m² (0.5 gal/min/ft²) where fuel separation occurs.

9.2.7.3.3 Provide a water spray density of 8.14 L/min/m² (0.3 gal/min/ft²), where hydrogen hazards exist.

9.2.7.3.4 Provide a water spray density of 10.175 L/min/m² (0.25 gal/min/ft²) in all other areas, where water spray is required.

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9.2.7.3.5 Be activated by manual means located in a place local to the area served and as coordinated with the emergency response plan for additional locations.

9.2.7.3.6 Use spray nozzles arranged to develop a pattern from above the hazard and impinge on cable trays, ground support equipment, and all similar equipment.

9.2.7.4 Launch pad service structures, that do not provide enclosed thermal and fire resistive barriers, shall provide water spray coverage over a width of 1.83 meters (6 feet) and height of 2.44 meters (8 feet) along the entire means of egress as follows:

Note: Water spray systems on launch pad structures are intended to provide alternative protection for occupants during egress. These requirements are intended to provide exposure protection against radiant heat through which personnel may move easily, produce an evaporative cooling effect of the air into which it is sprayed, and provide for wetting the skin and clothing of the escapee to cool and dilute any liquid propellant contaminant on the skin.

9.2.7.4.1 Provide 10.175 L/min/m² (0.25 gal/min/ft²) minimum density along the means of egress beyond the first heat barrier for a minimum distance of 6.096 m (20 ft.) or to an area of refuge.

9.2.7.4.2 Use spray nozzles arranged to provide the minimum required horizontal and vertical coverage in areas when subjected to wind and draft effects.

9.2.7.4.3 Be activated manually in accordance with 9.2.7.3.5 and with any fixed fire extinguishing system serving the hazardous area.

9.2.7.5 A standard FDC that meets the following criteria shall be provided for each 500 gpm of system demand for water spray system, where the design fire flow is less than 5,000 gpm:

9.2.7.5.1 The connection shall be located at a safe distance from the hazardous area and arranged so that the hose can be readily attached.

9.2.7.5.2 Connections shall be piped upstream of the actuating valve.

9.2.7.6 Discharge of a water spray system shall activate the facility fire alarm system and indicate an alarm condition at the central fire alarm control center.

9.2.7.7 Warning signs shall be posted in areas where a fixed water spray system has been installed.

9.2.7.8 All water spray systems shall be activated and completely tested to simulate performance under emergency conditions, prior to occupancy and use.

9.2.8 Commercial Cooking Systems

9.2.8.1 Commercial cooking equipment shall be in accordance with NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2017 Edition.

9.2.8.1.1 The actuation of the wet chemical fire extinguishing system shall automatically shut down the fuel or electrical power supply to the cooking equipment.

9.2.8.1.2 The fuel and electrical supply reset shall be manual.

9.2.9 Portable Fire Extinguishers

9.2.9.1 Portable fire extinguishers shall be selected, installed, and maintained in accordance with NFPA 10, Standard for Portable Fire Extinguishers, 2018 Edition.

9.2.9.2 Fire extinguishers shall be installed in areas in accordance with NFPA 1.

9.2.9.3 When the building is protected throughout with quick response sprinklers, the AHJ may allow for adjustments in travel distances to extinguishers as deemed necessary by local conditions and the AHJ's judgement of the ability of the building occupants to safely use the extinguishers.

9.2.9.4 Wet chemical (Class K) extinguishers shall be provided for use around deep fat fryers and mounted within 30 ft of the cooking equipment.

9.2.9.5 Clean agent extinguishers shall be permitted for specific protection of the following:

a. Electrical contacts or electronic equipment that may be damaged by dry chemical extinguishers.

b. Fire extinguishers located in aircraft areas in accordance with NFPA 407, Standard for Aircraft Fuel Servicing 2017 Edition.

9.2.9.6 Class D fire extinguishers shall be provided where the fire hazard is the result of combustible metals such as magnesium, titanium, and zirconium.

9.2.9.7 Where portable fire extinguishers are provided for employee use, an educational program shall be provided in accordance with Portable Fire Extinguishers, 29 CFR § 1910.157 to familiarize employees with the general principles of fire extinguisher use and the hazards involved with incipient stage firefighting.

9.2.9.8 Portable fire extinguishers provided by the contractor shall be installed on each floor of a structure undergoing new construction or major renovation.

9.3 Fire Alarm System

9.3.1 Fire alarm and signaling systems shall be designed, constructed, tested, and maintained in accordance with NFPA 70, National Electrical Code 2017 Edition, 72, 101, and Employee Alarm Systems, 29 CFR § 1910.165.

9.3.2 A complete fire alarm system shall be provided in facilities meeting any of the following conditions:

- a. Subject to occupancy of 50 or more occupants as determined using the NFPA 101 criteria.
- b. Floor area greater than 232.25 m² (2,500 ft²).
- c. A facility with one or more floors above or below the level of exit discharge.
- d. Temporary and permanent sleeping quarters.

9.3.2.1 Fire alarm and signaling systems shall be designed, installed, and maintained to minimize instances of nuisance and false alarms.

9.3.3 Annunciators

9.3.3.1 Interior fire alarm systems shall be equipped with annunciators.

9.3.3.2 An annunciator shall be provided for smoke detection systems in ITE areas.

9.3.3.3 Annunciators shall be designed and installed in accordance with NFPA 72, Chapter 10.

9.3.4 Central Fire Alarm Monitoring Systems

9.3.4.1 Alarms, supervisory and trouble signals initiated by fixed fire suppression systems, local fire alarm and signaling systems, fire detection systems, or exterior fire alarm stations shall be transmitted automatically to a constantly attended supervisory or proprietary station, except for listed single-station smoke alarms in accordance with NFPA 72.

9.3.4.2 Locations receiving fire alarm and other emergency messaging shall be designed, constructed, and maintained in accordance with NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems 2016 Edition.

9.4 Smoke Control and Exhaust Systems

9.4.1.1 Smoke control and exhaust systems shall be installed for the following:

- a. Windowless and subterranean buildings without sufficient natural ventilation.

- b. Storage and operational areas containing materials having a high heat release potential, flammable liquid storage and handling facilities, and other extra hazard occupancies.
- c. Atriums where an analysis in accordance with NFPA 101 shows that smoke control is required.

9.4.1.2 Listed smoke and heat vents shall be provided in accordance with NFPA 204, Standard for Smoke and Heat Venting 2018 Edition or a smoke control or exhaust system.

9.4.1.3 Smoke exhaust systems shall be in accordance with the requirements and guidelines contained in NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems 2018 Edition.

9.4.1.4 Smoke control systems shall be in accordance with the applicable sections of NFPA 92, Standard for Smoke Control Systems 2018 Edition.

9.4.1.5 Smoke control system design features shall include the following:

- a. Separate fan and duct systems for each fire and smoke area.
- b. Dampers and ducts for direct discharge of contaminated air to the outside.
- c. Separate manual controls readily accessible for fire department use.

9.4.2 Full-scale testing of the system shall be conducted, prior to acceptance, to verify satisfactory performance.

10. MEANS OF EGRESS

10.1 General

10.1.1 Means of egress shall be designed, constructed, and maintained in accordance with NFPA 101.

10.1.2 NFPA 101 shall be used in lieu of Chapter 10 of the IBC.

10.2 Means of Egress Marking

10.2.1 Incandescent or fluorescent exit signs are not permitted for new installation or replacement of fixtures.

10.2.2 Use of the graphic emergency exit symbols with and without directional arrows (NFPA 170, Standard for Fire Safety and Emergency Symbols 2018 Edition or Host Nation equivalents) in lieu of the text "EXIT" is permitted.

10.2.3 Radiation luminous exit signs (e.g., tritium signs) shall be used only with the approval of the designated Radiation Safety Officer.

10.2.4 Photoluminescent Exit Signs and Markings

10.2.4.1 The charging light source shall be continually illuminated at all times with normal power.

10.2.4.2 Controls for such lighting shall be accessible only to authorized personnel.

CHAPTERS 11 THROUGH 26

Note: NO FIRE PROTECTION OR LIFE SAFETY CHANGES TO THE IBC CHAPTERS 11 THROUGH 26.

27. ELECTRICAL FIRE PROTECTION CRITERIA

27.1 General

27.1.1 Unless otherwise specified, all electrical installations shall be in accordance with NFPA 70, 72, 75, 76, and 780.

27.1.2 Cable and wiring for demolished systems shall be removed.

Note: Cable and wiring may not be abandoned in-place because it represents a significant fire load that often penetrates walls and floor, providing a path for fire to spread between compartments.

27.2 Installation

27.2.1 Electrical equipment shall be installed in a neat and workman-like manner in accordance with NECA 1-2015.

27.2.2 Emergency lighting shall be designed, installed, tested, and maintained in accordance with NFPA 101 and NFPA 70.

27.2.3 Unless otherwise specified, electrical worker safeguarding shall be in accordance with NFPA 70E, Standard for Electrical Safety in the Workplace 2018 Edition.

27.2.4 Lightning protection system design and installation shall comply with NFPA 780, Standard for the Installation of Lightning Protection Systems 2017 Edition.

28. MECHANICAL SYSTEMS

28.1 General

28.1.1 Fire protection features for air handling, heating, ventilation, and exhaust systems, such as duct smoke detectors, fire dampers, and smoke dampers, shall comply with the requirements of NFPA 90A, except as modified by this standard.

28.1.2 Duct smoke detectors are not required where air distribution systems are incapable of spreading smoke beyond the enclosing walls, floors, and ceilings of the room or space in which the smoke is generated.

28.1.3 Plenums

28.1.3.1 Plenums used as an integral part of an air handling system shall be in accordance with NFPA 90A.

28.1.3.2 Combustible materials shall not be located within plenum spaces unless they are specifically plenum rated.

28.1.3.3 Electrical wiring passing through the space, including telephone and communication wiring, shall be plenum rated or must be in metal conduit.

28.2 Heating Equipment

28.2.1 Depending on the nature of the fuel, heating equipment shall comply with the appropriate provisions of NFPA 31, Standard for the Installation of Oil-Burning Equipment 2016 Edition, 54, 58, 59A, 86, 211, and Factory Mutual Data Sheets, except as noted otherwise.

28.2.2 Furnaces and boilers for central heating systems shall be located in a room separated from the remainder of the facility by fire-resistive construction.

28.2.3 Shop, storage, or other operations not directly related to the boiler operation and involving flammable materials shall not be located in boiler rooms.

28.2.4 Regardless of size, burners on suspended oil-fired heaters shall be provided with flame supervision that ensures shutdown in no more than 4 sec if flame failure occurs or trial for ignition does not establish a flame.

