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National Aeronautics and Space Administration
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SAFETY STANDARD FOR FIRE PROTECTION

Measurement System Identification:
Metric

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FOREWORD

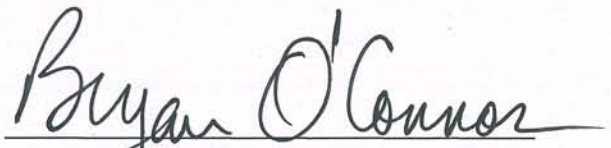
This NASA-STD is published by the National Aeronautics and Space Administration (NASA) to provide a uniform, comprehensive NASA Fire Protection Program. It contains minimum fire safety requirements and guidelines applicable to NASA Headquarters and all NASA Centers.

This NASA-STD is approved for use by NASA Headquarters and NASA Centers, including Component Facilities. This NASA-STD may be applied on contracts per contractual documentation.

This standard expands on the policy and requriements for fire protection listed in Chapter 5 of NPR 8715.3, "NASA General Safety Program Requirements." It is a compilation of pertinent requirements from the Occupational Safety and Health Administration (OSHA), National Fire Protection Association (NFPA), and unique NASA requirements. The intent is to combine the knowledge of all NASA Centers, standardize definitions, and develop uniform requirements. This document is not intended to be a substitute for Federal or applicable State and local government requirements.

Comments and questions concerning the contents of this publication should be referred to the National Aeronautics and Space Administration, Director, Safety and Assurance Requirements Division, Office of Safety and Mission Assurance, Washington, DC 20546.

Requests for information, corrections, or additions to this NASA-STD shall be submitted via "Feedback" in the NASA Technical Standards System at http://standards.nasa.gov or to National Aeronautics and Space Administration, Director, Safety and Assurance Requirements Division, Office of Safety and Mission Assurance, Washington, DC 20546.



November 19, 2008

Bryan O'Connor
Chief, Safety and Mission Assurance

Approval Date

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SAFETY STANDARD FOR FIRE PROTECTION

1. SCOPE

1.1 Purpose

This standard establishes requirements and responsibilities related to NASA's Fire Protection Program. It contains requirements for fire prevention, detection, control, and suppression through engineering, inspection, training, and firefighting.

1.2 Applicability

1.2.1 Compliance with this standard is mandatory for all NASA owned/leased and/or occupied facilities, both new and existing. The individual NASA Centers are responsible for implementation and enforcement. This document establishes ***minimum*** fire and life safety requirements. NASA Centers should apply risk management to processes in order to assess their individual programs and adopt additional requirements as needed. The contracting officer and the responsible NASA Center program fire safety office shall evaluate the need for compliance with this standard at NASA Centers by contractors performing NASA work and establish compliance as a contractual requirement where deemed necessary (Requirement).

1.2.2 This NASA-STD is applicable to all NASA Centers, facilities, and contractor sites.

1.2.3 This NASA-STD has been designed to be cited in contract, program, and other Agency documents as a technical requirement or as a reference for guidance.

1.2.4 Any decision to waive or vary from the requirements in this NASA-STD requires the concurrence of the Chief, Safety and Mission Assurance, Office of Safety and Mission Assurance (Chief/OSMA).

1.2.5 Within this NASA-STD, the word “shall” indicates a mandatory requirement, the word “should” indicates that a statement is strongly recommended for implementation but not required, and the word “may” indicates an optional implementation.

1.3 General Guidance

1.3.1 This document is not a substitute for Occupational Safety and Health Administration (OSHA) requirements. OSHA requirements apply to all NASA operations. This document meets or exceeds Federal OSHA requirements. Some States have their own OSHA programs that must comply with Federal OSHA. It is NASA's policy that where requirements are conflicting, the most stringent applies. All NASA Centers are responsible for keeping up to date with the current Federal and State OSHA requirements that apply to their operations.

1.3.2 Deviations/waivers from the requirements of this document shall be approved as outlined in NPR 8715.3, “NASA General Safety Program Requirements” (Requirement).

1.3.3 Deviations/waivers shall include any alternate or special fire protection criteria or procedures that will be imposed (Requirement).

1.3.4 By agreement with the Director, Facilities Engineering Division, this standard establishes fire protection requirements for NASA facilities.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable Documents

The documents listed in this section contain provisions that constitute requirements of this NASA-STD as cited in the text of Section 4. The latest issuance of cited documents is to be used unless otherwise approved by the assigned Technical Authority. The applicable documents are accessible via the NASA Online Directives Information System at http://nodis3.gsfc.nasa.gov/, or directly from the Standards Developing Organizations (SDO) or other document distributors.

2.1.1 GOVERNMENT DOCUMENTS:

Code of Federal Regulations:

24 CFR 3280	Manufactured Home Construction and Safety Standards
29 CFR 1910	Occupational Safety and Health
29 CFR 1910.22	General Requirements
29 CFR 1910.38	Employee Emergency Plans and Fire Prevention Plans
29 CFR 1910.94	Ventilation
29 CFR 1910.106	Flammable and Combustible Liquids
29 CFR 1910.107	Spray Finishing Using Flammable and Combustible Materials
29 CFR 1910.119	Process Safety Management of Highly Hazardous Chemicals
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.146	Permit Required Confined Spaces
29 CFR 1910.156	Fire Brigades
29 CFR 1910.158	Standpipe and Hose Systems
29 CFR 1910.159	Automatic Sprinkler Systems
29 CFR 1910.161	Fixed Extinguishing Systems/Dry Chemical
29 CFR 1910.162	Fixed Extinguishing Systems/Gaseous Agent
29 CFR 1910.163	Fixed Extinguishing Systems/Water Spray and Foam
29 CFR 1919.164	Fire Detection Systems
29 CFR 1910.165	Employee Alarm Systems
29 CFR 1910.251	Welding, Cutting, and Brazing, Definitions
29 CFR 1910.252	Welding, Cutting, and Brazing, General Requirements
29 CFR 1910.263	Oxygen-Fuel Gas Welding and Cutting

29 CFR 1910.254	Arc Welding and Cutting
29 CFR 1910.1450	Occupational Exposure to Hazardous Chemicals in Laboratories
29 CFR 1960	Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters
29 CFR 1960.12	Construction Work
41 CFR 101	Uniform Federal Accessibility Standards

NASA Documents:

NPR 8715.1	NASA Occupational Safety and Health Programs
NPR 8715.2	NASA Emergency Preparedness Plan Procedural Requirements
NPR 8715.3	NASA General Safety Program Requirements
NPR 8820.2	Facility Project Requirements.
NSS 1740.12	NASA Safety Standard for Explosives, Propellants, and Pyrotechnics (as of Oct 2008, in final review to become NASA-STD 8719.12)

Other Federal Documents:

DOD 6055.9	Department of Defense; Ammunition and Explosives Safety Standard

2.1.2 NATIONAL STANDARDS:

ACI 318	Building Code Requirements for Reinforced Concrete

American National Standards Institute (ANSI)

ANSI A17.1	Safety Code for Elevators and Escalators
ANSI A17.3	Safety Code for Existing Elevators and Escalators
ANSI A117.1	Accessible and Usable Buildings and Facilities
ANSI A119.1	Mobile Homes
ANSI RP7	Practices for Industrial Lighting

National Fire Protection Association (NFPA)

NFPA 1	Fire Prevention Code

NFPA 10	Standard for Portable Fire Extinguishers
NFPA 11	Low-, Medium-, and High-Expansion Foam
NFPA 12	Standard on Carbon Dioxide Extinguishing Systems
NFPA 12A	Standard on Halon 1301 Fire Extinguishing Systems
NFPA 13	Installation of Sprinkler Systems
NFPA 13D	Standard for the Installation of Sprinkler Systems in One- And Two-Family Dwellings and Manufactured Homes
NFPA 13R	Standard for Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height
NFPA 14	Standard for the Installation of Standpipe, Private Hydrants and Hose Systems
NFPA 15	Standard for Water Spray Fixed Systems for Fire Protection
NFPA 16	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 17	Standard for Dry Chemical Extinguishing Systems
NFPA 17A	Standard for Wet Chemical Extinguishing Systems
NFPA 20	Standard for the Installation of Stationary Fire Pumps for Fire Protection
NFPA 22	Standard for Water Tanks for Private Fire Protection
NFPA 24	Installation of Private Fire Service Mains and Their Appurtenances
NFPA 25	Inspection Testing and Maintenance of Water-Based Fire Protection Systems
NFPA 30	Flammable & Combustible Liquids Code
NFPA 31	Standard for the Installation of Oil-Burning Equipment
NFPA 33	Standard for Spray Application Using Flammable or Combustible Materials
NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 45	Standard on Fire Protection for Laboratories Using Chemicals
NFPA 51B	Standard for Fire Prevention During Welding, Cutting and Other Hotwork
NFPA 54	National Fuel Gas Code
NFPA 58	Liquefied Petroleum Gas Code

NFPA 59A	Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)
NFPA 68	Guide for Venting of Deflagrations
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm Code
NFPA 75	Standard for the Protection of Electronic Computer/Data Processing Equipment
NFPA 77	Recommended Practice on Static Electricity
NFPA 80	Standard for Fire Doors, Fire Windows
NFPA 80A	Recommended Practice for Protection of Buildings from Exterior Fire Exposures
NFPA 86	Standard for Ovens and Furnaces
NFPA 88B	Standard for Repair Garages
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 91	Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids
NFPA 92A	Recommended Practice for Smoke-Control Systems
NFPA 92B	Guide for Smoke Management Systems in Malls, Atria, and Large Areas
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
NFPA 101	Life Safety Code
NFPA 101A	Guide on Alternative Approaches to Life Safety
NFPA 170	Fire Safety and Emergency Symbols
NFPA 204	Guide for Smoke and Heat Venting
NFPA 211	Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning, Appliances
NFPA 214	Standard on Water-Cooling Towers
NFPA 221	High-Challenge Fire Walls, Fire Walls, and Fire Barrier Walls
NFPA 241	Standard for Safeguarding Construction, Alteration, and Demolition Operations

NFPA 251	Standard Methods of Tests of Fire Endurance of Building Construction and Materials
NFPA 253	Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source
NFPA 255	Standard Method of Test of Surface Burning Characteristics of Building Materials
NFPA 256	Standard Methods of Fire Tests of Roof Coverings
NFPA 291	Fire Flow Testing and Marking of Hydrants
NFPA 307	Marine Terminals, Piers, and Wharves
NFPA 402	Guide for Aircraft Rescue and Fire Fighting Operations
NFPA 403	Standard for Aircraft Rescue and Fire Fighting Services at Airports
NFPA 405	Recurring Proficiency of Airport Fire Fighters
NFPA 409	Standard on Aircraft Hangers
NFPA 410	Aircraft Maintenance
NFPA 412	Standard for Evaluating Aircraft Rescue and Fire Fighting Foam Equipment
NFPA 414	Standard for Aircraft Rescue and Fire Fighting Vehicles
NFPA 418	Heliports
NFPA 424	Airport/Community Emergency Planning
NFPA 450	Emergency Medical Services and Systems
NFPA 471	Recommended Practice for Responding to Hazardous Materials Incidents
NFPA 472	Standard for Professional Competence of Responders to Hazardous Materials Incidents
NFPA 473	Standard for Competencies for EMS Personnel Responding to Hazardous Materials Incidents
NFPA 550	Guide to the Fire Safety Concepts Tree
NFPA 551	Evaluation of Fire Risk Assessments
NFPA 600	Standard on Industrial Fire Brigades
NFPA 701	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
NFPA 704	Identification of the Hazards of Materials

NFPA 750	Water Mist Fire Protection Systems
NFPA 780	Installation of Lightning Protection Systems
NFPA 801	Facilities Handling Radioactive Materials
NFPA 820	Fire Protection in Wastewater Treatment and Collection Facilities
NFPA 850	Electric Generating Plants
NFPA 853	Stationary Fuel Cell Power Systems
NFPA 901	Standard Classifications for Incident Reporting and Fire Protection Data
NFPA 902	Fire Reporting Field Incident Guide
NFPA 903	Fire Reporting Property Survey Guide
NFPA 906	Guide for Fire Incident Field Notes
NFPA 914	Fire Protection in Historic Structures
NFPA 921	Guide for Fire and Explosion Investigations
NFPA 1001	Standard for Fire Fighter Professional Qualifications
NFPA 1002	Standard on Fire Apparatus Driver/Operator Professional Qualifications
NFPA 1003	Standard for Airport Fire Fighter Professional Qualifications
NFPA 1006	Rescue Technician Professional Qualifications
NFPA 1021	Standard for Fire Officer Professional Qualifications
NFPA 1031	Standard for Professional Qualifications for Fire Inspector and Plan Examiner
NFPA 1033	Standard for Professional Qualifications for Fire Investigator
NFPA 1035	Standard for Professional Qualifications for Public Fire and Life Safety Educator
NFPA 1041	Standard for Fire Service Instructor Professional Qualifications
NFPA 1051	Wildland Fire Fighter Professional Qualifications
NFPA 1061	Public Safety Telecommunicator Qualifications
NFPA 1071	Emergency Vehicle Technicians
NFPA 1081	Industrial Fire Brigade Member Professional Qualifications
NFPA 1123	Code for Fireworks Display
NFPA 1124	Code for the Manufacture, Transportation, and Storage of Fireworks and Pyrotechnic Articles