28.2.5 Fixed space heaters shall be approved or listed by the American Gas Association, LTL, or other nationally recognized testing authority and installed in complete compliance with all requirements of the manufacturer and the laboratory involved.

28.2.6 Each fuel-fired space heater shall be vented.

28.2.7 The manufacturer- or laboratory-specified clearances shall be maintained between the space heater and combustible materials.

29. PLUMBING SYSTEMS

Note: NO FIRE PROTECTION OR LIFE SAFETY CHANGES TO THE IBC CHAPTER 29.

30. ELEVATORS AND CONVEYING SYSTEMS

30.1 Elevators

30.1.1 Elevators, conveyers, dumbwaiters, and escalators shall be designed, installed, tested, and maintained in accordance with NFPA 101, ASME A17.1-2016, Safety Code for Elevators and Escalators, and ASME A17.3-2015, Safety Code for Existing Elevators and Escalators.

CHAPTERS 31 THROUGH 33

Note: NO FIRE PROTECTION OR LIFE SAFETY CHANGES TO THE IBC CHAPTERS 31 THROUGH 33.

34. EXISTING FACILITIES

34.1 Minimum Requirements

34.1.1 Existing facilities shall be in accordance with the International Existing Building Code (IEBC) and this chapter.

34.1.2 Where either the IEBC or NFPA 101 references meeting “new” construction requirements, all portions of this standard shall apply to that portion of work.

34.1.3 Existing facilities not under construction shall be maintained, inspected, and tested in accordance with NFPA 101 for existing occupancies.

34.1.4 Management protocols, approved by the AHJ, shall be implemented to provide a level of life safety equivalent to that required by NFPA 101 for existing occupancies, until an upgrade project can be completed.

34.1.5 Work in Existing Facilities

34.1.5.1 Rehabilitation work shall be in accordance with NFPA 101.

34.1.5.2 Where multiple categories of rehabilitation work are planned as part of a single project, the design shall identify each category of rehabilitation work to be performed, and for each, include what is required and what will be provided.

34.1.5.3 Phasing of construction and demolition operations shall be planned so that the integrity of fire-rated separations, smoke-tight boundaries, means of egress, exit enclosures, fire protection systems, and vertical openings are maintained.

34.1.5.3.1 The phasing plan shall ensure that obstruction of the means of egress is avoided or minimized.

34.1.5.3.2 If exits are obstructed during construction, the construction phasing plan shall provide alternate means of egress and exit routes during each phase of construction and identify the alternate routes on the construction drawings as part of the phasing plans.

34.1.5.4 Minimize, to the extent possible, any impairments or disruptions to active fire protection features. Delineate phasing of construction to ensure that installations of new features or systems or modifications to existing ones are expedited.

34.1.5.5 Prior to taking any actions to impair a fire protection feature or disrupt its performance, ensure alternative procedures have been prepared and incorporated and confirm that official notification of system impairments and schedules have been given to the staff of the facility.

34.1.5.6 The work shall not make the building less conforming with the other sections of this standard, or with any previously alternative arrangements, than it was before the repair was undertaken.

34.1.6 Change in Use or Occupancy

34.1.6.1 Where the use of a facility or a portion of a facility changes, but does not change the occupancy classification of the space, all of the following provisions shall apply.

34.1.6.1.1 When a change in use or occupancy occurs, the area of the change, and its associated means of egress shall comply with the requirements for new construction.

34.1.6.1.2 When a change in use results in a higher occupant load that exceeds the existing means of egress capacity, the facility shall meet the requirements for new construction as specified in this standard.

34.1.7 Vacant Buildings

34.1.7.1 When a vacant building is considered for reuse, the building shall be evaluated for the occupancy that is planned to be in the building.

34.1.7.2 The vacant building shall be evaluated to the requirements for new construction in this standard, the IBC, and NFPA 101.

34.2 Hazardous Materials

34.2.1 Existing storage and use of flammable and combustible liquids shall be in accordance with NFPA 30, Flammable and Combustible Liquids Code 2018 Edition.

34.2.2 Existing storage and use of other hazardous materials shall be in accordance with NFPA 400, Hazardous Materials Code 2016 Edition.

34.2.3 Existing facilities or areas containing explosives shall be in accordance with NASA-STD 8719.12 and this standard.

34.3 Roof Modification

34.3.1 Modifications to roof systems shall maintain the existing fire classification unless otherwise approved.

35. APPLICABLE AND REFERENCE DOCUMENTS

35.1 Applicable Documents

35.1.1 The documents listed in this section contain provisions that constitute requirements of this standard and are adopted by reference. Use of more recent issues of cited documents may be authorized by the responsible AHJ. The applicable documents are accessible via the NASA Technical Standards System at <https://standards.nasa.gov> or may be obtained directly from the Standards Developing Organizations or other document distributors.

35.1.2 Government Documents

35.1.2.1 Code of Federal Regulations (CFR)

14 CFR pt. 139	Certification of Airports
24 CFR pt. 3280	Manufactured Home Construction and Safety Standards
29 CFR pt. 1910	Occupational Safety and Health Standards
29 CFR pt. 1926	Safety and Health Regulations for Construction
29 CFR pt. 1960	Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters

35.1.2.2 NASA Documents

NPR 8621.1	NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping
NPR 8715.2	NASA Emergency Preparedness Plan Procedural Requirements
NASA-STD-8719.12	Safety Standard for Explosives, Propellants, and Pyrotechnics

35.1.3 Non-Government Documents

35.1.3.1 American Society of Mechanical Engineers (ASME)

ASME A17.1-2016	Safety Code for Elevators and Escalators
ASME A17.3-2015	Safety Code for Existing Elevators and Escalators

35.1.3.2 International Code Council

International Building Code (IBC), 2018 Edition

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International Existing Building Code (IEBC), 2018 Edition

35.1.3.3 National Fire Protection Association

NFPA 1	Fire Code, 2018 Edition
NFPA 10	Standard for Portable Fire Extinguishers, 2018 Edition
NFPA 13	Standard for the Installation of Sprinkler Systems, 2016 Edition
NFPA 13D	Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes, 2016 Edition
NFPA 13R	Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies, 2016 Edition
NFPA 14	Standard for the Installation of Standpipe and Hose Systems, 2016 Edition
NFPA 15	Standard for Water Spray Fixed Systems for Fire Protection, 2017 Edition
NFPA 20	Standard for the Installation of Stationary Pumps for Fire Protection, 2016 Edition
NFPA 22	Standard for Water Tanks for Private Fire Protection, 2018 Edition
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 2016 Edition
NFPA 25	Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2017 Edition
NFPA 30	Flammable and Combustible Liquids Code, 2018 Edition
NFPA 31	Standard for the Installation of Oil-Burning Equipment, 2016 Edition
NFPA 51B	Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, 2014 Edition
NFPA 70	National Electrical Code, 2017 Edition
NFPA 70E	Standard for Electrical Safety in the Workplace, 2018 Edition

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NFPA 72	National Fire Alarm and Signaling Code, 2016 Edition
NFPA 75	Standard for the Fire Protection of Information Technology Equipment, 2017 Edition
NFPA 80	Standard for Fire Doors and Other Opening Protectives, 2019 Edition
NFPA 80A	Recommended Practice for Protection of Buildings from Exterior Fire Exposures, 2017 Edition
NFPA 90A	Standard for the Installation of Air-Conditioning and Ventilating Systems, 2018 Edition
NFPA 92	Standard for Smoke Control Systems, 2018 Edition
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2017 Edition
NFPA 101	Life Safety Code, 2018 Edition
NFPA 170	Standard for Fire Safety and Emergency Symbols, 2018 Edition
NFPA 204	Standard for Smoke and Heat Venting, 2018 Edition
NFPA 214	Standard on Water-Cooling Towers, 2016 Edition
NFPA 221	Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls, 2018 Edition
NFPA 291	Recommended Practice for Fire Flow Testing and Marking of Hydrants, 2016 Edition
NFPA 400	Hazardous Materials Code, 2016 Edition
NFPA 403	Standard for Aircraft Rescue and Fire-Fighting Services at Airports, 2018 Edition
NFPA 407	Standard for Aircraft Fuel Servicing, 2017 Edition
NFPA 409	Standard on Aircraft Hangars, 2016 Edition
NFPA 424	Guide for Airport/Community Emergency Planning, 2018 Edition
NFPA 501	Standard on Manufactured Housing, 2017 Edition
NFPA 600	Standard on Industrial Fire Brigades, 2015 Edition

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NFPA 704	Standard System for the Identification of the Hazards of Materials for Emergency Response, 2017 Edition
NFPA 750	Standard on Water Mist Fire Protection Systems, 2015 Edition
NFPA 780	Standard for the Installation of Lightning Protection Systems, 2017 Edition
NFPA 921	Guide for Fire and Explosion Investigations, 2017 Edition
NFPA 1033	Standard for Professional Qualifications for Fire Investigator, 2014 Edition
NFPA 1061	Standard for Professional Qualifications for Public Safety Telecommunicator, 2018 Edition
NFPA 1081	Standard for Industrial Fire Brigade Member Professional Qualifications, 2018 Edition
NFPA 1221	Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems, 2016 Edition
NFPA 1500	Standard on Fire Department Occupational Safety and Health Program, 2018 Edition
NFPA 1561	Standard on Emergency Services Incident Management System and Command Safety, 2014 Edition
NFPA 1620	Standard for Pre-Incident Planning, 2015 Edition
NFPA 1710	Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments, 2016 Edition
NFPA 1963	Standard for Fire Hose Connections, 2014 Edition
35.1.3.4 Other	
AWWA M31	Distribution System Requirements for Fire Protection, 2008 Edition
FM Global 1-20	Factory Mutual Global Property Loss Prevention Data Sheet 1-20, Protection Against Exterior Fire Exposure
FM Global 1-53	Factory Mutual Global Property Loss Prevention Data Sheet 1-53, Anechoic Chambers

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FM Global 5-4	Factory Mutual Global Property Loss Prevention Data Sheet 5-4, Transformers
NECA 1-2015	Good Workmanship in Electrical Construction, 2015 Edition

35.2 Reference Documents

35.2.1 The reference documents listed in this section are not incorporated by reference within this standard but may provide further clarification and guidance.

35.2.1.1 Government Documents

NPD 1440.6	NASA Records Management
NPR 8715.1	NASA Safety and Health Programs
NPR 8820.2	Facility Project Requirements
NASA Facilities Design Guide	

35.2.1.2 Non-Government Documents

AWWA M17	Fire Hydrants: Installation, Field Testing, and Maintenance, 2016
ASME A17.6-2010	Standard for Elevator Suspension, Compensation and Governor Systems, 2010 Edition
ANSI A117.1-2017	Standard for Accessible and Usable Buildings and Facilities, 28 March 2017
ANSI A119.1	Mobile Homes Rules and Regulations, 1972 Edition
IES RP-7-17	Recommended Practices for Lighting Industrial Facilities, 2017 Edition
NFPA 2	Hydrogen Technologies Code, 2016 Edition
NFPA 3	Standard for Commissioning of Fire Protection and Life Safety Systems, 2018 Edition
NFPA 11	Standard for Low-, Medium-, and High-Expansion Foam, 2016 Edition
NFPA 12	Standard on Carbon Dioxide Extinguishing Systems, 2018 Edition

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NFPA 12A	Standard on Halon 1301 Fire Extinguishing Systems, 2018 Edition
NFPA 13E	Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems, 2015 Edition
NFPA 16	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems, 2015 Edition
NFPA 17	Standard for Dry Chemical Extinguishing Systems, 2017 Edition
NFPA 18	Standard on Wetting Agents, 2017 Edition
NFPA 18A	Standard on Water Additives for Fire Control and Vapor Mitigation, 2017 Edition
NFPA 30A	Code for Motor Fuel Dispensing Facilities and Repair Garages, 2018 Edition
NFPA 30B	Code for the Manufacture and Storage of Aerosol Products, 2015 Edition
NFPA 32	Standard for Dry-Cleaning Plants, 2016 Edition
NFPA 33	Standard for Spray Application Using Flammable or Combustible Materials, 2018 Edition
NFPA 34	Standard for Dipping, Coating and Printing Processes Using Flammable or Combustible Liquids, 2018 Edition
NFPA 35	Standard for the Manufacture of Organic Coatings, 2016 Edition
NFPA 36	Standard for Solvent Extraction Plants, 2017 Edition
NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 2018 Edition
NFPA 40	Standard for the Storage and Handling of Cellulose Nitrate Film, 2016 Edition

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NFPA 45	Standard on Fire Protection for Laboratories Using Chemicals, 2015 Edition
NFPA 51	Standard for the Design and Installation of Oxygen–Fuel Gas Systems for Welding, Cutting, and Allied Processes, 2018 Edition
NFPA 51A	Standard for Acetylene Cylinder Charging Plants, 2012 Edition
NFPA 52	Vehicular Gaseous Fuel Systems Code, 2016 Edition
NFPA 53	Recommended Practice on Materials, Equipment, and Systems Used in Oxygen-Enriched Atmospheres, 2016 Edition
NFPA 55	Compressed Gases and Cryogenic Fluids Code, 2016 Edition
NFPA 56	Standard for Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems, 2017 Edition
NFPA 59	Utility LP-Gas Plant Code, 2018 Edition
NFPA 61	Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities, 2017 Edition
NFPA 67	Guide on Explosion Protection for Gaseous Mixtures in Pipe Systems, 2016 Edition
NFPA 68	Standard on Explosion Protection by Deflagration Venting, 2018 Edition
NFPA 69	Standard on Explosion Prevention Systems, 2014 Edition
NFPA 70B	Recommended Practice for Electrical Equipment Maintenance, 2016 Edition
NFPA 73	Standard for Electrical Inspections for Existing Dwellings, 2016 Edition
NFPA 76	Standard for the Fire Protection of Telecommunications Facilities, 2016 Edition

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NFPA 77	Recommended Practice on Static Electricity, 2014 Edition
NFPA 79	Electrical Standard for Industrial Machinery, 2018 Edition
NFPA 82	Standard on Incinerators and Waste and Linen Handling Systems and Equipment, 2014 Edition
NFPA 85	Boiler and Combustion Systems Hazards Code, 2015 Edition
NFPA 87	Recommended Practice for Fluid Heaters, 2018 Edition
NFPA 88A	Standard for Parking Structures, 2015 Edition
NFPA 90B	Standard for the Installation of Warm Air Heating and Air-Conditioning Systems, 2018 Edition
NFPA 91	Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Non-combustible Particulate Solids, 2015 Edition
NFPA 99	Health Care Facilities Code, 2018 Edition
NFPA 99B	Standard for Hypobaric Facilities, 2018 Edition
NFPA 101A	Guide on Alternative Approaches to Life Safety, 2016 Edition
NFPA 102	Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures, 2016 Edition
NFPA 105	Standard for Smoke Door Assemblies and Other Opening Protectives, 2016 Edition
NFPA 110	Standard for Emergency and Standby Power Systems, 2016 Edition
NFPA 111	Standard on Stored Electrical Energy Emergency and Standby Power Systems, 2019 Edition
NFPA 115	Standard for Laser Fire Protection, 2016 Edition
NFPA 120	Standard for Fire Prevention and Control in Coal Mines, 2015 Edition

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NFPA 122	Standard for Fire Prevention and Control in Metal/Non-Metal Mining and Metal Mineral Processing Facilities, 2015 Edition
NFPA 130	Standard for Fixed Guideway Transit and Passenger Rail Systems, 2017 Edition
NFPA 140	Standard on Motion Picture and Television Production Studio Soundstages, Approved Production Facilities, and Production Locations, 2018 Edition
NFPA 150	Standard on Fire and Life Safety in Animal Housing Facilities, 2016 Edition
NFPA 160	Standard for the Use of Flame Effects Before an Audience, 2016 Edition
NFPA 220	Standard on Types of Building Construction, 2018 Edition
NFPA 225	Model Manufactured Home Installation Standard, 2017 Edition
NFPA 232	Standard for the Protection of Records, 2017 Edition
NFPA 241	Standard for Safeguarding Construction, Alteration, and Demolition Operations, 2013 Edition
NFPA 252	Standard Methods of Fire Tests of Door Assemblies, 2017 Edition
NFPA 253	Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source, 2015 Edition
NFPA 257	Standard on Fire Test for Window and Glass Block Assemblies, 2017 Edition
NFPA 259	Standard Test Method for Potential Heat of Building Materials, 2018 Edition
NFPA 260	Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture, 2013 Edition

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NFPA 261	Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes, 2018 Edition
NFPA 262	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces, 2015 Edition
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, 2015 Edition
NFPA 268	Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source, 2017 Edition
NFPA 269	Standard Test Method for Developing Toxic Potency Data for Use in Fire Hazard Modeling, 2017 Edition
NFPA 270	Standard Test Method for Measurement of Smoke Obscuration Using a Conical Radiant Source in a Single Closed Chamber, 2018 Edition
NFPA 271	Standard Method of Test for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter, 2009 Edition
NFPA 274	Standard Test Method to Evaluate Fire Performance Characteristics of Pipe Insulation, 2018 Edition
NFPA 275	Standard Method of Fire Tests for the Evaluation of Thermal Barriers, 2017 Edition
NFPA 276	Standard Method of Fire Test for Determining the Heat Release Rate of Roofing Assemblies with Combustible Above-Deck Roofing Components, 2015 Edition
NFPA 285	Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components, 2012 Edition

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NFPA 286	Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth, 2015 Edition
NFPA 287	Standard Test Methods for Measurement of Flammability of Materials in Cleanrooms Using a Fire Propagation Apparatus (FPA), 2017 Edition
NFPA 288	Standard Methods of Fire Tests of Horizontal Fire Door Assemblies Installed in Horizontal Fire Resistance-Rated Assemblies, 2017 Edition
NFPA 289	Standard Method of Fire Test for Individual Fuel Packages, 2013 Edition
NFPA 290	Standard for Fire Testing of Passive Protection Materials for Use on LP-Gas Containers, 2018 Edition
NFPA 301	Code for Safety to Life from Fire on Merchant Vessels, 2018 Edition
NFPA 302	Fire Protection Standard for Pleasure and Commercial Motor Craft, 2015 Edition
NFPA 303	Fire Protection Standard for Marinas and Boatyards, 2016 Edition
NFPA 306	Standard for the Control of Gas Hazards on Vessels, 2014 Edition
NFPA 307	Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves, 2016 Edition
NFPA 312	Standard for Fire Protection of Vessels During Construction, Conversion, Repair, and Lay-Up, 2016 Edition
NFPA 318	Standard for the Protection of Semiconductor Fabrication Facilities, 2018 Edition
NFPA 326	Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair, 2015 Edition

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NFPA 329	Recommended Practice for Handling Releases of Flammable and Combustible Liquids and Gases, 2015 Edition
NFPA 385	Standard for Tank Vehicles for Flammable and Combustible Liquids, 2017 Edition
NFPA 402	Guide for Aircraft Rescue and Fire-Fighting Operations, 2013 Edition
NFPA 405	Standard for the Recurring Proficiency of Airport Fire Fighters, 2015 Edition
NFPA 408	Standard for Aircraft Hand Portable Fire Extinguishers, 2017 Edition
NFPA 410	Standard on Aircraft Maintenance, 2015 Edition
NFPA 412	Standard for Evaluating Aircraft Rescue and Fire-Fighting Foam Equipment, 2014 Edition
NFPA 414	Standard for Aircraft Rescue and Fire-Fighting Vehicles, 2017 Edition
NFPA 415	Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways, 2016 Edition
NFPA 418	Standard for Heliports, 2016 Edition
NFPA 422	Guide for Aircraft Accident/Incident Response Assessment, 2010 Edition
NFPA 423	Standard for Construction and Protection of Aircraft Engine Test Facilities, 2016 Edition
NFPA 450	Guide for Emergency Medical Services and Systems, 2017 Edition
NFPA 472	Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents, 2018 Edition
NFPA 473	Standard for Competencies for EMS Personnel Responding to Hazardous Materials/Weapons of Mass Destruction Incidents, 2018 Edition
NFPA 484	Standard for Combustible Metals, 2015 Edition

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NFPA 495	Explosive Materials Code, 2018 Edition
NFPA 496	Standard for Purged and Pressurized Enclosures for Electrical Equipment, 2017 Edition
NFPA 497	Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, 2017 Edition
NFPA 498	Standard for Safe Havens and Interchange Lots for Vehicles Transporting Explosives, 2018 Edition
NFPA 499	Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, 2017 Edition
NFPA 501A	Standard for Fire Safety Criteria for Manufactured Home Installations, Sites, and Communities, 2017 Edition
NFPA 502	Standard for Road Tunnels, Bridges, and Other Limited Access Highways, 2017 Edition
NFPA 505	Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations, 2018 Edition
NFPA 520	Standard on Subterranean Spaces, 2016 Edition
NFPA 550	Guide to the Fire Safety Concepts Tree, 2017 Edition
NFPA 551	Guide for the Evaluation of Fire Risk Assessments, 2016 Edition
NFPA 555	Guide on Methods for Evaluating Potential for Room Flashover, 2017 Edition
NFPA 556	Guide on Methods for Evaluating Fire Hazard to Occupants of Passenger Road Vehicles, 2016 Edition
NFPA 557	Standard for Determination of Fire Loads for Use in Structural Fire Protection Design, 2016 Edition