NFPA 1142	Water Supplies for Suburban and Rural Fire Fighting
NFPA 1143	Wildland Fire Management
NFPA 1144	Protection of Life and Property from Wildfire
NFPA 1145	Class A Foams
NFPA 1150	Foam Chemicals for Fires in Class A Fuels
NFPA 1201	Standard for Developing Fire Protection Services for the Public
NFPA 1221	Standard for the Installation, Maintenance, and Use of Public Fire Service Communication Systems
NFPA 1250	Emergency Service Organization Risk Management
NFPA 1401	Recommended Practice for Fire Service Training Reports and Records
NFPA 1402	Building Fire Service Training Centers
NFPA 1403	Standard on Live Fire Training Evolutions
NFPA 1404	Standard for a Fire Department Self-Contained Breathing Apparatus Program
NFPA 1405	Guide for Land-Based Fire Fighters Who Respond to Marine Vessel Fires
NFPA 1410	Standard on Training for Initial Emergency Scene Operations
NFPA 1451	Fire Service Vehicle Operations Training Program
NFPA 1452	Training Fire Department Personnel to Conduct Dwelling Fire Safety Surveys
NFPA 1500	Standard on Fire Department Occupational Safety and Health Program
NFPA 1521	Standard for Fire Department Safety Officer
NFPA 1561	Standard on Fire Department Incident Management System
NFPA 1581	Standard on Fire Department Infection Control Program
NFPA 1582	Standard on Medical Programs for Fire Departments
NFPA 1583	Health-Related Fitness for Firefighters
NFPA 1584	Rehabilitation of Members Operating at Incident Scene Operations and Training Exercises
NFPA 1600	Disaster/Emergency Management
NFPA 1620	Pre-Incident Planning
NFPA 1670	Operations and Training for Technical Rescue Incidents

NFPA 1851	Structural Fire Fighting Protective Ensembles
NFPA 1852	Open-Circuit Self-Contained Breathing Apparatus (SCBA)
NFPA 1901	Standard for Automotive Fire Apparatus
NFPA 1906	Wildland Fire Apparatus
NFPA 1911	Standard for Service Tests of Fire Pump Systems on Fire Apparatus
NFPA 1912	Fire Apparatus Refurbishing
NFPA 1914	Standard for Testing Fire Department Aerial Devices
NFPA 1915	Fire Department Preventive Maintenance
NFPA 1931	Standard on Design of and Design Verification Tests for Fire Department Ground Ladders
NFPA 1932	Standard on Use, Maintenance and Service Testing of Fire Department Ground Ladders
NFPA 1936	Powered Rescue Tools
NFPA 1951	Protective Ensemble for USAR Operations
NFPA 1961	Standard for Fire Hose
NFPA 1962	Standard for the Care, Use and Service Testing of Fire Hose, Including Couplings and Nozzles
NFPA 1963	Standard for Fire Hose Connections
NFPA 1964	Standard for Spray Nozzles (Shutoff and Tip)
NFPA 1965	Fire Hose Appliances
NFPA 1971	Standard on Protective Ensemble for Structural Fire Fighting and Proximity Fire Fighting
NFPA 1977	Protective Clothing and Equipment for Wildland Fire Fighting
NFPA 1981	Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services
NFPA 1982	Standard on Personal Alert Safety Systems (PASS)
NFPA 1983	Standard on Fire Service Life Safety Rope and Equipment for Emergency Services
NFPA 1989	Breathing Air Quality for Fire and Emergency Services Respiratory Protection
NFPA 1991	Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies

NFPA 1992	Standard on Liquid Splash-Protective Clothing for Hazardous Materials Emergencies
NFPA 1994	Protective Ensembles for Chemical/Biological Terrorism Incidents
NFPA 1999	Standard on Protective Clothing for Emergency Medical Operations
NFPA 2001	Clean Agent Fire Extinguishing Systems
NFPA 2010	Fixed Aerosol Fire-Extinguishing Systems

National Institute of Standards & Technology

NIST Technical Note 708	Smoke Density Chamber

National Consensus Standards

Industrial Ventilation: A Manual of Recommended Practice; 25th Edition, American Conference of Governmental Industrial Hygienists

3. DEFINITIONS AND ACRONYMS

3.1 Definitions

Adequate: When referring to fire protection or life safety, the safeguards necessary to provide facilities and their occupants with protection against all known or recognized hazards.

Authority Having Jurisdiction (AHJ): Refers to the individual(s) at the NASA Centers and Headquarters responsible for implementing the fire safety provisions of NPR 8715.3, "NASA General Safety Program Requirements," and with the authority for "approving/concurring in" associated installations, procedures, and equipment.

Classification of Hazard Contents: Hazard contents of any building or structure are classified as low, ordinary, or high.

- Low Hazard Contents: Such low combustibility that no self-propagating fire therein can occur.
- Ordinary Hazard Contents: Likely to burn with moderate rapidity or to give off a large volume of smoke.
- High Hazard Contents: Likely to burn with extreme rapidity or from which explosions are likely.

Classification Of Occupancies For Fire Suppression: Occupancy classifications for this standard relate to sprinkler installations and their water supplies only. They are not intended to be a general classification of occupancy hazards. For purposes of determining required fire protection systems, occupancies will be protected according to their degree of hazard. Principal classifications, with typical examples, are listed under each category. (Note: The classification of unlisted occupancies will be based on an analysis of the hazards and a comparison with the definition and examples of listed occupancies).

- *Light Hazard Occupancies*: Occupancies or portions of other occupancies where the quantity and combustibility of contents are low and fires with relatively low rates of heat release are expected. The facilities of NASA typically exceed this classification.
- *Ordinary Hazard Occupancies (Group 1)*: Occupancies or portions of other occupancies where combustibility of contents is low, quantity of combustibles is moderate, stock piles of combustibles do not exceed a height of 8 feet (2.44 meters), and fires with moderate rates of heat release are expected. Modest, scattered amounts of flammable liquids in closed containers are allowed in quantities up to 20 gallons (75.7 liters). The following are examples of Ordinary Hazard Occupancies (Group 1).
  - Auditoriums
  - Automobile parking garages
  - Cafeteria food preparation areas
  - Cafeteria seating areas
  - Classrooms
  - Clinics
  - Computer rooms
  - Drafting rooms and map making rooms
  - Electronic laboratories not normally using flammable liquids
  - File Rooms (files in metal cabinets)

- Mechanical/electrical equipment room
- Museums
- Offices
- Small storage rooms
- Welding shops

- *Ordinary Hazard Occupancies (Group 2)*: Occupancies or portions of other occupancies where quantity and combustibility of contents are moderate, stockpiles do not exceed 12 feet (3.66 meters), and fires with a moderate rate of heat release are expected. Moderate, scattered amounts of flammable liquids in closed containers are allowable in quantities up to 50 gallons (189.3 liters). Small amount of flammable liquids may be exposed as required by normal operations. The following are examples of Ordinary Hazard Occupancies (Group 2).
  - Libraries
  - Mercantile
  - Magnetic tape libraries (tape in plastic cases and/or on plastic reels)
  - Model preparation areas
  - Piers and Wharves
  - Printing plants using inks having flash points at/or above 100 °F (37.9 °C)
  - Transformer vaults
  - Trash rooms
  - Vehicle repair garages
  - Warehouses (storage of noncombustible contents)
  - Woodworking shops
- *Extra Hazard Occupancies*: Occupancies or portions of other occupancies where the quantity and combustibility of contents are very high or where flammable and combustible liquids, dust, lint, or other materials are present, introducing the probability of rapidly developing fires with high rates of heat release. The following are examples of Extra Hazard Occupancies:
  - Group 1: Aircraft hangars; Chemical laboratories; Engine test cells; Flammable and combustible liquids storage; Printing plants (using inks having flash points below I00 °F (37.9 °C); Upholstering with plastic foams; Warehouse with plastic foams; Warehouse (combustible contents stored not greater than 15 feet (4.57 meters) in piles of 12 feet (3.66 meters) in racks
  - Group 2: Flammable liquid spraying; Flow coating; Mobile home or modular building assemblies (where finished enclosure is present); Combustible interiors ; Open oil quenching; Plastics processing; Solvent cleaning; Paint dipping
- *Special Occupancies*: Special Occupancies are facilities or areas which cannot be assigned a specific classification because of special protection requirements (refer to Chapter 10). This classification includes, but is not restricted to, the following occupancies.
  - High bay/payload processing areas
  - Launch facilities
  - Missile assembly areas
  - Ordnance storage/processing areas
  - Warehouses (high piled or high rack storage)
  - Combustible Liquid: A liquid having a flash point at or above I00 °F (37.9 °C)

Cost-Benefit Analysis: A procedure in which the present value of future expenditures associated with the installation and maintenance of a fire 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 of fire protection systems and must be limited to those situations where the possibility of loss of human life is low.

Essential Electronic Equipment: Equipment that meets one or more of the following criteria:

- Is directly related to the NASA mission and which, if lost, would seriously impact the ability of NASA to perform its mission.
- Is necessary to the safety and health of personnel.
- Is essential to the security or health of the Nation.
- Performs an operation that must be continued to completion without termination.
- Performs an operation which could be performed by substitute methods, but where the substitute methods would involve significant additional expenditures for personnel, facilities, and/or equipment or an unacceptable length of time.
- Has a high monetary value to the Federal Government (greater than $1 million). Electronic equipment includes all equipment and devices that are electrically powered and use the emission of electrons in vacuum tubes, cathode ray tubes, photoelectric cells, transistors, diodes, integrated circuits, and other solid state devices. This includes, but is not limited to, electronic digital and analog computers, telephone communications and switching equipment, and other electronic equipment used for statistics, communication, process control, measurement, guidance, simulation, or supervisory operations.

Egress: A continuous and unobstructed way of travel from any point in a building or structure to a public way. It consists of three separate and distinct parts (a) the exit access, (b) the exit, and (c) the exit discharge. A means of egress comprises the vertical and horizontal ways of travel and includes intervening room spaces, doorways, hallways, corridors, passageways, ramps, stairs, lobbies, horizontal exits, courts, and sidewalks.

Equivalent/Equivalency: When referring to fire protection and life safety, the technology, systems, devices, and designs that, while not meeting the letter of code provisions, will provide comparable levels of fire safety. This determination is to be made by the AHJ after a complete analysis of hazardous conditions and required levels of safety.

Facility: Buildings, structures, and other real property improvements including utilities and collateral equipment.

Fire Partition: A physical barrier to prevent the horizontal spread of fire between areas within buildings, constructed of materials sufficient to achieve a 1- or 2-hour fire-resistance rating as determined by NFPA 251. The barrier must extend from the floor to the floor/roof above the area involved (partitions may extend to a listed membrane ceiling at the discretion of the AHJ). Large openings in partitions must be protected by listed fire doors or fire dampers. "Poke-through" openings must be sealed with noncombustible materials listed for that use. Fire partitions are not to be confused with fire walls which have a greater hourly fire resistance and are capable of independent support. (See definition of firewall.)

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 Wall: A physical barrier to prevent the horizontal spread of fire between buildings, constructed of materials sufficient to achieve at least a 3 or 4 hour fire resistance rating as determined by NFPA 251.

Flammable Liquid: A liquid having a flash point below 100 °F (37.9 °C) and having a vapor pressure not exceeding 40 pounds per square inch (absolute (275.79 kilopascal) at I00 °F (37.9° C)) or a combustible liquid heated to, or above, its flash point.

Fuel Load (a.k.a. Fire Load): Expected maximum quantity of combustible material in a given fire area. In normal facilities, the combustible structural elements and the combustible contents contained within that area. Fire load is usually expressed as weight of combustible material per square foot of area.

Furnishings: Consists of all movable articles, such as tables, chairs, desks, bookcases, draperies, cabinets, and decorations, required for use or as an ornament in a 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 an interior finish. For purposes of controlling the hazards associated with combustible interior finish, the following classification system applies to Class A Materials having a Flame Spread Index not exceeding 25 and a Smoke Developed Index not exceeding 450, as determined by the test method described in NFPA 255. Carpets and rugs will also be Class A, if meeting the following criteria:
  - It has a value of CRF of 0.50 or above, as determined by the method described in NFPA 253.
  - It has a maximum specific optical density of not over 450 (flaming and non-flaming) as determined in NIST Technical Note 708 (Smoke Density Chamber). The critical specific optical density of 16 will not be reached in less than 30 seconds in both the flaming and non-flaming combustion.
- Class B - Material having a Flame Spread Index between 26 and 75 and a Smoke Developed Index not exceeding 200, as determined by NFPA 255. Carpets and rugs will also be Class B if meeting the following criteria:
  - CRF between 0.25 and 0.50, as determined by the method described for Class A carpeting, and
  - Maximum specific optical density of not over 450, as described above.
- Class C - Materials having a Flame Spread Index between 76 and 200 and a Smoke Developed Index not exceeding 450, as determined by NFPA 255. Carpets and rugs will also be Class C if they meet the following criteria.
  - Department of Commerce Standard for the Surface Flammability of Carpets and Rugs, FF 170, "Pill Test"
  - Maximum specific optical density of not over 450, as described above

Listed Or Approved: When referring to a material or device used in conjunction with fire protection, a product that has been tested by a recognized and independent research laboratory (e.g., Underwriters Laboratories and Factory Mutual), in accordance with generally accepted and

standardized test methods and verified that it will perform adequately and dependably under adverse conditions.

Means of Egress: A means of egress is 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.

Noncombustible: Structures in which the structure itself (exclusive of trim, interior finish, and contents) is noncombustible but not fire-resistive. Common forms include exposed steel beams and columns, and masonry or metal walls.