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NFPA 560	Standard for the Storage, Handling, and Use of Ethylene Oxide for Sterilization and Fumigation, 2007 Edition
NFPA 601	Standard for Security Services in Fire Loss Prevention, 2015 Edition
NFPA 610	Guide for Emergency and Safety Operations at Motorsports Venues, 2019 Edition
NFPA 654	Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, 2017 Edition
NFPA 655	Standard for Prevention of Sulfur Fires and Explosions, 2017 Edition
NFPA 664	Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities, 2017 Edition
NFPA 701	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, 2015 Edition
NFPA 703	Standard for Fire Retardant–Treated Wood and Fire-Retardant Coatings for Building Materials, 2018 Edition
NFPA 705	Recommended Practice for a Field Flame Test for Textiles and Films, 2018 Edition
NFPA 720	Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment, 2015 Edition
NFPA 730	Guide for Premises Security, 2018 Edition
NFPA 731	Standard for the Installation of Electronic Premises Security Systems, 2017 Edition
NFPA 790	Standard for Competency of Third-Party Field Evaluation Bodies, 2018 Edition
NFPA 791	Recommended Practice and Procedures for Unlabeled Electrical Equipment Evaluation, 2018 Edition

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NFPA 801	Standard for Fire Protection for Facilities Handling Radioactive Materials, 2014 Edition
NFPA 804	Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants, 2015 Edition
NFPA 805	Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2015 Edition
NFPA 806	Performance-Based Standard for Fire Protection for Advanced Nuclear Reactor Electric Generating Plants Change Process, 2015 Edition
NFPA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities, 2016 Edition
NFPA 850	Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations, 2015 Edition
NFPA 851	Recommended Practice for Fire Protection for Hydroelectric Generating Plants, 2010 Edition
NFPA 853	Standard for the Installation of Stationary Fuel Cell Power Systems, 2015 Edition
NFPA 900	Building Energy Code, 2016 Edition
NFPA 901	Standard Classifications for Incident Reporting and Fire Protection Data, 2016 Edition
NFPA 909	Code for the Protection of Cultural Resource Properties — Museums, Libraries, and Places of Worship, 2017 Edition
NFPA 914	Code for Fire Protection of Historic Structures, 2015 Edition
NFPA 1000	Standard for Fire Service Professional Qualifications Accreditation and Certification Systems, 2017 Edition
NFPA 1001	Standard for Fire Fighter Professional Qualifications, 2013 Edition

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NFPA 1002	Standard for Fire Apparatus Driver/Operator Professional Qualifications, 2017 Edition
NFPA 1003	Standard for Airport Fire Fighter Professional Qualifications, 2015 Edition
NFPA 1005	Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters, 2014 Edition
NFPA 1006	Standard for Technical Rescuer Professional Qualifications, 2017 Edition
NFPA 1021	Standard for Fire Officer Professional Qualifications, 2014 Edition
NFPA 1026	Standard for Incident Management Personnel Professional Qualifications, 2018 Edition
NFPA 1031	Standard for Professional Qualifications for Fire Inspector and Plan Examiner, 2014 Edition
NFPA 1035	Standard for Professional Qualifications for Public Fire and Life Safety Educator, 2015 Edition
NFPA 1037	Standard for Professional Qualifications for Fire Marshal, 2016 Edition
NFPA 1041	Standard for Fire Service Instructor Professional Qualifications, 2012 Edition
NFPA 1051	Standard for Wildland Fire Fighter Professional Qualifications, 2016 Edition
NFPA 1071	Standard for Emergency Vehicle Technician Professional Qualifications, 2016 Edition
NFPA 1122	Code for Model Rocketry, 2018 Edition
NFPA 1123	Code for Fireworks Display, 2018 Edition
NFPA 1124	Code for the Manufacture, Transportation, Storage, and Retail Sales of Fireworks and Pyrotechnic Articles, 2017 Edition
NFPA 1125	Code for the Manufacture of Model Rocket and High Power Rocket Motors, 2017 Edition

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NFPA 1126	Standard for the Use of Pyrotechnics Before a Proximate Audience, 2016 Edition
NFPA 1127	Code for High Power Rocketry, 2018 Edition
NFPA 1141	Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas, 2017 Edition
NFPA 1142	Standard on Water Supplies for Suburban and Rural Fire Fighting, 2017 Edition
NFPA 1143	Standard for Wildland Fire Management, 2018 Edition
NFPA 1144	Standard for Reducing Structure Ignition Hazards from Wildland Fire, 2018 Edition
NFPA 1145	Guide for the Use of Class A Foams in Manual Structural Fire Fighting, 2017 Edition
NFPA 1150	Standard on Foam Chemicals for Fires in Class A Fuels, 2017 Edition
NFPA 1192	Standard on Recreational Vehicles, 2018 Edition
NFPA 1194	Standard for Recreational Vehicle Parks and Campgrounds, 2018 Edition
NFPA 1201	Standard for Providing Emergency Services to the Public, 2015 Edition
NFPA 1250	Recommended Practice in Emergency Service Organization Risk Management, 2015 Edition
NFPA 1401	Recommended Practice for Fire Service Training Reports and Records, 2017 Edition
NFPA 1402	Guide to Building Fire Service Training Centers, 2012 Edition
NFPA 1403	Standard on Live Fire Training Evolutions, 2018 Edition
NFPA 1404	Standard for Fire Service Respiratory Protection Training, 2018 Edition
NFPA 1405	Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires, 2016 Edition

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NFPA 1407	Standard for Training Fire Service Rapid Intervention Crews, 2015 Edition
NFPA 1410	Standard on Training for Initial Emergency Scene Operations, 2015 Edition
NFPA 1451	Standard for a Fire and Emergency Service Vehicle Operations Training Program, 2018 Edition
NFPA 1452	Guide for Training Fire Service Personnel to Conduct Dwelling Fire Safety Surveys, 2015 Edition
NFPA 1521	Standard for Fire Department Safety Officer Professional Qualifications, 2015 Edition
NFPA 1581	Standard on Fire Department Infection Control Program, 2015 Edition
NFPA 1582	Standard on Comprehensive Occupational Medical Program for Fire Departments, 2018 Edition
NFPA 1583	Standard on Health-Related Fitness Programs for Fire Department Members, 2015 Edition
NFPA 1584	Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises, 2015 Edition
NFPA 1600	Standard on Disaster/Emergency Management and Business Continuity Programs, 2016 Edition
NFPA 1670	Standard on Operations and Training for Technical Search and Rescue Incidents, 2017 Edition
NFPA 1720	Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations and Special Operations to the Public by Volunteer Fire Departments, 2014 Edition
NFPA 1801	Standard on Thermal Imagers for the Fire Service, 2018 Edition
NFPA 1851	Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, 2014 Edition

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NFPA 1852	Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA), 2013 Edition
NFPA 1855	Standard on Selection, Care, and Maintenance of Protective Ensembles for Technical Rescue Incidents, 2018 Edition
NFPA 1901	Standard for Automotive Fire Apparatus, 2016 Edition
NFPA 1906	Standard for Wildland Fire Apparatus, 2016 Edition
NFPA 1911	Standard for the Inspection, Maintenance, Testing, and Retirement of In-Service Automotive Fire Apparatus, 2017 Edition
NFPA 1912	Standard for Fire Apparatus Refurbishing, 2016 Edition
NFPA 1917	Standard for Automotive Ambulances, 2016 Edition
NFPA 1925	Standard on Marine Fire-Fighting Vessels, 2018 Edition
NFPA 1931	Standard for Manufacturer's Design of Fire Department Ground Ladders, 2015 Edition
NFPA 1932	Standard on Use, Maintenance, and Service Testing of In-Service Fire Department Ground Ladders, 2015 Edition
NFPA 1936	Standard on Powered Rescue Tools, 2015 Edition
NFPA 1951	Standard on Protective Ensembles for Technical Rescue Incidents, 2013 Edition
NFPA 1952	Standard on Surface Water Operations Protective Clothing and Equipment, 2015 Edition
NFPA 1961	Standard on Fire Hose, 2013 Edition
NFPA 1962	Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances, 2018 Edition
NFPA 1964	Standard for Spray Nozzles, 2018 Edition
NFPA 1965	Standard for Fire Hose Appliances, 2014 Edition

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NFPA 1971	Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting, 2018 Edition
NFPA 1975	Standard on Station/Work Uniforms for Emergency Services, 2014 Edition
NFPA 1977	Standard on Protective Clothing and Equipment for Wildland Fire Fighting, 2016 Edition
NFPA 1981	Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services, 2013 Edition
NFPA 1982	Standard on Personal Alert Safety Systems (PASS), 2018 Edition
NFPA 1983	Standard on Life Safety Rope and Equipment for Emergency Services, 2017 Edition
NFPA 1984	Standard on Respirators for Wildland Fire-Fighting Operations, 2016 Edition
NFPA 1989	Standard on Breathing Air Quality for Emergency Services Respiratory Protection, 2013 Edition
NFPA 1991	Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies, 2016 Edition
NFPA 1992	Standard on Liquid Splash-Protective Ensembles and Clothing for Hazardous Materials Emergencies, 2018 Edition
NFPA 1994	Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents, 2018 Edition
NFPA 1999	Standard on Protective Clothing for Emergency Medical Operations, 2018 Edition
NFPA 2001	Standard on Clean Agent Fire Extinguishing Systems, 2018 Edition
NFPA 2010	Standard for Fixed Aerosol Fire-Extinguishing Systems, 2015 Edition

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NFPA 2112	Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire, 2018 Edition
NFPA 2113	Standard on Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire, 2015 Edition
35.2.1.3 Others	
UL 263	Standard for Fire Tests of Building Construction and Materials, 2011 Edition
UL 300	Standard for Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment, 2005 Edition
UL 723	Standard for Safety Test for Surface Burning Characteristics of Building Materials, 11th Edition

APPENDIX A. FIRE PREVENTION PROCEDURES

A.1 General Fire Prevention

A.1.1 According to NPR 8715.1, NASA Center Directors are responsible and accountable for the safety and health aspects of all activities assigned to their Center, which requires implementing an effective fire and life safety program at their Centers.

A.1.1.1 The following references shall be utilized in the development of a Fire Prevention Program:

- a. Fire Inspection and Code Enforcement Manual (IFSTA).
- b. Local Building and Fire Codes.
- c. National Fire Code (NFPA 1).
- d. Fire Protection Handbook (NFPA).
- e. Fire and Life Safety Inspection Manual (NFPA).
- f. Occupational Safety and Health (Occupational Safety and Health Standards, 29 CFR pt. 1910, Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters, 29 CFR pt. 1960, and Safety and Health Regulations for Construction, 29 CFR pt. 1926).
- g. NASA Safety Standards (NASA).
- h. Plans Examiner for Fire and Emergency Services Manual (IFSTA).
- i. International Fire Code (IFC)
- j. FM Global Data Sheets

A.1.2 Fire Reporting and Documentation

A.1.2.1 The following documents shall remain on file for the periods shown:

- a. Fire Prevention Inspections (2 years).
- b. Fire and Evacuation Drills (2 years).
- c. Plan Reviews (5 years).
- d. Fire Protection System Inspections (5 years).
- e. Fire Incident Reports (indefinite).
- f. Fire Investigation Reports (indefinite).