Occupied Facility: A building or facility occupied by persons on a regular basis and not used for sleeping purposes.

Open Plan: When referring to office space, it denotes large floor areas (greater than 3,000 square feet [279 square meters]) characterized by the lack of fixed, ceiling-high partitions and conventional doorways. Individual workstations are identified by the arrangement of desks, chairs, files, bookcases, and movable partitions. The hazard from a fire safety standpoint is due to the ill-defined nature of means of egress and the lack of a significant physical barrier against the spread of smoke and fire, thus magnifying potential loss.

Ordinary: Masonry exterior load-bearing walls or load-bearing portions of exterior walls that are of noncombustible construction.

Protected Noncombustible: Noncombustible structures enclosed with partitions having a minimum of 1 hour fire-resistance rating.

Senior Fire Officer: A fire department’s Fire Chief or his/her designee.

Shall: The word "shall" indicates that the requirement is mandatory and must be followed.

Should: The word "should" indicates that the rule is a recommendation, the advisability of which depends on the facts in each situation.

Smoke Removal System: An interconnected system of fans, ducts, dampers, and automatic and manual controls designed to effectively remove smoke and other products of combustion from select facility areas. Its use is primarily intended to compensate for the lack of a readily available means to ventilate buildings during and after structural fires, such as in below-grade or windowless building areas.

3.2 Acronyms

ac	alternating current
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AFFF	Aqueous Film Forming Foam
AGA	American Gas Association

AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
ARFF	Aircraft rescue and fire-fighting
ASTM	American Society for Testing and Materials
°C	degree Celsius
CoF	Construction of Facilities
CFR	Code of Federal Regulations
CRF	Critical Radiant Flux
dc	direct current
DoD	Department of Defense
EMS	Emergency Medical Service
°F	degree Fahrenheit
FAA	Federal Aviation Administration
FEH	Facilities Engineering Handbook
FDC	Fire Department Connection
FM	Factory Mutual (Data Sheets)
ft	feet
sq ft	square feet
FSI	Flame Spread Index
gal	gallons
gpm	gallons per minute
GSA	General Services Administration
HAD	Heat actuated device
HSPD-5	Homeland Security Presidential Directive
IFSTA	International Fire Service Training Association
in	inches
kg	kilograms
kPa	kilopascal
KVA	kilovoltampere

lb	pounds
L	liters
L/min	liters per minute
m	meters
m^2	square meters
min	minutes
mm	millimeter
MMH	Monomethylhydrazine
NASA	National Aeronautics and Space Administration
NEC	National Electrical Code
NFC	National Fire Code
NFPA	National Fire Protection Association
NIMS	National Incident Management System
NIST	National Institute of Standards and Technology (Formerly the National Bureau of Standards)
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NTIS	National Technical Information Service
OS&Y	Outside Screw and Yoke
OSHA	Occupational Safety and Health Administration
PA	picoampere
PIV	Post Indicator Valve
PPE	personal protective equipment
psi	pounds per square inch
SDI	Smoke Development Index
SPECSINTACT	Specifications kept intact (guide specification system)
SR&QA	Safety, Reliability, and Quality Assurance
UDMH	Unsymmetrical Dimethylhydrazine
UL	Underwriters Laboratories

4. FIRE PROTECTION REQUIREMENTS

4.1 Responsibilities

NASA responsibilities for fire protection (Director, Safety and Assurance Requirements Division, NASA Center Directors, the NASA Authority Having Jurisdiction) are documented in NPR 8715.3, NASA General Safety Program Requirements, Chapter 5, Fire Safety.

4.2 Legal Requirements, Codes, and Standards

4.2.1 The following requirements shall apply to NASA's fire protection program; where requirements are conflicting the most stringent applies (Requirement).

4.2.1.1 Code of Federal Regulations (CFR), latest revision.

4.2.1.2 NPR 8820.2, “Facility Project Implementation Guide,” latest revision.

4.2.1.3 National Fire Protection Association (NFPA) Fire Codes, latest revision (Codes and Standards only). The use of NFPA Recommended Practices (Appendices) contained in the NFC is encouraged, but is not mandatory unless otherwise specified in this document. The NFPA Fire Codes provide a minimum standard of protection (Requirement).

> *Note: All NASA Centers assess their individual programs and develop additional requirements as needed.*

4.2.1.4 Public Law 100-678, "Public Buildings Amendments of 1988.”

> *Public Law 100-678 requires all federal agencies to follow the latest editions of nationally recognized fire and life safety codes. It also requires federal agencies to give local fire protection officials the opportunity to review and comment on projects for compliance with local regulations and compatibility with local fire fighting practices. All reviews by local fire protection officials are to be at no cost to the Government. Designers should meet with local fire authorities during early stages of design to incorporate local requirements to the extent practical; however, recommendations made by local officials should be reviewed for adequacy, cost, and nationally accepted practice before being incorporated into project design.*

4.2.1.5 NPR 8715.3, NASA General Safety Program Requirements.

4.2.1.6 Factory Mutual (FM) Data Sheets and Approval Guides, when required by the AHJ.

4.2.1.7 Individual NASA Center-unique requirements.

4.3 Basis for Determining the Level of Fire Protection for Specialized Facilities

Due to the unique nature of NASA's mission, a number of specialized facilities and operations are required. In some cases, conventional fire protection doctrine and existing codes and standards may not be appropriate. Nevertheless, adequate safeguards are to be provided for all facilities and operations (see Section 4.2 for detailed definitions). This can be accomplished by applying the following principles:

4.3.1 Analysis - An analysis shall be conducted to identify all fire hazards and accomplish the following (Requirement).

4.3.1.1 Elimination of hazards - Significant hazards shall be eliminated or reduced to acceptable risk levels (Requirement). (See NPR 8715.3, NASA General Safety Program Requirements.)

4.3.1.2 Relocation of hazards - Where the hazard cannot be eliminated or reduced, it shall be relocated to an area less threatening to people and property as directed by the AHJ (Requirement).

4.3.1.3 Isolation of hazards - Where the hazard cannot be eliminated or removed, it shall be isolated within the facility so as not to pose a danger to the remainder of the structure or its occupants (Requirement).

4.3.1.4 Protection from hazards

4.3.1.4.1 Where the hazard cannot be eliminated, relocated, or isolated, protection shall be provided to ensure adequate levels of human and structural safety (Requirement).

4.3.1.4.2 In the event of a fire occurrence, the occupants of the facility shall be provided with protection to enable them to leave the area safely, with the structure protected to ensure its continued integrity (Requirement).

4.3.2 Consultation - Final decisions regarding fire safety shall be made after consultation with the AHJ (Requirement).

4.4 Required Acceptance Inspection and Tests of Fire Protection and Life Safety Systems

4.4.1 The installing contractor shall submit to the AHJ and to the NASA contracting officer a written statement, indicating that the system has been installed and performs in accordance with design drawings and specifications (Requirement).

4.4.2 The certification in 4.4.1 shall be maintained as part of the system documentation and records (Requirement).

4.4.3 All inspections and tests shall be conducted according to appropriate codes and as specified in contract documents (Requirement). Failure to meet the criteria is sufficient justification for refusal to grant final payment to the installation contractor. In addition, failure to meet the criteria also may represent sufficient justification for refusal to allow permanent occupancy of the facility subject to a decision by the AHJ.

4.4.4 The contract or bid package shall include a requirement for an acceptance test (Requirement).

4.4.4.1 Following installation, the contractor shall verify the proper functioning of the fire protection system prior to scheduling the final acceptance test (Requirement).

4.4.4.2 The final acceptance test shall be conducted by a representative of the installing contractor and witnessed by the AHJ or his/her designee, the NASA contracting officer, and other interested parties (Requirement).

4.5 Equivalency

4.5.1 Concept - The concept of equivalency (see Section 3) is intended to be applied to new or existing facilities. Sound fire protection judgment is necessary to assure that adequate levels of fire and life safety are achieved. Nothing in this Standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard. The AHJ shall review and formally approve equivalency proposals (Requirement).

4.5.2 Guidelines - Guidelines set forth in NFPA 101A, Alternative Approaches to Life Safety, or a performance-based fire safety design as set forth below shall be used by the AHJ in determining acceptable levels of equivalency (Requirement):

4.5.2.1 It is permissible that performance-based fire safety design methods be applied to the renovation, restoration, remodeling, or modernization of existing facilities to address the evaluation of a subsystem, system, or complete building when it is not possible to meet the provided prescriptive requirements for new construction. New facilities for which established prescriptive criteria exist are not to be permitted to use performance-based fire and life safety design methods. The use of performance-based fire safety design methods is only to be permitted upon authorization by the AHJ for new essential electronic areas or unique facilities, where the user mandates requirements and objectives that are not addressed by established prescriptive requirements of national codes or by NASA standards. Performance-based fire safety design methods may not be used to eliminate required exiting requirements of NFPA 101, nor to eliminate automatic sprinkler systems required by NASA.

4.5.2.2 If performance-based fire safety design is used or permitted by the AHJ, the following requirements apply:

4.5.2.2.1 The performance-based fire safety design approach of the Society of Fire Protection Engineers (SFPE), Introduction to Performance-Base Fire Safety shall be used or an equivalent proven method by any other federal agency (Requirement).

4.5.2.2.2 A fire protection engineer (a licensed professional engineer in the principles and practices of fire protection engineering in the state of the NASA facility) shall perform the performance-based fire safety design (Requirement).

4.5.2.2.3 If the state does not offer a professional engineering exam in the principles and practices of fire protection engineering, the AHJ should review and accept the qualifications of the person submitting the design.

4.5.3 Acceptance - Alternative systems, methods, or devices approved as equivalent by the AHJ shall be recognized as being in compliance with this Standard (Requirement).

5. SITE PLANNING AND CIVIL ENGINEERING CRITERIA

5.1 Siting of Facilities

5.1.1 Exposure Protection Factors shall be used - For minimum fire separation distance between buildings, see NFPA 80A and the applicable building codes (Requirement).

5.1.2 Explosive/Propellant Operations - For facilities that contain, or are exposed to, explosive/propellant operations, the siting distances shall be as prescribed in NASA-STD-8719.12, NASA Safety Standard for Explosives, Propellants, and Pyrotechnics (Requirement).

5.1.3 Trailers and mobile home units shall be located at least 25 feet (7.62 meters) from permanent buildings and at least 25 feet (7.62 meters) apart, unless joined to form a single complex (Requirement).

5.2 Water Supply Requirements for Fire Protection

5.2.1 Water Supply - Water supply shall comply and be capable of meeting both fire protection and domestic demand for that area (Requirement).

5.2.2 Mission essential/critical facilities or areas shall have a looped or "gridded" supply system (Requirement).

5.2.3 Water Storage Capability - The design and installation of water storage tanks shall comply with NFPA 22 (Requirement).

5.2.4 Pump Requirements - 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 8.16 of this standard (Requirement).

5.3 Water Distribution System Criteria

5.3.1 General

5.3.1.1 The design of the water distribution system shall be such that a single electrical or mechanical failure, obstruction, mishap, or other event will not seriously impair the system's capability to deliver an adequate water supply for fire suppression (Requirement).

5.3.1.2 The installation of "dead-end" water mains shall be avoided in favor of a looped distribution system (Requirement).

5.3.1.3 An appropriate number of sectional control valves are required to limit damage affected areas. These valves shall be prominently identified and supervised in the open position by the use of locks or electronic supervisory (tamper) switches (Requirement).

***EXCEPTION**: Underground gate valves with road boxes.*

5.3.1.4 Future growth shall be reviewed (See NFPA 24) (Requirement).

5.3.2 Fire Hydrants - Hydrants shall be selected based on local site conditions (Requirement) and be located adjacent to paved areas as follows:

5.3.2.1 Not over 400 feet (121.9 meters) apart in built-up areas and placed so that every permanent facility can be served from not less than two hydrants using not more than 300 feet (91.4 meters) of hose per hydrant outlet (Requirement).

5.3.2.2 Not less than 40 feet (12.19 meters) from a building (Requirement).

5.3.2.3 Not less than 3 feet (0.9144 meters) nor more than 7 feet (2.134 meters) from the roadway shoulder or curb line (Requirement).

5.3.2.4 Not less than 7 feet (2.134 meters) from an obstruction (Requirement).

5.3.2.5 With at least 18 inches (458 millimeters) between the lowest hydrant outlet and grade and not more than 4 feet (1.219 meters) between the operating nut and grade (Requirement).

5.3.2.6 With the principal discharge facing the nearest roadway (Requirement).

5.3.2.7 Where deemed necessary by the AHJ (Requirement).

5.3.2.8 Marked with a blue reflective marker in the roadway as deemed necessary by the AHJ to aid in locating at night (Requirement). In areas that are susceptible to the accumulation of snow, a permanent marker attached to the hydrant can be substituted. This marker should extend to approximately three feet above the hydrant and be flexible to be relocated during an emergency.

5.3.3 A hydrant isolation valve shall be installed (Requirement).

5.3.3.1 The valve shall be an underground gate with a road box and be located at least 5 feet (1.524 meters) from the centerline of the hydrant (Requirement).

5.3.4 Hydrant Specifications

5.3.4.1 Hydrants shall be equipped with one 4.5 inch (114 millimeters) and two 2.5 inch (63.3 millimeters) connections with American National Fire Hose Connection Screw Threads or per local requirements (Requirement).