A.1.3 Documentation of Fire Protection and Life Safety Incidents

A.1.3.1 Fires meeting the definition of a “close call” shall be reported in accordance with NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping.

A.1.3.2 All NASA Centers shall report to the National Fire Incident Reporting System (NFIRS).

A.1.3.3 All fires shall be reported to the NASA Mishap Information System (NMIS), and the OSMA.

A.2 Fire Investigation

A.2.1 The AHJ at each NASA Center shall designate persons responsible for the investigation of all fires at their facilities.

A.2.2 The requirements in NPR 8621.1 and NFPA 921, Guide for Fire and Explosion Investigations 2017 Edition shall be used in these investigations.

A.2.3 Contacts for outside assistance shall be established.

A.2.4 Security shall be notified of all fires that are suspicious in nature.

A.2.5 Persons within NASA assigned the responsibility of determining origin and cause shall be trained at the level of NFPA 1033, Standard for Professional Qualifications for Fire Investigator 2014 Edition, with annual refresher training provided by independent parties or certified origin and cause instructors.

A.3 Smoking Locations

A.3.1 Smoking within government buildings is prohibited. Outside smoking is prohibited within the following locations:

- a. Hot and warm zones of any hazardous material incidents.
- b. 10 ft of any non-maintained vegetation.
- c. 25 ft of any storage or transfer of flammable or combustible liquids or gasses.
- d. 50 ft of any explosives transfer or storage magazine.
- e. 200 ft of any storage or transfer of liquid oxygen.
- f. 3-5 ft of any general combustible storage.
- g. Surplus scrap yards.
- h. Lumber storage yards.

- i. Active airport ramp, taxiway, or runway.
- j. On building or structure roofs.
- k. 25 ft from a building entrance or exit.

A.4 Fire Safety Education

A.4.1 Fire or Evacuation Drills

A.4.1.1 Fire drills shall be conducted annually in all facilities occupied by 10 or more persons.

A.4.1.2 Fire drills shall be conducted and evaluated by persons knowledgeable in fire and life safety.

A.4.1.3 Fire drills shall not be announced to the general population; however, the AHJ may wish to have key personnel involved to prevent interruption of mission essential activities.

A.4.1.4 Emergency plans shall include contingencies for all phases of operations including mission essential operations.

A.4.1.5 These plans shall be approved by the AHJ.

A.4.2 Fire Safety Education

A.4.2.1 Each Center or facility shall establish and maintain a comprehensive fire safety education or awareness program.

A.4.2.2 Fire Safety Education Programs shall be provided to all occupants and shall include the following components at a minimum.

A.4.2.2.1 New employees shall receive an introduction to emergency systems within 30 days of employment that includes how to activate the emergency notification system, the operation of fixed systems, the evacuation plan for the building and the facility awareness of emergency signals, hazard recognition and reporting, and the use of portable fire suppression equipment.

A.4.2.2.2 Training on all fire safety equipment expected for occupants' assigned duties shall be provided prior to operation of that equipment.

A.4.3 Fire Extinguisher Training

A.4.3.1 Personnel that are required to use fire extinguishers shall be instructed in their use in accordance with Emergency Action Plans, 29 CFR § 1910.38.

A.4.3.2 The training shall include all fire extinguishers that personnel may reasonably be expected to encounter.

A.4.3.3 Persons who have not been trained in extinguishers shall not be required to use them.

A.4.3.4 Training shall include a hands-on exercise under similar conditions personnel would be expected to encounter in the workplace.

A.4.3.5 Industry Refresher Training shall be conducted in accordance with 29 CFR § 1910.157.

A.5 Housekeeping

A.5.1 Good housekeeping in all operations is essential for effective fire prevention. Accumulation of rubbish, waste, and industrial residue as well as concentrations of flammable vapors provide excellent fuel sources for fire. To minimize fire hazards in the workplace, the following housekeeping requirements shall be followed:

A.5.2 Waste cans shall be as small as is practicable for the task and constructed of steel.

A.5.3 Waste cans shall be emptied at regular intervals to prevent accumulation of combustible materials.

A.5.4 Smoking material shall not be disposed of in waste cans until 12 hr have passed since the can was last used.

A.5.5 Dumpsters and recycle bins shall not be stored closer than 10 ft from a structure with a fire-rated wall and 15 ft from any other nonrated structure including towers.

A.5.6 Hazardous materials shall not be disposed of in general waste dumpsters.

A.5.7 Paper in excess of that necessary to perform a task shall be removed.

A.5.8 Listed and approved non-combustible waste cans shall be provided in areas where oily waste or flammable or combustible finishes are used or found.

A.5.8.1 Waste cans shall be emptied at least daily.

A.5.9 Exit access ways, exits, and exit discharge paths shall be maintained free and clear at all times in accordance with NFPA 101.

Note: Furniture, equipment, interior decoration, vehicle, debris, or other substantial physical items placed or stored temporarily or permanently in a path of emergency travel (corridor, exit door, stairway, and point of exit discharge) may make the pathways impassible during an emergency.

A.5.10 No object shall be located in such a manner as to prevent access to, or use of, fire protection equipment (fire extinguishers, fire alarm pull stations, hydrants, fire hose outlets, fire alarm panel, sprinkler valves, and Fire Department connections).

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A.5.11 Combustible dust shall not be removed by air pressure or other means that causes the dust to become suspended in air.

A.5.11.1 Listed and approved vacuum shall be used for combustible dust clean-up unless otherwise approved.

A.5.12 Scrap piles of combustible materials shall have fire lanes between piles at least 12 ft wide.

A.5.13 Mechanical and electrical rooms, elevator rooms, space above ceilings, beneath raised floors, and under stairwells shall be kept free of combustibles and flammable materials and not be used as offices, shops, or storage rooms.

A.5.14 All hoods, ducts, fans, and filters above stoves or grills shall be cleaned at frequent intervals to prevent them from becoming contaminated with grease or oily sludge.

A.5.14.1 The minimum frequency of cleaning shall be daily for stoves and hoods, weekly for filters, and semi-annually for ducts and fans.

A.5.15 No stove or grill shall be used without the filter in place.

A.5.16 A minimum of a 25-ft clear area shall be maintained between combustible brush land and facilities including temporary facilities (e.g., trailers or storage containers).

A.5.17 A 50-ft clear area shall be maintained between facilities and densely wooded areas.

A.5.18 Mops and other cleaning materials shall be stored only in janitorial closets or approved storage areas.

A.5.19 The use of free-burning foams and plastics shall be used only in approved locations.

A.6 Electrical Appliances

A.6.1 Electrical appliances, which have been modified, shall not be used.

A.6.2 Electrical appliances shall only be used on circuits sized in accordance with NFPA 70 for the anticipated load.

A.6.3 All electrical appliances shall be unplugged or switched to an off position that cannot automatically energize a heating element when not in use.

A.6.4 Coffee makers, refrigerators, crock pots, toasters and microwaves used on site shall meet approval of the AHJ.

A.6.5 Electrical appliances for food preparation shall be used in designated areas that meet the approval of the AHJ.

A.6.6 Portable space heaters are prohibited unless approved by the AHJ.

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Note: Permits are intended for validated medical reasons or during heating system outage.

A.6.6.1 Portable space heaters shall be plugged directly into wall outlets.

Note: The use of multi-outlet power taps or extension cords to power space heaters is prohibited.

A.6.6.2 A minimum 36-in clearance from combustible materials shall be maintained at all times.

A.7 Fire Prevention Inspections

A.7.1 Fire prevention inspections shall be conducted by persons trained to recognize fire-related issues in accordance with this standard.

A.7.2 Fire prevention inspections shall be documented and maintained as outlined in Section A.1.2.1.

A.7.3 The frequency and the time of inspections shall be in accordance with the following unless otherwise approved:

A.7.3.1 Quarterly Inspections

- a. Mission essential
- b. High dollar value
- c. High life load (greater than 300 people)
- d. Moderate to high risk hazardous storage or process
- e. High fire/smoke/explosion potential

A.7.3.2 Semi-Annual Inspections

- a. Ordinary hazard (most facilities)
- b. Moderate dollar value
- c. Moderate life load (Less than 300 people)
- d. Moderate risk hazardous storage or process
- e. Moderate fire/smoke development

A.7.3.3 Annual Inspections

- a. Not normally occupied

- b. Low dollar value
- c. No or low life load (less than 10 people)
- d. Low risk hazardous storage or process
- e. Low fire/smoke development

A.7.3.4 Inspection findings shall be documented and tracked to completion.

A.7.3.5 Within 30 days of the issuance of an inspection report, areas of noncompliance shall be corrected or provided with a written corrective action plan.

A.8 Hot Work

A.8.1 All work involving burning, welding, or a similar operation shall be prohibited without first obtaining a hot work permit.

A.8.2 Hot work shall be conducted in accordance with NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work 2014 Edition and this standard.

A.8.3 Hot work permits may be issued annually for designated hot work areas meeting the approval of the AHJ.

A.8.4 Temporary hot work permits shall be issued for no more than 30 days for specific tasks.

A.8.5 When fire systems are required to be deactivated for welding, cutting, open flames or other hot work, a fire system impairment procedure shall also be required in accordance with NFPA 1.

A.8.6 Whenever changes are made that either alter the permitted area, require new processes to be introduced into the area, or cause relocation to a different site, a new permit shall be required.

A.8.7 Tar pots are considered hot work and shall be in accordance with this standard.

A.8.7.1 Tar pots shall not be located within 20 ft of a facility or be protected from the facility by a 1-hr fire-resistive barrier standing 4 ft above and to all sides of the pot that are exposed to the building.

A.8.7.2 Rope barriers shall be provided to regulate personnel 20 ft from the tar pot.

A.8.7.3 Equipment lids shall remain closed tight.

A.8.7.4 Tar pots shall be constantly attended from 30 minutes prior to operations until 30 minutes after all heat is removed from the equipment.

A.9 Flammable and Combustible Liquids

A.9.1 All storage cabinets for flammable and combustible liquids shall comply with NFPA 30, Flammable and Combustible Liquids Code and the following:

A.9.1.1 Locations for flammable and combustible liquid cabinets shall be approved.