5.3.4.2 Hydrants shall be of greater than 500 gallons per minute (1,892.5 liters per minute) capacity and comply with NFPA 24 (Requirement).

5.3.4.3 Painting shall be in accordance with NFPA 291 or the current local practice (Requirement).

5.3.4.3.1 In either case, the hydrant tops and caps shall be painted to denote flow capacity of the hydrant (Requirement).

5.3.4.4 Hydrants shall, as a minimum, be connected to a 6 inch (153 millimeter) supply line (Requirement).

5.3.4.5 In situations where a hydrant cannot be located away from traffic (e.g., loading dock and warehouse areas), it shall be equipped with sturdy barriers for mechanical protection (Requirement).

5.3.4.5.1 The arrangement of the barriers shall not interfere with the connection to/or operation of the hydrant (Requirement).

5.3.5 Meters - Where meters are installed in firewater distribution systems, they shall be FM or certified testing laboratory approved or Underwriters Laboratories, Inc. (UL), listed fire flow meters (Requirement).

5.3.5.1 Notification and coordination with the local fire department (and water department where applicable) shall be accomplished prior to installing any meters on the distribution system (Requirement).

5.3.6 Flow Testing

5.3.6.1 At least biennially, an appropriate number of hydrant flow tests shall be conducted in accordance with NFPA 291 to develop a water supply profile for the NASA Center (Requirement). The intent is to verify the ability of the system to deliver the required fire flows at various locations and to discover any degradation of the system due to sedimentation or inadvertent valve closures.

5.3.6.2 Hydrants shall be flushed in accordance with NFPA 25 at least once per year to ensure proper operation and drainage (Requirement).

6. ARCHITECTURAL FIRE PROTECTION CRITERIA

6.1 Life Safety Provisions

6.1.1 All NASA buildings shall comply with the following:

6.1.1.1 Appropriate provisions of NFPA 101 (Requirement).

6.1.1.2 Applicable State and local building codes (Requirement).

6.1.2 Egress routes and exits shall comply with the requirements of NFPA 101 (Requirement).

6.1.2.1 Hallways, corridors, and doorways shall be kept clear at all times (this includes copiers, file cabinets, paper storage, pallets, furniture, lockers, or other material or equipment) (Requirement).

6.1.2.2 Equipment or other objects which protrude into exit routes shall not be installed without prior approval of the AHJ or authorized designee (Requirement).

6.1.2.3 Stairwell doors, fire doors, and other egress doors shall not be blocked or left open (Requirement).

6.1.2.4 Emergency egress and fire doors equipped with an automatic closure mechanism or latching device shall not be rendered inoperative (Requirement).

6.1.3 Rooms, corridors, fire doors, and the like shall not be altered in any manner that would reduce the required level of fire safety (Requirement).

6.1.3.1 Modifications shall be subjected to review/approval by the AHJ or authorized designee (Requirement).

6.1.4 Normally secured rooms shall be placarded with an access contact phone/location or rendered visible to emergency response personnel from the corridor via a vision panel (Requirement).

6.1.4.1 Where a vision panel is installed for this or any other purpose, it shall be maintained free of obstruction (i.e., paint, posters) (Requirement).

6.1.5 The use of exit signs containing Tritium or any other radioactive material must be approved by the AHJ. The AHJ will assure coordination with the installation Radiation Safety Officer (Requirement).

6.2 Segregation of Hazards

6.2.1 A room/area within a facility may present a significantly greater hazard to the facility or its occupants than may be indicated by the occupancy hazard classification of the overall facility. Such rooms/areas shall be separated from the remainder of the structure by a fire partition and/or suppression system according to the following general rules (Requirement):

6.2.1.1 If the room/area to be isolated falls within an occupancy hazard classification, one severity level above that of the overall facility (Requirement). For example, an Ordinary Hazard

Occupancy (Group 2) library in an Ordinary Hazard (Group 1) office building requires separation by a minimum 1-hour fire partition or automatic sprinkler protection.

6.2.1.2 If the room/area to be isolated falls within an occupancy hazard classification, two or more severity levels above that of the overall facility (Requirement). For example, an Extra Hazard Occupancy (Group 1) chemical laboratory in an Ordinary Hazard Occupancy (Group 1), office building requires separation by a minimum 2-hour fire partition or 1-hour separation with automatic sprinkler protection. (Reference Section 3 for detailed definitions.)

6.2.1.3 If a room/area contains high value items or is the location of a critically important operation, it shall be separated from the remainder of the structure by a fire partition having a fire-resistance rating of at least 1 hour and protected by an automatic sprinkler system (Requirement). Criticality is determined and documented by the AHJ.

6.3 Open Plan Office Space

Open plan office space denotes floor areas characterized by the lack of fixed ceiling-high partitions and conventional doorways and is occupied by 30 or more personnel. Every open plan floor area shall have at least two easily identifiable exits in accordance with NFPA 101 (Requirement).

6.4 Interior Finishes

6.4.1 Interior walls, partitions, modular partitions, and ceiling finish materials shall be Class A (Requirement) with the following:

6.4.1.1 A Flame Spread less than 25, in accordance with ASTM E84 (Requirement).

6.4.1.2 A Smoke Development less than 450, in accordance with ASTM E84 (Requirement).

6.4.1.3 No continued propagation of fire as determined by the test method described in NFPA 255 (Requirement).

6.4.2 Interior floor finish materials shall be Class I having a critical radiant flux value of 0.45 W/cm2 or above in accordance with NFPA 253 (Requirement).

6.5 Fire Protection for Employees with Disabilities

6.5.1 Facility Design - NASA facility design, in conjunction with emergency planning, shall be structured to assure that individuals with disabilities, who are present in a building at the time of a fire or other emergency, are:

6.5.1.1 Made aware of the conditions (Requirement).

6.5.1.2 Are provided the means to reach an area of safety (Requirement).

6.5.2 Evacuation procedures and design standards shall be in accordance with 29 CFR 1910, Occupational Safety and Health Standards, 41 CFR 101, Uniform Federal Accessibility Standards, NFPA 101, Life Safety Code, ANSI A17.1, Safety Code for Elevators and Escalators, and ANSI A117.1, Accessible and Usable Buildings and Facilities (Requirement).

6.5.3 In facilities where disabled individuals may be present, the required facility emergency action plan shall be structured so as to assign responsible persons (with alternates) the task of

notifying the individual(s) with disabilities of the existence of an emergency situation and assisting them to an area of safety (Requirement).

6.6 Issuance of Use and Occupancy

6.6.1 No new construction or renovation project or portion thereof shall be occupied until the AHJ has approved a Use and Occupancy Certificate - and provide it to the Project Manager or Tenant (Requirement).

6.6.2 Issuance of a Use and Occupancy Certificate shall not be construed as an approval of any violation of a Code or NASA standard (Requirement).

6.6.3 Once the AHJ has ensured that to the best of his or her knowledge all fire protection and life safety systems have been completed, inspected, successfully tested and approved, and all outstanding fire and life safety deficiencies have been corrected to afford a reasonable degree of safety to the building occupants from fire and similar emergencies; the Use and Occupancy Certificate may be issued to the Project Manager or Tenant.

6.6.4 The AHJ is authorized to approve a temporary Use and Occupancy Certificate.

6.6.4.1 This certificate shall allow partial occupancy of specific areas, prior to completion of the project (Requirement).

6.6.4.2 All life safety and fire protection systems serving the areas proposed for occupancy and all floors below shall be completed, inspected, successfully tested, and approved by the AHJ (Requirement).

6.6.4.3 The temporary Use and Occupancy Certificate shall identify the specific area(s) of the project where occupancy is permitted (Requirement).

6.6.4.4 Following the approval of a temporary Use and Occupancy Certificate, the AHJ shall set a time frame for the completion, inspection, testing, and approval of all life safety and fire protection systems for entire project, and the correction of any outstanding life safety and fire protection deficiencies (Requirement).

6.6.4.5 Upon completion, inspection, successful testing, and approval of all fire protection and life safety systems and correction of all outstanding fire and life safety deficiencies, the AHJ shall approve a Use and Occupancy Certificate to the Project Manager or Tenant (Requirement).

7. STRUCTURAL FIRE SAFETY CRITERIA

7.1 General

7.1.1 Structural features of NASA facilities shall be in accordance with this chapter and the requirements and guidelines of NPR 8820.2, Facility Project Requirements and applicable building codes (Requirement).

7.1.2 Where requirements are conflicting, the most stringent shall apply (Requirement).

7.2 Structural Selection

Selection of the basic construction classification of proposed NASA facilities shall be made after a thorough review of anticipated occupancy hazards, occupational exposures, floor area, building height, interior construction, automatic sprinkler systems, and costs (Requirement).

7.3 Fire Resistant Construction

7.3.1 Fire rated walls and barriers shall comply with NFPA 221 and NFPA 251 (Requirement).

7.3.2 Every fire wall shall be of noncombustible material having a fire-resistance rating (Requirement).

7.3.3 Fire partitions (see Section 3) shall be constructed of materials sufficient to achieve a 1 or 2-hour fire-resistance rating with a UL listed method (Requirement).

7.3.4 Fire walls shall extend from the ground or fire-resistive floor through the roof above or to the underside of a fire-resistive slab or noncombustible roof, or an approved fire-resistive ceiling assembly (Requirement).

7.4 Vertical Openings and Shafts

Stairway and elevator enclosures, pipe and electrical chases, heating, ventilation, and air conditioning shafts, atriums, and floor penetrations shall comply with the appropriate provisions of NFPA 101 (Requirement).

7.4.1 Shafts

7.4.1.1 All shafts in buildings up to and including three levels in height shall be constructed of materials having a fire-resistance rating of at least 1 hour (Requirement).

7.4.1.2 Shafts in buildings greater than three levels in height shall be of materials having a fire-resistance rating of at least 2 hours (Requirement).

7.4.1.3 Shafts shall terminate at the top by extending to, or through, the roof or tight against a floor or shaft cover having a fire-resistance rating equal to the shaft itself (Requirement).

7.4.1.4 Shafts shall terminate at the bottom against earth or the surface of the floor (Requirement).

7.4.1.5 Shafts for elevators and dumbwaiters also shall conform to the requirements of ANSI A17.1 (Requirement).

7.4.2 Telephone/Electrical Rooms - When telephone rooms or electrical closets are located one above the other, with unprotected floor penetrations, the enclosure walls are considered to form a shaft and protection shall be in accordance with the requirements contained in this chapter and the National Electrical Code, NFPA 70 (Requirement).

7.4.3 Atriums and Interior Stairwells

The fire hazards associated with atriums and interior stairwells are due to the lack of an effective vertical fire cutoff, similar to open stairways or unprotected vertical shafts. Therefore, the design of atriums and interior stairwells shall comply with NFPA 101 (Requirement) and incorporate the following as determined by the AHJ:

7.4.3.1 Smoke Removal System - When required by building codes, atriums and interior stairwells shall have a smoke removal system capable of venting the products of combustion outside the building without affecting upper floor areas (Requirement).

7.4.3.2 Fire Partitions - Fire partitions shall be installed around an atrium or stairwell used as part of a required exit access corridor (Requirement).

7.4.3.2.1 The fire rating of the separation shall be in accordance with the applicable fire and building codes (Requirement).

7.4.3.2.2 The partitions may feature limited amounts of wired glass vision panels.

7.4.3.2.3 Openings in the fire partitions of an atrium or stairwell shall be limited and must be protected by listed fire dampers, doors, or other assembly approved by the AHJ (Requirement).

7.4.3.2.4 A balcony or walkway may be provided on the atrium side of a fire partition provided that it does not form a portion of an exit access corridor, or the atrium is provided with sprinklers and smoke control systems.

7.5 Ceilings

7.5.1 Suspended ceiling systems provided as part of a listed fire-resistive assembly shall be installed and maintained as required by the listed design at all times (Requirement).

7.5.2 When work activities require access above such systems, the system shall be restored to its original configuration immediately following such work (Requirement).

Note: Suspended ceiling systems of this nature shall be avoided whenever possible due to the difficulty in assuring that the fire-resistance of the assembly is maintained.

7.6 Fire Door and Window Assemblies

7.6.1 Fire door and window assemblies shall be installed in accordance with the requirements of NFPA 80 (Requirement).

7.6.2 All fire door and window assemblies shall be labeled with a UL listing or have FM or other AHJ approved testing laboratory approval for their application (Requirement).

7.7 Fire Stopping

7.7.1 Fire stopping and draft stopping in combustible construction shall comply with the local building codes and NFPA 101 (Requirement).

7.7.2 Openings in fire rated partitions or walls shall be protected by listed fire doors, frames, and fire windows, in accordance with NFPA 80 and 101 (Requirement).

7.7.3 Through-penetrations ("poke-through" openings) shall be protected by sealing the penetration with a "fire stopping assembly" that is UL listed, or is FM or certified testing laboratory approved for that purpose, and is capable of maintaining the fire-resistance rating of the barrier per NFPA 251 (Requirement).

7.7.4 For sealing purposes, all floors shall have a minimum rating of 2 hours (Requirement).

7.8 Fireproofing

7.8.1 All fireproofing shall be installed per the manufacturer's instructions (Requirement).

7.8.2 Where the specification for a fireproofing material is given as an average thickness, the average thickness shall be used as a minimum (Requirement).

7.9 Roofing Materials and Systems

7.9.1 All roofing materials and systems shall be listed/approved type Class A or B as determined by the AHJ (Requirement).