A.9.2 All storage buildings, sites, and designated rooms for flammable and combustible liquids shall be in accordance with NFPA 30 and this standard.

A.9.2.1 Designated storage locations shall be placarded in accordance with NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response 2017 Edition.

A.9.2.2 Safety Data Sheets (SDS) shall be located on the exterior of cabinets documenting all contents of cabinet.

A.9.2.3 Bungs on cabinet shall be closed unless approved ventilation system is installed.

A.9.2.4 No storage allowed on top of cabinets. No wood, paper, cardboard, absorbants or similar materials shall be inside cabinets.

A.9.2.5 Outside storage sites shall be graded to ensure drainage away from any facilities.

A.9.2.6 Where likelihood of vehicular impact is possible, bollards shall be installed to prevent damage to cabinet.

A.9.3 Vehicles (loaded or empty) used for transporting flammable and combustible liquids shall not enter any building unless specifically approved.

A.9.3.1 Vehicles and engines shall not be fueled or defueled inside a building unless specifically approved.

A.10 Aircraft Hangars

A.10.1 Flammable and combustible liquids used to service aircraft shall be stored in approved flammable liquid storage cabinets at the end of each shift.

A.10.2 Aircraft storage areas shall be kept clear of combustibles that may increase the risk of fire to aircraft.

A.10.3 Aircraft areas shall be kept clear of non-classified electrical devices or systems.

A.10.4 Aircraft shall not be fueled or de-fueled within the hangar.

APPENDIX B. FIRE SERVICE OPERATIONS AND REQUIREMENTS

B.1 General

B.1.1 A fire protection program consists of fire protection engineering to minimize fire loss through engineering designs and systems, fire prevention to inspect for employee-created fire hazards and provide fire safety education and training, and a fire suppression force to minimize losses in the event of a fire. This section pertains to the fire service operations element of a fire protection program including command and control, firefighting, emergency medical service, rescue, and hazardous materials response.

B.1.2 According to NPR 8715.1, NASA Center Directors are responsible and accountable for the safety and health aspects of all activities assigned to their Center, which requires implementing effective fire service operations and firefighting at their Centers.

B.1.3 This Appendix outlines requirements for NASA-provided fire service response operations. Where a Center does not have a NASA-provided fire service response organization, the Center Director shall ensure that similar capabilities to this Appendix exist within the fire service response organization that services their Center.

B.1.4 The fire department shall be equipped with a sufficient amount of first-line and reserve fire-fighting vehicles to combat anticipated fires.

B.1.5 The Center individual who is the AHJ shall authorize personnel staffing. The following may provide fire service operations:

- a. NASA contractor
- b. Civil service employees
- c. Local fire departments
- d. Onsite fire brigade
- e. Any combination previously listed

B.1.6 NASA Centers shall utilize NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments 2016 Edition to determine the correct level of firefighter support and response capabilities except as specified in B.1.7.

B.1.7 Centers are allowed to deviate from NFPA 1710 in structural firefighting staffing and or aggregate response times through the request for relief process referenced in section 1.4 where it is supported by a documented risk-based assessment specific to the Center to show where a reduction in firefighter staffing levels and aggregate response times may be authorized. Assessment shall be accomplished utilizing a nationally recognized process and is to take into account staffing resources based on historical fire response data; reduced staffing during periods of lower risk; use of mutual aid agreements; sprinklered versus nonsprinklered facilities; and

similar methods appropriate to the installation to mitigate risk. Each facility on the Center shall be assessed and included in the risk assessment. Risk assessment must prove that a reduction in staffing and or aggregate response times will still provide an equivalent or alternative level of protection as the National Consensus Standard, NFPA 1710.

B.1.7.1 Risk assessment with the reduction in staffing and or aggregate response times shall be submitted to the NASA HQ AHJ in the Office of Safety & Mission Assurance for approval.

B.1.7.2 Risk assessment shall be reviewed annually by the Center AHJ and resubmitted for approval to the NASA HQ AHJ in the Office of Safety & Mission Assurance for approval.

B.1.8 Hazardous Materials

B.1.8.1 The widespread use of hazardous materials increases the possibility of a spill, leak, or fire involving these materials. The fire protection role in such incidents is to provide command and control, provide rescue and EMS assistance, extinguish the fire, and contain the materials. Once these actions have been accomplished, the involvement of the fire department reverts to a support role. Trained experts in the related field accomplish recovery, neutralization, cleanup, and disposal of hazardous materials.

B.1.9 The fire department's Fire Chief or designee shall notify the AHJ when staffing levels or the minimum number of fire-fighting vehicles needed to support the NASA mission fall below the number required by NFPA 1710, or the approved alternative staffing/resource levels, to operate adequately in time of emergency.

B.1.10 Incident Management System

B.1.10.1 Each NASA Center or facility shall adopt, implement, train in the use of, and utilize an Incident Management System in accordance with Homeland Security Presidential Directive, the Agency automated system, and NFPA 1561, Standard on Emergency Services Incident Management System and Command Safety 2014 Edition when managing any emergency or disaster.

B.1.10.2 Specific responsibilities shall be identified in each NASA Center's Emergency Preparedness Plan required by NPR 8715.2, NASA Emergency Preparedness Plan Procedural Requirements.

B.1.11 Local Fire Service Support

B.1.11.1 When fire suppression, rescue, EMS, or hazardous materials response and other fire service-related emergency responses are provided by a non-NASA local fire service organization, responsibilities and agreements shall be placed in writing.

B.1.12 NASA Contractor or Civil Service Fire Service Operations

B.1.12.1 Contractors shall be held responsible for contract compliance.

B.1.12.2 Civil service and contracted fire departments at each NASA Center or facility shall develop and implement a written Fire Service Operations Plan that ensures compliance with applicable NFPA, OSHA, Federal Aviation Administration (FAA), and NASA documents.

B.1.12.3 The Fire Service Operations Plan shall include the following:

- a. Mission Statement
- b. Management Plan
 - (1) Organizational Structure and Lines of Communication
 - (2) Occupational Safety and Health Plan
 - (3) Self-Inspection/Self Audit Process
 - (4) Training and Certification Plan
- c. Operations Plan
 - (1) Emergency Response Plan
 - (2) Minimum Staffing Plan
 - (3) Vehicle Maintenance and Refurbishment Plan
 - (4) Physical Fitness Plan

B.1.13 Fire Brigades

B.1.13.1 Where industrial fire brigades are established and operated at a NASA Center or facility, the brigades shall, as a minimum, comply with this standard, NFPA 600, Standard on Industrial Fire Brigades 2015 Edition, NFPA 1081, Standard for Industrial Fire Brigade Member Professional Qualifications 2018 Edition, and Fire Brigades, 29 CFR § 1910.156.

B.1.14 Communications

B.1.14.1 Where consolidated communications centers are not employed, the provisions for providing and maintaining adequate facilities for the receipt of alarms and communications functions at each NASA Center or facility shall be provided and operated by qualified operators that meet the requirements of NFPA 1061, Standard for Professional Qualifications for Public Safety Telecommunicator 2018 Edition and NFPA 1221.

B.1.15 Aircraft Operations

B.1.15.1 Each NASA Center or facility that has runways, taxiways, and facilities for the arrival and departure of aircraft shall have sufficient amounts of Aircraft Rescue and Fire Fighting (ARFF) resources to respond to and suppress fires and maintain a means of egress

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for the flight crews during aircraft emergencies in compliance with Certification of Airports, 14 CFR pt. 139 and NFPA 403, Standard for Aircraft Rescue and Fire-Fighting Services at Airports 2018 Edition.

B.1.16 Fire Stations

B.1.16.1 Fire stations located at NASA Centers and facilities shall be designed, constructed, and maintained to allow the fire department to effectively fulfill its assigned missions and to provide firefighters with a safe working environment orientated to their operational needs including the following:

- a. A training and education center to provide firefighters an environment conducive to learning manipulative and technical skills.
- b. A dining room with tables and chairs, stove and oven, refrigerator, sink, dishwasher, counter space, and cabinet storage.
- c. Furnished day room and recreational area.
- d. Sleeping accommodations with individual or crew cubicle, clothing racks, nightstands, lockers, drapes, individual lighting, and carpeting.
- e. Physical fitness room equipped with proper exercise equipment.
- f. Storage areas for extinguishing agents, equipment, and materials including personal protective equipment (PPE).
- g. Bays to house assigned fire apparatus and support vehicles.
- h. Administrative space.
- i. Heating and air conditioning.
- j. Fire Alarm Communications Center for those NASA Centers and facilities that assign this function to the fire department.
- k. Compliance with applicable portions of NFPA 1500, Standard on Fire Department Occupational Safety and Health Program 2018 Edition.
- l. Maintenance and repair areas for facility, apparatus, or equipment including PPE (e.g., sink, washer, and dryer).
- m. Emergency Operations Center (e.g. primary or alternate site) for those NASA Centers and facilities that assign this function to the fire department.
- n. Compliance with applicable portions of NFPA Fire Protection Handbook.

B.2 Response Time and Distance

B.2.1 For NASA Centers and facilities, the AHJ shall establish response times to various facility locations to ensure that the fire response arrives in a timely manner so that appropriate actions are taken to mitigate an emergency situation.

B.3 Pre-Fire Planning

B.3.1 NASA Centers or facilities shall implement a pre-fire plan program.

B.3.1.1 Pre-fire plans shall be prepared for facilities with a current replacement value in excess of \$500,000 or more than 10,000 ft² of floor space.

B.3.1.2 Pre-fire plans shall be prepared for each type aircraft that is based at a Center or regularly frequents a Center.

B.3.1.3 While NFPA 1620 (facilities), Standard for Pre-Incident Planning 2015 Edition and NFPA 424 (aircraft), Guide for Airport/Community Emergency Planning 2018 Edition shall be referenced, the minimum required data for a pre-fire plan is as follows:

B.3.1.4 Facility Pre-Fire Plans

- a. Facility number, type, occupancy, and fire loading
- b. Square footage and number of floors
- c. Location of water supply, connections, and valves
- d. Facility hazards, laboratories, flammable storage, or other potential hazards
- e. Approach access and fenced areas
- f. Water available, determined by fire flow
- g. Type of fire systems, locations of water and utility shut-off valves
- h. Single line drawing with NFPA 170 symbols
- i. Tools required to gain entry
- j. Specialized facility features
- k. Approximate number of occupants (day and night)

B.3.1.5 Aircraft Pre-Fire Plans

- a. Any hazards not indicated in the applicable Technical Manual, Aircraft Emergency Rescue Information (Fire Protection)

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- b. Type of aircraft
- c. Optimum vehicle positions (ARFF vehicles)
- d. Approach to entry points on aircraft
- e. Pre-designated rescue duties
- f. Other factors pertaining to aircraft fire fighting

APPENDIX C. FIRE PROTECTION ACCESS AND WATER SUPPLY

C.1 Fire Department (Emergency) Vehicle Access

C.1.1 All-Weather Ground

C.1.2 All facilities greater than 465 m² (5,000 ft²), or more than two stories in height, shall have at least one means of all-weather ground access to allow emergency vehicles unimpeded access to the facility.