7.9.2 All roofing materials and systems shall meet the test criteria in NFPA 256 (Requirement).

7.10 Labeling Fire Rated Construction

7.10.1 All new fire rated construction shall be labeled (Requirement).

7.10.2 The label shall describe the wall hourly rating (Requirement).

7.10.3 The lettering of the label shall be made with a minimum of 6 inch (152.4 millimeters) red letters and a maximum spacing of 20 feet (6.1 meters) (Requirement).

7.10.4 The labeling is required for both under floor and above ceiling locations (Requirement).

8. MECHANICAL CRITERIA

8.1 General

The purpose of this chapter is to provide the necessary information to properly design and maintain the mechanical aspect of facilities in accordance with the National Fire Codes and Federal and local government codes. All fire protection equipment shall be UL listed or have FM or AHJ approved testing laboratory approval for the intended purpose (Requirement).

8.2 Standpipe Systems

8.2.1 Design and Installation - The design, installation, and maintenance of standpipe and hose systems shall be in accordance with NFPA 14, NPFA 25, 29 CFR 1910.158, and local government codes (Requirement).

8.2.2 Application - Standpipes shall be of the pre-primed type (where temperature conditions permit) and are required for the following types of facilities and areas (Requirement):

8.2.2.1 Buildings with three or more stories or having a level that is 50 feet (15.24 meters) or more above grade (Requirement). (Standpipes are recommended in 2 story buildings.)

8.2.2.2 Windowless or underground buildings or facilities where the dimensions are such that all areas cannot be reached by hose lengths of 300 feet (91.44 meters) (Requirement).

8.2.2.3 Where the interior partition arrangement prevents easy access to all areas within the building using 300 feet (91.44 meters) of exterior fire hose lines (Requirement).

8.2.2.4 Where specified by an occupancy requirement of the Life Safety Code (Requirement).

8.2.2.5 Under special occupancy situations (not covered by this chapter) as determined by the AHJ (Requirement).

8.2.3 Classification - Standpipes shall be equipped for Class 1 service as defined in NFPA 14 (Requirement).

8.2.4 Hose Connections - Hose cabinets with hoses shall not be permitted (Requirement). However, cabinets may be installed and used for portable extinguisher cabinets instead of fire hose.

8.2.5 Standpipe - When standpipe hose stations are mounted on walls, at least 48 inches of clearance shall be maintained between all obstructions and the wall to allow proper use of standpipe hose station access for portable fire extinguishers (Requirement).

8.3 Sprinkler Systems

8.3.1 Sprinkler Locations - Application, Design, Installation, and Maintenance

8.3.1.1 Automatic sprinkler protection shall be provided for all new building/facility construction (Requirement).

8.3.1.2 Sprinklers shall be provided in renovation projects involving over 50 percent of the building (Requirement).

8.3.1.3 Sprinklers shall be considered for renovation projects over 2,500 square feet (232.26 square meters) (Requirement).

8.3.1.4 Sprinklers shall be installed, if required due to occupancy change (Requirement).

8.3.1.5 Small building construction, housing only non-hazardous materials, may not require automatic sprinkler protection if approved by the AHJ.

8.3.2 Design, Installation, and Maintenance

8.3.2.1 The design, installation, and maintenance of sprinkler systems shall be in accordance with NFPA 13, 13D, 13R, 25 and 29 CFR 1910.159, and the additional requirements provided below (Requirement).

8.3.2.2 Partially-sprinklered buildings shall be considered as non-sprinklered (Requirement).

8.3.3 Water Supply Demands

8.3.3.1 Hydraulically designed sprinkler systems should be designed for a supply pressure of at least 10% but not less than 10 psi below the supply curve.

8.3.3.2 The AHJ shall determine the need for the increased or decreased water supply requirements to provide for occupancy flexibility (Requirement).

8.3.4 Design Density

8.3.4.1 The occupancy classification for the design density of a sprinkler system shall be increased by one occupancy classification (Requirement).

8.3.4.2 The increase applies only to light and Ordinary (Group 1) occupancies, as defined by NFPA 13, for all NASA facilities. For example, an Ordinary Hazard (Group 1) NASA Facility shall use the NFPA 13 water supply density requirements specified for Ordinary Hazard (Group 2).

8.3.4.3 The minimum design density for NASA facilities shall be Ordinary Group 1 (Requirement).

8.3.5 Fire Department Connection (FDC)

8.3.5.1 At least one FDC shall be provided for each facility with a sprinkler system and/or standpipe system (Requirement).

8.3.5.2 The FDC should serve the sprinkler system and interior standpipe system in buildings equipped with both. All standpipes and sprinkler systems should be interconnected so that each FDC serves all fire protection needs simultaneously.

8.3.5.3 Explosive hazardous facilities and large heavy fire load facilities shall be provided with a remotely located FDC (Requirement).

8.3.5.4 Each FDC shall be unobstructed and located within 200 feet (60.96 meters) of a fire hydrant. (Requirement)

8.3.5.5 For new construction, the FDC shall be within 100 ft. of the fire hydrant (Requirement).

8.3.5.6 Permanent signs reading, "STANDPIPE AND AUTOMATIC SPRINKLER" shall be provided (Requirement).

8.3.5.7 FDCs shall be provided with protective caps and chains (minimum length of this chain shall be 12 inches (305 millimeters)) (Requirement).

8.3.5.8 If the FDC does not protect 100 percent of the facility, the area protected shall be identified on the FDC (Requirement).

8.3.6 Water flow alarms

8.3.6.1 Water flow alarms, interconnected with the building fire alarm system and central fire reporting system (see Chapter 9), shall be provided for each floor level protected by the automatic sprinkler system (Requirement).

8.3.6.2 For smaller buildings, where the location of a fire would be readily apparent, only one water flow alarm is necessary (Requirement).

8.3.6.3 Dry pipe and pre-action sprinkler systems shall be equipped with an automatic air maintenance device and high/low air pressure alarm (Requirement).

8.3.6.4 The alarm shall be connected to a constantly attended location (Requirement).

8.3.7 All valves on connections to water supplies and on supply pipes to sprinklers shall be of the indicating type with tamper switches that activate a supervisory signal on the building fire alarm system (Requirement).

***EXCEPTIONS**:*

(1) Valves 2.5 inches (64 millimeters) or less in size,
(2) standpipe valve outlets,
(3) drain valves,
(4) inspector's test valves,
(5) valves located in areas where the installation of tamper switches is impractical, and
(6) underground valves that may be secured open by the use of a substantial lock.

8.3.7.1 Sprinkler system control valves shall be inventoried and subjected to periodic visual inspection and maintenance (Requirement).

8.3.8 Existing Facilities

8.3.8.1 If sprinkler protection is not provided throughout an existing facility, the area protected by the sprinkler shall be separated from sections not protected by the sprinkler by a fire partition of at least 1-hour fire-resistance (Requirement).

8.3.8.2 Sprinkler protection shall be provided in accordance with paragraph 8.3 (Requirement).

8.3.9 Drains - In areas protected by sprinklers that are subject to excessive water damage, floor drains with sufficient capacity shall be provided to handle anticipated accumulation of sprinkler system and hose stream discharge (Requirement). (Examples are computer rooms and electronic repair rooms.)

8.3.10 Inspections and Tests

8.3.10.1 Sprinkler systems shall be inspected and tested in accordance with the provisions of NFPA 13 and 25 (Requirement).

8.3.10.2 Inspector test connections should be located in the most hydraulically remote area from the flow or pressure switch and accessible within 7 feet (2.133 meters) of the finished floor.

8.3.10.3 They shall have an outlet size equal to the sprinkler head installed and discharge to a location capable of accepting a full flow from the connection until the water flow switch operates (Requirement).

8.3.10.4 In dry pipe systems, water shall reach the inspector's test pipe within 60 seconds after opening the test valve (Requirement).

8.3.11 The following are minimum sprinkler system performance criteria:

8.3.11.1 Full opening of the valve to the inspector's test pipe shall activate the required water flow indicator within 90 seconds for all sprinkler systems; also activate the local fire alarm system, the central fire alarm monitoring system, and a visual and audible signal on the fire alarm and annunciator panels (Requirement).

8.3.11.2 The closing of a sprinkler system control valve by no more than 2 turns shall activate the required tamper switch and cause a trouble alarm to register on the main fire alarm control panel, annunciator panel (if provided), and the central fire alarm monitoring system, and the system must be capable of being restored to the normal condition when the valve is reopened (Requirement).

8.3.11.3 For dry pipe sprinkler systems, full opening of the valve to the inspector's test pipe shall cause the dry pipe valve to trip and deliver a steady stream of water at the test outlet within 60 seconds (Requirement).

8.3.12 Out-of-Service Sprinkler Systems - The requirements contained in NFPA 101 shall be followed when removing a sprinkler system from service for construction, repair, maintenance, or other reason (Requirement).

8.4 Clean Agents

8.4.1 The United States treaty obligations to help protect stratospheric ozone (The Montreal Protocol), coupled with Environmental Protection Agency (EPA) regulations (Amendments of the Clean Air Act), limit the production and consumption of Halon.

8.4.1.1 NASA Centers shall take action to convert from Halon to alternatives (Requirement).

8.4.1.2 Expansion of any existing or new applications using Halon shall be approved by NASA Headquarters Office of Safety and Mission Assurance (Requirement).

8.4.1.3 Existing systems and extinguishers shall be inspected and maintained per NFPA 10, 12A, and 29 CFR 1910.160 (Requirement).

8.4.1.4 Alternative clean agent systems shall be designed, installed, and maintained in accordance with NFPA 2001 (Requirement).

8.4.2 Essential equipment areas where the maximum possible fire loss exceeds twenty-five (25) million dollars (this would include the construction of the area housing the equipment, the equipment within the area, and the cost to replace any data/information lost due to a fire or water damage) shall be equipped with a gaseous clean agent fire extinguishing system in addition to automatic fire sprinklers (Requirement).

8.4.3 For areas where the installation of these extinguishing systems may not be feasible due to openness of the area, the size of the area, or type of equipment in the area, the AHJ shall be consulted and/or a Performance Based Fire Safety Design shall be conducted in accordance with Section 4.5 of this standard (Requirement).

8.4.4 Sprinklers within these areas may be increased to a standard response sprinkler or higher, as recommended by the AHJ.

8.4.5 Fire extinguishing systems that may cause asphyxiation due to its air displacement properties shall not be installed in occupied areas (Requirement).

8.5 Chemical Extinguishing Systems

Chemical extinguishing systems shall be designed, installed, tested, and maintained in accordance with NFPA 17, 17A and 29 CFR 1910.161 (Requirement).

8.5.1 Chemical extinguishing systems shall be required to protect the following:

8.5.1.1 Kitchen cooking equipment and exhaust systems in accordance with the requirements of NFPA 96 (Requirement).

8.5.1.2 Special hazard areas where a comprehensive engineering analysis reveals that a chemical extinguishing agent would be the most effective and most practical (Requirement).

8.5.2 When installed to protect kitchen equipment, the system shall be designed to discharge the chemical into the plenum area behind grease filters, into the duct work, and onto the cooking surface of deep fat fryers, ranges, and broilers (Requirement).

8.5.3 At least one manual system release shall be located along the normal means of egress from the protected area (Requirement).

8.5.4 Activation of the system shall transmit a signal to the central fire alarm monitoring system, sound a local alarm at the facility, and cutoff/disconnect the gas/electricity to the system (Requirement).

8.6 Fixed Carbon Dioxide

8.6.1 Carbon dioxide systems shall not be used in occupied areas (Requirement).

8.6.2 Carbon dioxide ($C0_2$) systems are special purpose and shall only be used where automatic sprinklers, chemical, or foam-water would be inappropriate (Requirement).

8.6.3 The design, installation, inspection, maintenance, and testing of $C0_2$ systems shall be in accordance with NFPA 12 and 29 CFR 191O.163 (Requirement).

8.6.4 All $C0_2$ systems shall have a permanently connected 100 percent reserve supply (Requirement).

8.7 Foam

8.7.1 Foam extinguishing systems shall conform to the applicable requirements of NFPA 11, 11A, 16, 30, 409, and 29 CFR 1910.162, including design, installation, acceptance testing, and maintenance (Requirement).

8.7.2 The system shall be installed by a qualified contractor experienced with all types of foam protection (Requirement).

8.7.3 Application - Fixed foam extinguishing systems should be considered in the following areas:

8.7.3.1 All petroleum based rocket fuel pump rooms and valve manifolds, unless protected by an automatic sprinkler system.

8.7.3.2 Aircraft hangar service areas where a fixed foam fire-suppression system is required by NFPA 409.

8.7.3.3 Special hazard areas, where a comprehensive engineering analysis identifies foam as the most cost-effective method of protection.

8.7.4 System Activation - The foam extinguishing system shall activate the central fire alarm monitoring system and a local alarm at the protected facility (Requirement).

8.8 Water Spray

8.8.1 The design, installation, testing, and maintenance of fixed water spray systems shall be in accordance with NFPA 15 and 29 CFR 1910.163 (Requirement).

8.8.2 With the exception of pre-primed high-speed systems, water spray systems shall be of the deluge valve and open spray nozzle type (Requirement).

8.8.3 These systems are provided to protect defined hazardous equipment/areas and are not intended for complete facility protection.

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

8.8.4.1 Propellant - All transfer units containing hydrazine based fuels shall be provided with fixed spray systems delivering a coarse spray of not less than 0.5 gallons per minute per square foot (20.35 liters per minute per square meter) (Requirement).

8.8.4.2 Propellant - The system control shall be by manual means, immediately adjacent to the standpipe outlet (Requirement).

8.8.4.3 Propellant - Curbs, dikes, perimeter trenches, and impounding facilities shall be provided in accordance with EPA regulations (Requirement).

8.8.4.4 Nitrogen Tetroxide - All areas where transfer operations of nitrogen tetroxide propellant oxidizer are performed shall be protected by a water density of 0.25 gallons per minute per square foot (10.175 liters per minute per square meter) for areas (Requirement).

8.8.4.5 Nitrogen Tetroxide - The system control shall be by manual means, immediately adjacent to the standpipe outlet (Requirement).

8.8.4.6 Nitrogen Tetroxide - Curbs, dikes, perimeter trenches, and impounding facilities shall be provided in accordance with EPA regulations (Requirement).

8.8.4.7 Propellant testing laboratories, except solid propellant testing laboratories, shall be protected with a water spray system(s) designed to extinguish propellant fires that can occur (Requirement).

8.8.4.8 Where multiple fuels are handled or processed, the system shall be designed to provide protection from the potentially most severe hazard (Requirement).

8.8.4.9 Hazardous spacecraft systems test facilities, such as those containing cryogenic, hypergolic, and environmental systems, shall be provided with a water spray system designed to provide protection from the most severe hazard anticipated during normal test operations (Requirement).

8.8.5 Launch pad service structure and assembly building work platforms shall be provided with water spray systems designed to provide full coverage over the deck areas as follows:

8.8.5.1 Provide 0.25 gallons per minute per square foot (10.175 liters per minute per square meter) design density for normal checkout and assembly with no fuel propellant transfer (Requirement).

8.8.5.2 Provide 0.5 gallons per minute per square foot (20.35 liters per minute per square meter) design density for normal checkout with fuel propellant transfer (Requirement).

8.8.6 Launch facilities for solid rocket propellant shall be evaluated using sound engineering practices and feasibility and risk assessments to determine what fire protection is needed for these facilities (Requirement).

8.8.7 Spray nozzles shall be arranged to develop a pattern from above the hazard and shall impinge on cable trays, ground support equipment, and all similar equipment normally in use on such platforms (Requirement).

8.8.8 Platform spray systems shall be controlled manually (Requirement).

8.8.9 Where launch pad service structures are exposed to liquid propellant hazards, exit passageways shall be provided with water spray systems to aid egress by:

8.8.9.1 Providing exposure protection against radiant heat through which personnel may move easily (Requirement).

8.8.9.2 Producing an evaporative cooling effect of the air into which it is sprayed (Requirement).

8.8.9.3 Wetting the skin and clothing of the escapee to cool and dilute any liquid propellant contaminant on the skin (Requirement). The minimum spray rate is 0.2 gallons per minute per square foot (8.14 liters per minute per square meter) of egress path, over a width of 6 feet (1.83 meters) and height of 8 feet (2.44 meters) up to the first heat barrier (such as a platform bulk-head).

8.8.9.3.1 A like amount shall be sprayed along the prescribed escape route beyond the first heat barrier for a minimum distance of 20 feet (6.096 meters) or to an area of refuge (Requirement).

8.8.9.3.2 The pattern of nozzles employed shall provide the minimum required horizontal and vertical coverage in areas when subjected to wind and draft effects (Requirement).

8.8.9.3.3 The egress and spray system shall be activated with the fixed fire extinguishing system serving the hazardous area (Requirement).

8.8.10 Liquid propellant transfer control manifolds located adjacent to launch vehicles shall be provided with a water spray system(s) designed for fire control (Requirement).

8.8.11 Where a potential fire hazard exists, water spray systems shall be provided for cryogenic, gaseous oxygen, and hydrogen storage containers, grouped piping, and pumps (Requirement).

8.8.11.1 The system(s) shall be arranged to deliver a uniform spray pattern to provide exposure protection for the container surface, pumps, and adjacent piping (Requirement).

8.8.11.2 The minimum spray rate is 0.2 gallons per minute per square foot (8.14 liters per minute per square meter) of exposed surface.

8.8.11.3 Manual control stations shall be located outside the hazardous area, but within effective sight of the facility protected (Requirement).

8.8.11.4 Remote control capability shall be provided as directed by the AHJ (Requirement).

8.8.12 High speed water spray systems with a design density of 0.25 gallons per minute per square foot (10.175 liters per minute per square meter) or greater, and controlled by automatic detector(s) with manual override, shall be provided at ordinance inspection areas where solid propellant grains are exposed for visual, optical, or mechanical examination (Requirement). Facilities where solid propellant grains are x-rayed through their cases do not require these systems.

8.8.12.1 High speed water spray systems are special purpose systems and shall be designed and installed by personnel experienced in this field (Requirement).

8.8.13 A water spray system shall be provided for fuel (monomethylhydrazine, unsymmetrical dimethylhydrazine, etc.) separator systems in accordance with the following criteria (Requirement):

8.8.13.1 A density of 0.5 gallons per minute per square foot (20.35 liters per minute per square meter) over the entire containment area for each fuel separator system shall be provided (Requirement).

8.8.13.2 The water spray system shall be released by a manually activated quarter turn ball valve (release station) located an acceptable distance away (Requirement).

8.8.13.3 Actual location of the manual release station shall be field verified and approved by the AHJ (Requirement).

8.8.13.4 The quarter turn ball valve shall be enclosed in a metal or plastic housing which allows the use of supervisory seals (Requirement).

8.8.13.5 The valve shall be oriented in accordance with industry standards (handle parallel to pipe flow indicates open, handle perpendicular to pipe flow indicates closed) (Requirement).

8.8.13.6 A plastic label permanently affixed to the front cover that explicitly defines the operating procedures for the manual release station shall be provided (Requirement).

8.8.13.7 Fuel separators shall have a minimum separation distance of 20 feet (6.096 meters) from the building exterior walls and exits (Requirement). The separation distance can be reduced by the use of other exposure protection methods when acceptable to the AHJ.

8.8.13.8 A separate zone for the water flow switch on the facility fire alarm control panel capable of transmitting alarm and trouble signals to the central fire alarm control center shall be provided (Requirement).

8.8.13.8.1 Transmission of a trouble or alarm signal on this zone shall not cause evacuation of the facility unless so directed by the AHJ (Requirement).

8.8.13.9 A standard fire department connection is not required on systems where the demand exceeds the capabilities of the fire service vehicles.

8.8.13.10 Containment for the fuel separators shall be in accordance with EPA regulations (Requirement).

8.8.14 A water spray system shall be provided for oil-insulated transformers located adjacent (in accordance with FM DS 5-4) to any facility containing personnel, hazardous chemicals, and/or essential equipment (Requirement).

8.8.15 A standard fire department connection shall be provided for each water spray system (unless excepted by this standard) (Requirement).

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

8.8.15.2 Connections can be piped upstream of the actuating valve.

8.8.16 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 (Requirement).

8.8.17 Appropriate warning signs shall be posted in areas where a fixed water spray system has been installed (Requirement).

8.8.18 After installation and prior to acceptance, all water spray systems shall be activated and completely tested to simulate performance under emergency conditions (Requirement).

8.9 Portable Fire Extinguishers

8.9.1 Portable fire extinguishers shall be provided in accordance with NFPA 1 and 101 and inspected, and maintained in accordance with NFPA 10, 29 CFR 1910.157, and this standard (Requirement).

8.9.2 Fire Extinguishers. Multipurpose dry chemical extinguishers shall be provided unless deemed inappropriate for use against a known hazard as determined by the AHJ (Requirement). Notable exceptions include the following:

8.9.2.1 Wet Chemical (Class K) extinguishers shall be provided for use around deep fat fryers (Requirement). (Multipurpose dry chemical can cause boil over of hot fat and shall not be used in cooking areas).

8.9.2.2 $C0_2$ or other clean agent extinguishers shall be provided where delicate electrical contacts or electronic equipment is involved or other instances where the deposit of dry chemical powder will cause contamination or require expensive cleanup (Requirement).

8.9.2.3 Clean Agent extinguishers shall be provided around aircraft in accordance with NFPA 408 (Requirement). See paragraph 8.4 for the use of Halon in any new or existing facilities (Requirement).

8.9.2.4 Foam extinguishers shall be provided where a Class B (flammable liquid) hazard is confined to a dip tank or similar vessel and a foam "blanket" is needed to prevent re-ignition (Requirement).

8.9.2.5 Class D Fire Extinguishers shall be provided where the fire hazard is due to combustible metals, such as magnesium, titanium, and zirconium (Requirement).

8.9.2.5.1 The selection of extinguishers shall be made by the AHJ (Requirement).

8.9.2.6 Pressurized water can be suitable at times, subject to the approval of the AHJ. (Cleanup and corrosion characteristics shall reviewed.)

8.9.2.7 Fire extinguishers used in protecting aircraft fuel servicing areas shall meet the requirements of NFPA 407 (Requirement).

8.9.3 Where portable fire extinguishers are provided for employee use, training shall be provided in accordance with 29 CFR 1910.157 to familiarize employees with the general principles of fire extinguisher use and the hazards involved with incipient stage firefighting (Requirement).

8.9.4 Extinguishers shall not be obstructed or obscured from view at any time (Requirement).

8.9.5 Tampering with, maliciously discharging, removing, or using a fire extinguisher for any purpose other than for extinguishing fires or conducting authorized training exercises is prohibited and shall result in disciplinary action (Requirement).

8.9.6 Portable fire extinguishers and cabinets do not have to be installed in common areas, or general offices when the building is protected throughout with quick response sprinklers. In office buildings protected throughout with quick response sprinklers, fire extinguishers shall only be installed in areas such as mechanical and elevator equipment areas, computer rooms, UPS rooms, generator rooms, kitchen areas, or special hazard areas (Requirement).

8.10 Air Conditioning Systems

8.10.1 Except as specified below, all air conditioning and ventilation systems for the handling of air, not contaminated with flammable or explosive vapors or dust, shall conform to the requirements of NFPA 90A and 90B (Requirement).

8.10.2 The construction of shafts containing, or used as, vertical ducts shall be in accordance with the requirements of paragraph 7.4 (Requirement).

8.10.3 Duct linings and coverings shall be of noncombustible construction (Requirement).

8.10.3.1 The total assembly of the duct, including the adhesive and any coatings or additives involved, shall have a Flame Spread Index not exceeding 25 and a Smoke Developed Index not exceeding 50, as determined by NFPA 255 (Requirement).

8.10.3.2 The total assembly of the duct, including the adhesive and any coatings or additives involved, shall be approved for use by the AHJ (Requirement).

8.10.4 The area above suspended ceilings and below raised floors can be used as a plenum, provided that these areas do not contain combustibles, are not constructed of combustible materials, and have only materials and equipment listed for plenum use.

8.10.5 The protection of cooling towers shall be in accordance with the requirements contained in paragraph 10.5 (Requirement).

8.11 Ventilation Systems

8.11.1 All processes, operations, or other situations that present the possibility of a hazardous accumulation of combustible or explosive vapors, dusts, fumes, or other airborne or potentially airborne substances shall be provided with ventilation systems in accordance with NFPA 91, 29 CFR 1910.94, and the ACGIH Industrial Ventilation Manual of Recommended Practices (Requirement).

8.11.2 Paint Spraying - All paint spraying and finishing booths and rooms shall be provided with ventilation equipment in accordance with NFPA 33, 91, 29 CFR 1910.107, and the ACGIH Industrial Ventilation Manual of Recommended Practices (Requirement).

8.11.3 Cooking Equipment - Cooking equipment exhaust systems over processes producing smoke or grease shall be designed and protected in accordance with NFPA 96 and the ACGIH Industrial Ventilation Manual of Recommended Practices (Requirement).

8.11.3.1 Insulation shall be type Class A with a Flame Spread Index not to exceed 25 and a Smoke Development Index not to exceed 450 (Requirement).

8.11.3.2 The interior exhaust ducts shall be cleaned at a minimum frequency of semi-annually unless otherwise determined by the AHJ (Requirement).

8.12 Smoke Control/Exhaust Systems

8.12.1 The guidance provided in NFPA 92A, 92B, 101, and 204 shall be used in determining the degree of smoke control/exhaust required, installation procedures testing, operations, and maintenance requirements (Requirement).

8.12.2 Smoke control/exhaust systems should be considered for the following:

8.12.2.1 Windowless and subterranean buildings.

8.12.2.2 Warehouses containing materials having a high heat release potential, flammable liquid storage and handling facilities, and other extra hazard occupancies.

8.12.2.3 UL listed smoke and heat vents shall be provided in accordance with NFPA 204 and/or a smoke control/exhaust system (Requirement).

8.12.3 Design Principles - The design of smoke exhaust systems shall be in accordance with the requirements and guidelines contained in NFPA 90A and shall be based on the following principles (Requirement):

8.12.3.1 Achievement of negative pressures in the fire/smoke area (entire floor level or subdivisions) by shutdown of air supply fans and diversion of return air directly outside.

8.12.3.2 Development of positive pressure in adjacent areas by shutdown of return air fans. The design of smoke control systems shall be in accordance with NFPA 92A and 92B.

8.12.4 Design features shall include:

8.12.4.1 Separate fan and duct systems for each fire/smoke area (Requirement).

8.12.4.2 Provision of dampers and ducts for direct discharge of contaminated air to the outside (Requirement).

8.12.4.3 Provision of separate manual controls readily accessible for fire department use (Requirement).

8.12.5 Testing - Full-scale testing of the system shall be conducted, prior to acceptance, to verify satisfactory performance (Requirement).