C.1.2.1 All-weather ground access shall be paved, start from the road, and terminate no farther than 10 m (33 ft) from an exterior door accessible for fire department ingress (i.e. a stair door or some other exterior door that provides access to the facility interior).

C.1.2.2 The route between the access surface and exterior door shall be able to be traversed without the use of a ladder.

C.1.2.3 An engineered all-weather surface that is not paved may be provided if approved.

C.1.3 Aerial Apparatus Access

C.1.3.1 New facilities four stories or more in height and all new warehouses shall be provided with suitable all-weather ground access for aerial apparatus on a minimum of two sides of the perimeter of the structure meeting all of the following:

C.1.3.1.1 The access shall be parallel to at least one entire side of the facility with windows to allow aerial access to the entire side.

C.1.3.1.2 The distance between the aerial apparatus access and the facility shall be based on the responding aerial apparatus and facility height and be approved by the AHJ.

Note: The intent of this paragraph is to provide aerial apparatus access to two sides of the building, with one side having access along the entire side of the building so that the aerial apparatus has multiple locations to set up operations. Aerial apparatus access should be coordinated with fire department ingress.

C.2 Vehicle Access

C.2.1 All security equipment, such as bollards or gates, shall require not more than one person to remove or open.

C.2.2 Access may require fire apparatus to drive over a curb.

C.2.3 Any locking device controlling vehicle access shall be under control of the fire department or 24-hr security personnel located at the specific facility.

C.2.4 Dimensions of fire department access roads and turnarounds shall comply with NFPA 1.

C.2.5 Vehicle access shall be coordinated with the installation or responding fire department.

C.3 Water Supply Requirements for Fire Protection

C.3.1 Water Supply

C.3.1.1 Water supply shall comply and be capable of meeting both fire protection and domestic demand for that area in accordance with NFPA 1.

C.3.1.2 Mission essential or critical facilities or areas shall have a looped or "gridded" supply system.

C.3.2 Water Storage Capability

C.3.2.1 The design and installation of water storage tanks shall comply with NFPA 22, Standard for Water Tanks for Private Fire Protection 2018 Edition.

C.3.3 Pump Requirements

C.3.3.1 Where pumps are required to furnish the necessary fire protection water flow and pressure, the pumps shall be designed and installed in accordance with NFPA 20 and paragraph 9.2.2 of this standard.

C.3.4 Sprinklered Facilities

C.3.4.1 Fire flow for sprinklered facilities shall be a minimum of 1,000 gpm at 20 psi (3785 L/min at 138 kPa) for a 2-hr duration. Where the fire flow cannot be met, the AHJ is permitted to approve a reduction in fire flow. Fire flow is calculated independently of the Fire Water Demand.

C.3.5 Non-Sprinklered Facilities

C.3.5.1 Fire flow shall be in accordance with NFPA 1 and this section.

C.3.5.2 Yard and Outdoor Storage

C.3.5.2.1 Yard and outdoor storage shall comply with the requirements of NFPA 80A (2017 Edition), and Factory Mutual Global Property Loss Prevention Data Sheet 1-20, Protection Against Exterior Fire Exposure.

C.3.5.2.2 Aisle widths and separation distances shall be maintained to limit the exposure to nearby facilities and to enable manual firefighting operations.

C.3.5.3 Aircraft Parking and Refueling Facilities

C.3.5.3.1 A minimum Fire Flow of 1,000 gpm (3,785 L/min) for a 2-hour duration is to be provided for all such facilities.

C.3.5.4 Vehicle Parking Areas

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C.3.5.4.1 A minimum fire flow of 500 gpm (1,900 l/m) for a 2-hour duration shall be provided for all such areas.

C.3.6 Service Mains and Laterals–General

C.3.6.1 Service Mains and Service Laterals shall comply with American Water Works Association (AWWA) M31, Distribution System Requirements for Fire Protection 2008 Edition and NFPA 24 except where specifically modified by this standard.

C.3.6.2 This section applies to both dedicated (fire only) and combined (domestic and fire) water distribution systems.

C.3.6.3 For Service Mains served by fire pumps or Service Laterals serving fire pumps, velocities shall be calculated using 150 percent of the rated capacity of the fire pump.

C.3.6.4 Provide appropriate corrosion protection based on pipe material and corrosive properties of the water supply and earth.

C.3.6.5 Where cathodic protection is indicated based upon present conditions, comply with NFPA 24 Service Mains.

C.3.6.6 Service Mains shall be sized to accommodate fire flow plus domestic and industrial demands that cannot be restricted during fires.

C.3.6.7 Service Mains shall be looped to provide at least 50 percent of the required fire flow in case of a single break.

C.3.6.8 Service Mains shall not be dead ends.

C.3.6.9 Service Mains shall be sized so that the minimum residual pressure available, at 150 percent of a facility fire pump rating, if provided, is not less than 20 psi.

C.3.7 Service Laterals

C.3.7.1 Not more than two fire hydrants can be located on a Service Lateral.

C.3.7.2 Minimum size service lateral for fire sprinkler systems shall be not less than 150 mm (6 in) in diameter.

C.3.7.3 For NFPA 13R systems, the Service Lateral is permitted to be 101 mm (4 in) if supported by hydraulic calculations.

C.3.7.4 For NFPA 13D systems, the minimum Service Lateral size shall be based on hydraulic calculations.

C.3.7.5 The minimum residual pressure in a Service Lateral shall not be less than 20 psi at the greater of fire flow or fire water demand. This residual pressure shall be maintained at the inlet of the backflow preventer or suction side of the fire pump, whichever is closer to the Service Main.

C.3.7.6 A Service Lateral supplying a fire pump shall be able to support 150 percent of the fire pump rated capacity without falling below the required net positive suction head (NPSH) at the suction side of the pump.

C.3.7.7 Piping downstream of the fire pump is not a Service Lateral. Piping downstream of the fire pump must be sized based on the fire water demand of the facility or the minimum required by NFPA 20, whichever is greater, not 150 percent of the fire pump-rated capacity.

C.4 Valves

C.4.1 Control valves shall be provided in each source of water supply, such as tanks and pumps.

C.4.2 A control valve shall be provided on the Service Lateral downstream of the connection to the Service Main.

C.4.3 A sufficient number of sectional valves shall be provided on the Service Main, so that not more than a combined total of five hydrants or the Service Laterals to not more than three separate buildings are out of service because of a single break.

C.4.4 Sectional valves on Service Mains may be key-operated type. New valves shall open by counter-clockwise rotation of the stem.

C.5 Supervision

C.5.1 When provided, post indicator valves (PIV) shall be supervised using a lock or tamper seal, at a minimum.

C.6 Hydrants

C.6.1 Fire hydrants shall be listed or approved by a NRTL and shall have two 65 mm (2.5 in) hose outlets and one 115 mm (4.5 in) outlet with national standard fire hose threads in accordance with NFPA 1963, Standard for Fire Hose Connections 2014 Edition.

C.6.2 Comply with the Center fire department or local responding fire department when they require a different arrangement or hose threads.

C.6.3 Wet barrel or California-type hydrants are preferable in areas where there is no danger of freezing. Dry barrel or traffic-type hydrants shall be used in areas where there is a danger of freezing. Hydrants shall be above ground type and match the type used on the Installation.

C.6.4 In NASA Centers serviced by only local fire departments, hydrant hose threads shall meet local requirements.

C.6.5 See AWWA M17 and AWWA M31 for additional information.

C.6.6 All hydrants shall also be marked based on the fire flow capacity, in accordance with NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants 2016 Edition or by the Center established marking standard.

C.6.7 Clearly mark each new hydrant with an identification number assigned by the installation.

C.7 Construction Requirements

C.7.1 Installation shall be in accordance with NFPA 24 except as modified by this standard.

C.7.2 Hydrants shall be installed adjacent to paved areas, accessible to fire department apparatus.

C.7.3 Service Lateral supplying hydrants shall be minimum 150 mm (6 in) and valved at the connection to the Service Main.

C.7.4 Barrels shall be long enough to permit at least 450 mm (18 in) clearance between the center of the 115 mm (4.5 in) outlet and grade.

C.7.5 The ground shall be graded so that any surface drainage is away from the hydrant.

C.7.6 The 115 mm (4.5 in) outlet shall be perpendicular to the street to allow straight connection to the apparatus with a pump.

C.7.7 Landscaping, fencing, bollards and similar shall be located a minimum of 36 in from the horizontal centerline of the hydrant and not directly in front of any outlet.

C.7.8 For hydrants adjacent to airfield pavement, comply with NFPA 409 and NFPA 24.

C.8 Spacing Requirements

C.8.1 A sufficient number of hydrants shall be provided so that fire flow can be met without taking more than 4,740 L/min (1,250 gpm) from any single hydrant.

C.8.2 All parts of the facility exterior shall be within 106 m (350 ft) of a hydrant with consideration given to accessibility and obstructions.

C.8.3 Hydrants shall be located with consideration given to emergency vehicle access.

C.8.4 Hydrants shall also be spaced in accordance with the following requirements:

- a. At least one hydrant shall be located within 45 m (150 ft) of the fire department connection.
- b. Hydrants protecting warehouses shall be spaced at 91 m (300 ft) maximum intervals.

C.8.5 Hydrants located adjacent to parking areas, vehicle traffic areas or other areas subject to mechanical damage, shall be protected by bollards.

C.8.5.1 The bollards shall be located so they are not directly in front of an outlet.

C.8.5.2 The bollards shall allow clearance to attach hoses, the removal of the hydrant caps, and for the hydrant to be opened and closed without obstructions.

C.9 Water Storage

C.9.1 General

C.9.1.1 Onsite fire protection water storage shall comply with NFPA 22, except where specifically modified by this standard.

C.9.1.2 The discharge or suction lines from each individual tank or reservoir section shall be sized to deliver the maximum required flow.

C.9.2 Quantity

C.9.2.1 The total supply stored for fire protection purposes shall be sufficient to meet the facility's maximum required fire water demand for the applicable duration specified in this standard. Provide a usable storage capacity equal to 120 percent of the maximum fire protection system demand.

C.9.2.2 In calculating the fire protection water storage requirement, a reduction in storage capacity is acceptable if an adequate replenishment source is available. Factors that shall be evaluated include the reliability of the makeup supply, its sustained flow capacity, its method of operation (automatic or manual), and flow limitations imposed by the capacity of treatment operations.

C.9.3 Replenishment of Storage

C.9.3.1 The water storage shall be capable of being self-replenished to its required volume within 48 hr, during normal domestic and industrial consumption of the supplying utility.

C.9.4 Monitoring

C.9.4.1 The water level shall be remotely monitored in accordance with NFPA 22.

C.9.4.2 In locales subject to freezing, water temperature of above ground storage tanks shall be monitored in accordance with NFPA 22.

APPENDIX D. PROCEDURE FOR PERFORMANCE-BASED FIRE SAFETY DESIGN

D.1 Equivalent Level of Safety and Protection

D.1.1 Any proposed performance-based fire safety design shall demonstrate, to the satisfaction of the AHJ, a level of safety equivalent to the minimum applicable prescriptive requirements of this standard.

D.2 Fire Safety Design Documentation

D.2.1 Any facility designed using performance-based fire safety design methods shall have supporting documentation, including a Fire Protection Engineering Design Brief, a Performance-Based Design Report, Specification, Drawings, Building Operation and Maintenance Manuals, and a Warrant of Fitness.

D.2.2 Fire Protection Engineering Design Brief

D.2.2.1 This is a separate document from the project Basis of Design, prepared by the QFPE and containing general qualitative project information that has been agreed upon by the stakeholders. As a minimum, the design brief includes the project scope; facility and occupant characteristics; project goals and objectives; performance criteria; design fire scenarios; technical references and resources; at least two trial designs; documentation of project design engineers and their qualifications; and a record of agreement on the aforementioned components.

D.2.2.2 Project Scope

D.2.2.2.1 Describe the boundaries of the performance-based design as agreed upon by all stakeholders, and includes realistic and sustainable design information regarding facility use, design purpose and approach, project constraints, and applicable regulations. The project budget shall be clearly defined, so that the limitations and available budget for the proposed solutions can be known.

D.2.2.3 Facility and Occupant Characteristics

D.2.2.3.1 Facility characteristics include an accurate and complete description of the facility construction, operations, systems, physical contents, and occupants. Occupant characteristic description includes the number, age, facility familiarity, gender, occupant loading, and potential for self-preservation of a facility's occupants. Accurately identify any necessary occupant response and interaction needed to provide hazard mitigation or securing of specific process or operational equipment. The occupant load is the maximum number of people realistically expected to occupy an area, as agreed upon by the stakeholders, but not less than the prescriptive occupant load densities of NFPA 101.

D.2.2.4 Goals

D.2.2.4.1 Detail and document the goals of life safety, property protection, and continuity of operations, as defined by NFPA 101, and as additionally defined by the stakeholders. Adequately address the allied fire safety goals of historic preservation and environmental protection from fire protection measures. Identify each goal—realistically, quantifiably, and consistently—throughout the design process. Address each goal by each proposed trial design, regardless of the goal’s individual importance.

D.2.2.5 Objectives and Acceptable Levels of Risk

D.2.2.5.1 Clearly identify stakeholder and design objectives associated with each of the required and user-defined goals.

D.2.2.5.2 Stakeholder objectives are the specific project objectives based on agreed fire safety goals and shall be stated in terms of objectives, functional statements, or performance objectives. Stakeholders’ objectives may be defined in terms of acceptable or sustainable loss or in terms of an acceptable level of risk. Where a design requires the determination of an acceptable level of risk, the AHJ shall ensure that the appropriate stakeholders make the determination. The level of risk may affect an entire base/community/command; therefore, it is essential to ensure the persons determining the level of risk are authorized to do so.

D.2.2.5.3 Design objectives are developed by the design engineer based on the stakeholder objectives, and are stated in engineering terms. Use design objectives as the basis for the development of performance criteria, against which the predicted performance of a trial design will be evaluated.

D.2.2.6 Performance Criteria

D.2.2.6.1 Develop quantitative performance criteria to represent the intent of each design objective and retained prescriptive requirement. Completely describe and document these criteria. The performance criteria reflect the event consequences that need to be avoided to fulfill the design objectives, and include realistic values that are capable of being evaluated or measured using existing engineering tools and methods.

D.2.2.6.2 The performance criteria shall be a combination of the life safety and property protection criterion, along with criteria developed from stakeholder objectives.

Note: NFPA 101 and the SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings provide guidance regarding the development and evaluation of appropriate performance criteria.

D.2.2.7 Design Fire Scenarios

D.2.2.7.1 Document complete descriptions of the reasoning, intent, and details of all required and stakeholder-defined fire scenarios. Use realistic and accurate fire scenarios, with respect to all fire elements, including initial fire location, early rate of growth in fire

severity, and smoke generation. Indicate in the description of the fire scenarios all applicable data, characteristics and assumptions, which shall remain consistent between all fire scenarios. Ensure the omission of certain details will not reduce the reality of the proposed design fire scenario. The QFPE must justify any design fire scenario data that is omitted or cannot be considered by available evaluation methods, and this justification must be noted and approved by the AHJ.

D.2.2.8 Technical References and Resources

D.2.2.8.1 Thoroughly document all technical references, including methodologies, data, and sources. Identify the scientific basis of each engineering calculation method or model. Develop, review, and validate these methods using a consensus, peer-review process, or obtain from resource publications. Where the chosen methods do not permit the incorporation of all data or do not accurately address the incorporation of the data, perform a sensitivity analysis for any design, performance criteria, or fire scenario data that cannot be included or used in the chosen methods. Address all degrees of conservatism and factors of safety, and clearly identify the limitations of the calculation methods. Any method whose outcome is significantly altered by the omission of trial design or fire scenario details shall not be approved, and the omission of critical data is prohibited. The use of proprietary and non-peer reviewed data or source is not permitted. The AHJ shall approve the assessment methods, data, and sources, and confirm the validity of all technical references and resources prior to the design evaluation. Provide the technical reviewer, upon request, any technical references or resources.

D.2.2.8.2 The performance criteria shall be capable of being proved or measured using existing engineering tools and methods.

D.2.2.9 Trial Designs

D.2.2.9.1 Identify and document the general details, including the proposed construction, systems, and protection methods. Include in the documentation the safety factors associated with each trial design, as agreed upon by the stakeholders. Clearly identify the impact of the safety factors so that a reasonable decision can be made as to whether their level is appropriate and sufficient. State any retained prescriptive requirements. Where the interaction of emergency response personnel is a designed protection method, accurately identify and confirm the impact and responsibility of the emergency personnel.

D.2.2.9.2 The performance criteria shall be equally considered and addressed by each trial design against each fire scenario.

D.2.2.9.3 Evaluate each trial design in each fire scenario using the agreed upon performance criteria.

D.2.2.10 Project Team and Qualifications

D.2.2.10.1 Provide the qualifications and contact information for the entire design team, including the QFPE as part of the required documentation. A performance-based,

fire safety design shall be prepared by a QFPE with experience in performance-based fire safety design and specific experience with the engineering tools and methodologies that are anticipated for a particular project.

D.2.3 Performance-Based Fire Safety Design Report

D.2.3.1 This documentation shall be prepared by the QFPE, and used for general guidance. The report shall indicate that the facility was designed using a performance-based fire safety design approach, and shall convey the expected hazards, risks, and system performance over the entire facility life cycle. Include the project scope, design goals and objectives, performance criteria, design fire scenarios, critical design assumptions, critical design features, final design, cost benefit analysis, design engineer's qualifications and capabilities, and data and evaluation method references.

D.2.4 Cost Benefit

D.2.4.1 The performance-based fire safety design report shall indicate how the performance-based design maximizes the cost/benefits ratio while maintaining a level of safety equivalent to the established prescriptive requirements. A performance-based design shall not be undertaken where the prescriptive requirements provide the same level of safety for a lesser cost. Where multiple acceptable proposed design scenarios exist, the cost benefit analysis shall aid in the identification and determination of the best solution.

D.2.5 Building Operations and Maintenance Documentation

D.2.5.1 The QFPE must produce Building Operation and Maintenance documentation for the facility based on the objectives, performance criteria, limitations, and final design. Include all associated specifications and design drawings, and a description of the required maintenance procedures that need to be performed to ensure continued compliance with performance-based fire safety design.

D.2.6 Warrant of Fitness

D.2.6.1 The host-tenant agreement shall require that an annual Warrant of Fitness be prepared for any subsystem, system, or facility that has been designed using performance-based fire safety design methods. Submit this warrant to the AHJ for review and assurance that the current facility characteristics comply with the requirements of the approved performance design. This warrant shall reflect any existing or proposed changes in facility occupancy, operation, features, systems, or emergency personnel response. Where emergency response is a critical element in the accepted fire safety design, reevaluate the design when changes are made to the operational procedures, location, or structure of the emergency response personnel.

D.3 Review of Trial Designs

D.3.1 Provide every performance-based fire safety design with a technical review, and develop a Review Brief. Analyze each trial design to determine the compliance with the required performance criteria. The reviewer shall be an individual capable of providing a

thorough evaluation of the proposed design, and shall have the same minimum qualifications as the QFPE. If the authority responsible for the review of the performance-based fire safety design does not have the required qualifications, they shall direct the designer to submit the design to a qualified third party for review.

D.3.2 Review Brief

D.3.2.1 The Review Brief details how each proposed design compares with the required fire safety goals, objectives and performance criteria. The Brief provides a brief description of the details of each trial design, the technical resources and references, any concerns about steps in the design process and general concerns about the designer's performance-based fire safety design approach. The Brief indicates the acceptability of each design, the reasoning for each acceptance or rejection, and which design is recommended for final acceptance. It shall also discuss levels of confidence over validation. The Brief shall indicate how personnel and property protection are considered, which objectives the design stresses, a statement of what has been checked, the design solution, and the entire design approach and process.

D.3.3 Third Party Review

D.3.3.1 When required, an assigned third party shall provide an objective review of the project, and shall not provide the actual fire safety design. When a third party is reviewing the design, the AHJ remains a stakeholder and ultimately is responsible for the approval of the final design. When a review is assigned to a third party, provide the AHJ with a Review Brief.

D.3.4 Compliant Fire Safety Design

D.3.4.1 A compliant fire safety design shall meet the stated performance criteria when subjected to each design fire scenario. A subsystem, system, or facility design that complies with all requirements of the applicable prescriptive criteria is deemed as satisfying the minimum fire safety goals and objectives, and does not need to be evaluated against the design fire scenarios. Completely evaluate a performance-based fire safety design that incorporates only portions of applicable prescriptive criteria as other portions are not considered to provide the minimum levels of protection.

D.3.4.2 Where a design does not meet the performance criteria, it may be revised and reevaluated. The revision shall not reduce any agreed upon goals, objectives, performance criteria, or level of performance to ensure a proposed design complies with the stated requirements. Criteria may be changed based on additional analysis and the consideration of additional data.