8.13 Heating Equipment

8.13.1 Depending on the nature of the fuel, heating equipment shall comply with the appropriate provisions of NFPA 31, 54, 58, 59A, 86, 211, and Factory Mutual Data Sheets except as noted otherwise (Requirement).

8.13.2 Furnaces and Boilers

8.13.2.1 Furnaces and boilers for central heating systems shall be located in a room separated from the remainder of the facility by fire-resistive construction (including walls and ceiling) (Requirement).

8.13.2.2 If a sprinkler system is provided, the fire-resistance rating shall be a minimum of 1 hour (Requirement).

8.13.2.3 If no sprinkler system is provided, the fire-resistance rating shall be a minimum of 2 hours (Requirement).

8.13.2.4 Openings shall be protected by listed fire doors or dampers (Requirement).

8.13.3 Operations - Shop, storage, or other operations, not directly related to the boiler operation, involving flammable materials, shall not be located in boiler rooms (Requirement).

8.13.4 Burners - Regardless of size, burners on suspended oil-fired heaters shall be provided with flame supervision that ensures shutdown in not more than 4 seconds if flame failure occurs or trial for ignition does not establish a flame (Requirement).

8.13.5 Space Heaters - Fixed space heaters shall be approved or listed by the American Gas Association (AGA), LTL, or other nationally recognized testing authority and installed in

complete compliance with all of the requirements of the manufacturer and the laboratory involved (Requirement).

8.13.5.1 Each fuel-fired space heater shall be vented (Requirement).

8.13.5.2 The clearances specified by the manufacturer and/or the laboratory shall be maintained between the space heater and combustible materials (Requirement).

8.13.5.3 Portable space heaters for personal comfort shall not be permitted unless approved by the AHJ (Requirement).

8.13.6 Gas

8.13.6.1 Gas piping entry into the building shall be protected against the possibility of breakage due to settling or vibration (Requirement).

8.13.6.2 Where practical, piping shall be brought above grade and provided with a swing joint before entering the building (Requirement).

8.13.6.3 The physical arrangement and venting shall be such that a break in the gas line due to settling or other causes at/or near the point of entry cannot result in the free flow of gas into the building (Requirement).

8.13.6.4 Automatic gas shut off shall be required (Requirement).

8.13.6.5 To avoid placing any strain on the gas piping, any meters, regulators, or similar attachments shall be adequately supported (Requirement).

8.13.6.6 Any vents or rupture discs on the equipment shall be vented to the outside of the building (Requirement).

8.13.6.7 Earthquake sensitive shutoff valves shall be provided for each gas entry into buildings located in earthquake prone areas (Requirement).

8.13.6.8 Gas piping shall not be run in any space between or directly behind a structural member and its fireproofing (Requirement).

8.13.6.9 Gas meter rooms shall be ventilated in a manner which ensures removal of any gas leakage without moving it through the structure (Requirement).

8.13.6.10 For large capacity gas services over 3 inches (76 millimeters) diameter at 4 inches (102 millimeters) of water pressure head or any other size having equivalent or greater delivery capabilities), the piping shall be enclosed in fire-resistive shafts and vented directly to the outside at top and bottom (Requirement).

8.13.6.10.1 Any horizontal runs of the gas pipe shall be enclosed in a conduit or chase, also directly vented at each end to the exterior or to the vented vertical shaft (Requirement).

8.13.6.10.2 Gas detection and automatic shutoff shall be provided (Requirement).

8.14 Internal Combustion Engines

Stationary internal combustion engines, such as gasoline or diesel-powered generator sets or fire pumps, shall conform to the requirements of NFPA 20 and 37 (Requirement).

8.15 Elevators

The design, installation, testing, and maintenance of elevators, conveyers, dumbwaiters, and escalators shall be in accordance with the requirements contained in NFPA 101 and ANSI A17.1, and ANSI A17.3 “Safety Code for Existing Elevators and Escalators (Requirement).

8.16 Fire Pumps

8.16.1 Pumps for fire protection shall have adequate capacity with reliable power and water supply (Requirement).

8.16.2 Fire pump design, installation, testing, and maintenance shall comply with NFPA 20 and NFPA 25 (Requirement).

8.16.3 Fire pump drivers shall comply with NFPA 37 for diesel engines and NFPA 70 for electric motors (Requirement).

8.16.4 Electric centrifugal fire pumps shall also comply with the relevant requirements of NFPA 70 (Requirement).

8.16.5 Fire pumps shall be arranged to start automatically (Requirement).

8.16.6 All fire pumps shall include manual shutdown features (Requirement).

8.17 Fire Suppression System Outages

8.17.1 Whenever a fire suppression system (e.g., sprinkler, standpipe, water distribution) is removed from service for a period in excess of four hours, the AHJ and the fire department responsible for initial response shall be notified (Requirement).

8.17.2 Whenever a fire suppression system (e.g., sprinkler, standpipe, water distribution) is removed from service for a period in excess of four hours, an approved fire protection system impairment plan/procedure shall be implemented (Requirement).

9. ELECTRICAL FIRE SAFETY CRITERIA

9.1 General

9.1.1 Unless otherwise specified, all electrical installations shall conform to the applicable requirements of NFPA 70, 70E, 72, 75, 101, and local codes (Requirement).

9.1.2 Fire Safety Impact

9.1.2.1 The selection of materials, electrical equipment, and the manner in which they are installed shall minimize the negative fire safety impact they will have on the facility (Requirement). Of particular concern are fire alarm systems, power plants, generators, motors, switch gear, transformers, lightning protection, grounding, static electricity, electrical equipment in hazardous locations, heating equipment, types of cables, insulation materials, electronic test equipment, computer systems, telephone exchanges, and other special electrical installations.

9.1.2.2 Noncombustible materials shall be selected where feasible (Requirement).

9.1.2.3 Fire and smoke potentials shall be considered in the development of the overall fire protection for the facility (Requirement).

9.1.2.4 Cable and wiring shall not be abandoned in place and must be removed to reduce the fuel loading in NASA buildings (Requirement).

9.1.3 Installation - Electrical equipment shall be installed in such a manner as to maintain the integrity of fire or smoke compartment including fire stopping, fire resistance, fire separation, smoke control, and other structurally oriented fire safety features (Requirement).

9.1.4 Wiring - All electrical wiring shall be in accordance with NFPA 70 (Requirement).

9.2 Emergency Power and Lighting

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

9.3 Fire Alarm Systems

9.3.1 The fire alarm system shall be designed, installed, tested, and maintained in accordance with the provisions of NFPA 70, 72, 101, and 29 CFR 1910.165 (Requirement).

9.3.2 Requirements - A complete alarm system shall be provided in facilities meeting any of the following conditions (Requirement):

9.3.2.1 Subject to occupancy of 50 or more occupants as determined using the Life Safety Code (NFPA 101) criteria.

9.3.2.2 Floor area greater than 2,500 square feet (232.25 square meters).

9.3.2.3 A facility with one or more floors above or below the level of exit discharge.

9.3.2.4 Temporary and permanent sleeping quarters including all access corridors.

9.3.2.4.1 Smoke detection that includes audible devices shall be provided as a minimum (Requirement).

9.3.2.5 Computer rooms and essential electronic equipment areas as designated by the AHJ.

9.3.2.6 Facilities with partitions that prevent occupants from readily identifying fire effects and the subsequent need to evacuate.

9.3.2.7 Areas within the facility that require a fixed suppression system and where automatic suppression, flow switches, and tamper switches are installed.

9.3.2.8 Where air-conditioning duct detectors are required.

9.3.2.9 Other instances as determined by the AHJ.

9.3.3 Functions - The system shall perform the following:

9.3.3.1 Indicate general alarm (Requirement).

9.3.3.2 Indicate building evacuation (Requirement).

9.3.3.3 Summon trained fire and emergency service personnel (Requirement).

9.3.3.4 Initiate protective measures including shutdown of equipment (Requirement).

9.3.3.5 Maintain supervision of system circuits (Requirement).

9.3.3.6 Function during power outages for a minimum of 24 hours (Requirement).

9.3.4 System components shall be listed or approved for use by a recognized, independent testing laboratory, such as UL or FM (Requirement).

9.3.5 Facility environmental monitoring systems and security systems can share common equipment with the fire alarm components required in this chapter; however:

9.3.5.1 The performance of the fire alarm system shall not be compromised (Requirement).

9.3.5.2 The fire alarm system shall comply with the other requirements in this chapter (Requirement).

9.3.6 The design of the fire alarm system shall provide for both manual and automatic alarm initiation (Requirement).

9.3.6.1 Manual Alarm:

9.3.6.1.1 Initiation of manual alarms shall be via listed fire alarm stations (Requirement).

9.3.6.1.2 Stations shall be non-destructive, able to be reset, and feature a telltale method to signify activation or tampering (Requirement). (Hammer-through-glass or palm-plunger through-glass types are not acceptable.)

9.3.6.1.3 Each station shall have a provision for authorized personnel to gain keyed access to the switching mechanism of the station (Requirement).

9.3.6.1.4 Manual fire alarm stations shall be located in corridors adjacent to each exit stairway and at each grade exit discharge from the building (Requirement).

9.3.6.1.5 Facilities with large bays or open areas shall have stations located within 200 feet (60.96 meters) of travel distance from any normal work area (Requirement).

9.3.6.1.6 In special risk areas, additional stations may be located as deemed appropriate by the AHJ (Requirement).

9.3.6.2 Automatic Fire Detectors:

9.3.6.2.1 Initiation of an automatic alarm shall be via listed water flow switches, smoke, heat, or linear projected beam detectors, ultraviolet/infrared (UV/IR) flame detectors, and alarm initiating devices associated with the activation of fixed, automatic, fire extinguishing systems (see Chapter 8) (Requirement).

9.3.6.2.2 Automatic fire detectors shall be installed, tested, and maintained in accordance with NFPA 72 and 29 CFR 1910.164 (Requirement).

9.3.6.2.3 Units shall have field-adjustable sensitivity to compensate for varying environmental conditions (Requirement).

9.3.6.2.4 The detector shall feature an alarm indicating light or diode (Requirement).

9.3.6.3 Multiple-Zoned Detection - In areas having conditions conducive to false alarms or where automatic fire detectors are used to activate a fixed fire suppression system, multiple detectors or counting technology may be utilized in the design.

9.3.6.4 Ultraviolet/infrared flame detectors or Smoke Detection (Very Early Smoke Detection Apparatus) shall be utilized when other types of detection methods will not provide a reasonable response time (e.g., high bay areas) (Requirement).

9.3.6.5 Supervisory/trouble alarms, consisting of both an audible and visual signal, shall be transmitted to a 24 hour manned location under the following conditions (Requirement):

9.3.6.5.1 Loss of primary power to the fire alarm system, electric fire pump, or extinguishing system (Requirement).

9.3.6.5.2 Activation of tamper switches located on the control valves of the water supply to automatic sprinkler systems, fire pumps, standpipe systems, or interior building fire main systems (Requirement).

9.3.6.5.3 Low pressure in special extinguishing system actuation pressure supply cylinders (Requirement).

9.3.6.5.4 Loss of air pressure for dry pipe or pre-action sprinkler systems (Requirement).

9.3.6.5.5 Operation of a fire pump (Requirement).

9.3.6.5.6 Low water level in pressure tanks, elevated tanks, and reservoirs (Requirement).

9.3.6.5.7 Open/short circuit or ground condition in any circuit (Requirement).

9.3.6.5.8 Phase reversal on electric driven fire pumps (Requirement).

9.3.6.5.9 Fire pump controllers turned to the off position (Requirement).

9.3.7 Operation

9.3.7.1 The signals shall be sufficiently distinct so as not to be confused with other signals in the area (Requirement).

9.3.7.2 Alarms shall be audible in all areas of occupied facilities (Requirement).

9.3.7.3 Audio/visual devices shall be used in all common areas and areas specifically identified by the AHJ (Requirement). In areas where the use of bells is impractical, alternate methods such as voice messages, flashing lights, red rotating beacons, or horns can be employed, if approved by the AHJ.

9.3.7.4 The fire alarm shall operate continuously until reset (Requirement).

9.3.8 Annunciators

9.3.8.1 Interior fire alarm systems shall be equipped with annunciators, located near the building entrance to indicate to responding personnel the location of the affected alarm-initiating device when required by the AHJ (Requirement).

9.3.8.2 Annunciators shall also be provided for smoke detection systems in essential electronic equipment areas when required by the AHJ (Requirement).

9.3.9 Monitoring - All fire alarm systems shall be monitored by the NASA Center's central fire alarm monitoring system (Requirement).

9.3.10 Equipment and Wiring

9.3.10.1 All power supply equipment and wiring for the fire alarm system shall be installed in accordance with the requirements of NFPA 70 (Requirement).

9.3.10.2 The conductors of the alarm system power supply circuit shall be connected on the line side of the main service to the building via a dedicated circuit (Requirement).

9.3.10.3 Dedicated branch circuits conforming to NFPA 72 are acceptable if approved by the AHJ.

9.3.10.4 A circuit disconnecting means with a suitable over-current protective device shall be installed so that it is accessible only to authorized personnel and shall be clearly marked "Fire Alarm Disconnect” (Requirement).

9.3.10.5 Electrical circuits associated with the fire alarm system shall be arranged so that the occurrence of a single break, a ground fault, or both, will not prevent the transmission of an alarm signal in accordance with NFPA 72 (Requirement).

9.3.11 Emergency Power - Emergency power shall be provided by an approved secondary source (batteries or emergency generator) to enable the fire alarm system to operate in a normal supervisory mode for a minimum period of 24 hours, with sufficient capacity at the end of that period to operate all alarm indicating appliances (such as bells or horns), for a minimum period of 5 minutes or facility evacuation time, whichever is greater (Requirement).

9.3.12 Performance Criteria

9.3.12.1 The entire system, including all alarm initiating devices, shall be completely tested under simulated fire and power failure conditions prior to acceptance (Requirement).

9.3.12.2 Tests shall be conducted by the installation contractor and witnessed by the contracting officer or his/her representative and the AHJ or their designee (Requirement).

9.3.12.3 The following are the minimum performance criteria (Requirement):

9.3.12.3.1 Activation of any manual pull station or other alarm initiating device (water flow alarm) shall immediately activate all bells, strobes, horns, rotating beacon lights, or voice alarm speakers that form a portion of the alarm system and activate the fire alarm monitoring system and a visual and audible alarm on the main fire alarm panel and the annunciator panel (if provided) (Requirement).

***EXCEPTION**: A pre-alarm system, complying with NFPA 101, is permitted subject to approval by the AHJ.*

9.3.12.3.2 Bells, horns, and speakers shall be audible in all areas of the facility (except high ambient noise level areas where rotating beacon lights or strobes shall be provided) (Requirement).

9.3.12.3.3 An alarm condition on the fire alarm panel shall activate auxiliary devices that are to be interfaced with it, such as motorized dampers and automatic door closers (Requirement).

9.3.12.3.4 The fire alarm system shall function satisfactorily under emergency power as indicated in paragraph 9.2 (Requirement).

9.4 Central Fire Alarm Monitoring Systems

9.4.1 Actuation

9.4.1.1 Alarms initiated by fixed fire suppression systems, local fire alarm systems, fire detection systems, or exterior fire alarm stations shall be transmitted automatically, to a constantly attended fire dispatch station (Requirement).

9.4.1.2 All equipment shall be designed, installed, tested, and maintained in accordance with appropriate sections of NFPA 70, 72, and 1221 (Requirement).

9.4.2 Supervisory Conditions - Supervisory conditions shall be transmitted as a separate and distinct signal to the central fire alarm control center (Requirement).

9.4.3 Drills and Tests - Evacuation drills and periodic tests of the central alarm monitoring systems shall be conducted in accordance with NFPA 1 and 29 CFR 1910.38 (Requirement).

9.5 Fire Alarm and Detection System Outages

Whenever a fire protection system (i.e., fire detection, reporting, notification devices) is removed from service for a period in excess of four hours, the AHJ and the fire department responsible for initial response shall be notified and an approved fire protection system impairment plan/procedure implemented (Requirement).

10. SPECIFIC OCCUPANCY REQUIREMENTS

10.1 Aircraft Hangars and Maintenance Areas

10.1.1 NASA aircraft hangars and hangars that house NASA Aircraft (including leased) shall be constructed and protected in accordance with the appropriate provisions of NFPA 409 (Requirement).

10.1.2 Draft Curtains

10.1.2.1 Draft curtains shall be provided in accordance with the guidelines contained in NFPA 204 (Requirement).

10.1.2.2 The distance between curtain boards shall not exceed 100 feet (30.48 meters) (Requirement).

10.1.3 Fire Alarms

10.1.3.1 Aircraft hangars shall be equipped with an evacuation fire alarm system designed in accordance with paragraph 9.3 (Requirement).

10.1.3.2 Maintenance areas shall be constructed and protected in accordance with the appropriate provisions of NFPA 409 and NFPA 410 (Requirement).

10.2 Vehicle Repair Garages

10.2.1 Vehicle repair garages shall comply with NFPA 88B (Requirement).

10.2.2 Vehicle repair garages shall be located in 1 story buildings of non-combustible construction (Requirement).

10.2.3 **EXCEPTION**: Existing buildings. Modifications/upgrades to existing facilities shall comply with NFPA 88B (Requirement).

10.3 Buildings Under Construction

10.3.1 Buildings under construction shall comply with NFPA 1, NFPA 241, OSHA requirements, local codes, and general conditions of the specifications (Requirement).

10.3.2 Fire Protection Removal Requirements

10.3.2.1 When the work requires the temporary removal of the protection provided by an installed fire protection system, the work shall be programmed to limit the outage to the absolute minimum, and to assure that all practical precautions are taken, in the form of substitute protection and rescheduling of hazardous “hot work” until protection is restored (Requirement).

10.3.2.2 Contractors shall not shut down, shut off, disconnect, block, or otherwise impair any fire protection sprinkler system, fire hydrant, fire alarm system, special extinguishing, or other installed fire protection system without prior authority in writing from the AHJ (Requirement).

10.3.3 Sprinkler Systems

10.3.3.1 The installation of automatic sprinkler protection required as part of a project shall closely follow the construction and be placed in service as soon as practical and before occupancy or use of the area for storage or shops is allowed (Requirement).

10.3.3.2 Placing portions of the automatic sprinkler system in service during construction shall not release the contractor from completing a final acceptance test as specified by the AHJ (Requirement).

10.3.4 Space Heating Requirements

10.3.4.1 All temporary space-heating installations (such as salamanders or plaster drying equipment) shall be approved by the AHJ (Requirement).

10.3.4.2 All temporary space-heating installations shall comply with the following requirements (Requirement):

10.3.4.2.1 No liquid fuel tanks shall be pressurized except liquefied petroleum (LPG) in approved containers (Requirement).

10.3.4.2.2 To prevent fuel box explosions, liquid and gas burning units shall be provided with appropriate safeguards properly designed for the size and fuel rate of the equipment (Requirement). For example, all gas or liquefied petroleum gas-heating units shall be equipped with safety pilots.

10.3.4.2.3 Liquid and gas-fired units shall be shut down for refueling (Requirement).

10.3.4.2.4 Solid fuel equipment shall be completely enclosed and vented to the outside (Requirement).

10.3.4.2.5 Temporary heating units shall be of a stable design to guard against overturn and spilling fire and/or fuel (Requirement).

10.3.4.2.6 Adequate clearance shall be maintained to prevent ignition of combustible materials (Requirement).

10.3.5 Asphalt and Tar Kettles

10.3.5.1 Asphalt and tar kettles or similar fired equipment for preparing hot substances shall be located in a safe place outside the building at a point where there is no danger of ignition of combustible materials (Requirement).

10.3.5.2 Continuous supervision by the user shall be maintained while such equipment is in operation (Requirement).

10.3.5.3 Each tar kettle shall be provided with a metal cover and an accurate thermometer or other gage located in full view of the operator (Requirement).

10.3.5.4 Tar kettles shall be operated at temperatures at least 25 degrees below the ignition point of the material being used (Requirement).

10.3.5.5 Two 4A:60BC rated fire extinguishers shall be provided and maintained within 25 feet of each tar kettle (Requirement).

10.3.5.6 Tar kettles shall not be located within 20 feet of a facility or shall be protected from the facility by a barrier standing 4 feet above and to both sides of the pot (Requirement).

10.3.5.7 Rope barriers shall be provided to keep unrelated personnel 20 feet from the tar kettle (Requirement).

10.3.5.8 The contractor shall verify that the lid will close tight and that the tar kettle will be constantly attended from 30 minutes prior to operations until 30 minutes beyond (Requirement).

10.3.6 Torch Down Roofing

10.3.6.1 All personnel on the roof during torch application shall be trained on the proper use of a fire extinguisher (Requirement).

10.3.6.2 At least two 2½-gallon containers of water and two 20-pound ABC (dry chemical) shall be available within 10 feet of torch operation, per torch for use during the fire watch (Requirement).

10.3.6.3 Fire watch personnel shall be provided during torch application and for two hours after completion of torch application (Requirement).

10.3.6.4 At least one calibrated infrared heat detection gun per torch shall be provided for use during the fire watch to verify cool, safe, and a non-combustible conditions exist (Requirement).

10.3.6.5 For at least 2 hours, fire watch personnel properly trained shall be provided to survey the underside of the roof deck (whenever possible), as well as the topside for possible smoldering elements (Requirement).

10.3.6.6 All fire extinguishers prior to the completion of the day’s work shall be examined to make sure they are full and operable (Requirement).

10.3.7 Scaffolding Shoring and Forms

10.3.7.1 Steel or other noncombustible scaffolding, shoring, and forms are recommended, where practical.

10.3.7.2 Wood, when used, shall be subject to the following (Requirement):

10.3.7.2.1 Unnecessary accumulation of combustible forms or form lumber shall be avoided (Requirement)

10.3.7.2.2 Storage of wood material shall be kept outside of, and as far as practical from, the perimeter of the building (Requirement).

10.3.7.2.3 Forms and shoring shall be stripped from the building as soon as possible after completion of that phase of construction (Requirement).

10.3.7.2.4 Scaffolding shall be removed as soon as it is no longer needed (Requirement).

10.3.8 Gasoline-Powered Equipment - Gasoline-powered air compressors, hoists, derricks, or pumps shall be located so that the exhaust is well away from combustible material and exhaust vapors are piped outside, away from air intakes or otherwise adequately dispersed (Requirement).

10.3.9 Occupied Building Alterations

10.3.9.1 When additions or major alterations are undertaken in occupied buildings, a barrier shall be erected to separate the construction areas from the remainder of the building (Requirement).

10.3.9.2 This barrier shall be of noncombustible construction having a fire-resistance rating equivalent to that of the existing facility (Requirement).

10.3.10 Emergency Exits

10.3.10.1 Emergency exits shall be maintained during construction operations (Requirement).

10.3.10.2 In the construction of new multistory buildings, at least one usable stairway (or ramp) shall be provided at all times (Requirement).

10.3.10.3 The stairway shall be extended upwards as each floor level is erected during rehabilitation of/or modifications to existing buildings (Requirement).

10.3.10.4 If normal paths of exit travel are blocked by construction, clearly defined and illuminated alternate exits shall be provided (Requirement).

10.3.11 Inspections - The contractor shall conduct or have conducted an inspection of the entire work area at the end of each workday to discover any smoldering or incipient fires and to remove any hazardous conditions (Requirement).

10.3.12 Fire Planning - The contractor shall prepare for necessary action in case of fire (Requirement).

10.3.12.1 The degree of preparation depends upon the individual project but shall include (Requirement):

10.3.12.1.1 Fire alarm-initiating procedures (Requirement).

10.3.12.1.2 Notification of the fire department (Requirement).

10.3.12.1.3 Location of fire protection equipment (Requirement).

10.3.12.1.4 Evacuation procedures (Requirement).

10.3.12.1.5 Manual fire fighting efforts (Requirement).

10.3.12.1.6 Fire watch procedures (Requirement).

10.4 Essential Electronic Equipment Areas/Record Storage/Laboratory

10.4.1 Essential electronic equipment areas (see Chapter 3 for definition) shall be constructed and protected in accordance with the appropriate provisions of NFPA 70 and 75 (Requirement).

10.4.2 Automatic Sprinkler Protection

10.4.2.1 Automatic sprinkler protection is required for all electronic equipment and record storage areas and shall be installed in accordance with NFPA 13 and Chapter 8 of this document (Requirement).

10.4.2.2 The sprinkler system shall be valved independently from other sprinkler systems (Requirement).

10.4.2.3 The zone valve shall be equipped with electrical supervision (Requirement).

10.4.3 Under floor smoke detection shall be provided in all new raised floors (Requirement).

10.4.4 All construction under floor shall be of noncombustible material, including any ramps and/or stairs (Requirement). Use of wood or fire-retardant treated plywood is not acceptable.

10.4.5 Automatic Smoke Detection Equipment

10.4.5.1 Automatic smoke detection equipment capable of early warning shall be installed in all areas (Requirement).

10.4.5.2 Each installation shall be engineered for the specific area to be protected and meet the requirements of NFPA 72 (Requirement).

10.4.5.3 Smoke aspiration systems shall be used for new or refurbished essential electronic equipment areas (Requirement).

10.4.5.4 The smoke detection system shall be connected to a locally sounding alarm (Requirement).

10.4.5.5 The smoke detection system shall relay the alarm automatically to an approved central fire alarm control center (Requirement).

10.4.6 Areas shall be separated from the remainder of the facility by 1 hour fire-resistive construction (Requirement).

10.4.7 Record storage areas shall be separated from the remainder of the facility by 2 hour fire-resistive construction (Requirement).

10.4.8 Power cables in under floor spaces shall be either type Mineral Insulated, Metal Sheathed (MI), Metal Clad cable (MC), or Armored Cable (AC) cables or shall be installed in approved conduit or metallic tubing (Requirement).

10.4.9 Communication, data, and interconnecting cables shall be installed in approved conduit or metallic tubing or listed as approved for use in air plenums.

> ***EXCEPTION**: Under floor spaces not meeting the above cabling requirements shall be provided with an automatic fire suppression system. Sprinklers should only be used if the floor is raised a minimum of 4 feet (1.219 meters) and the sprinklers have at least 18 inches (458 millimeters) clearance to blockage potential.*

10.5 Cooling Towers

10.5.1 Cooling towers shall be constructed and protected in accordance with the appropriate provisions of NFPA 214 (Requirement).

10.5.2 Additionally, the following shall be considered with concurrence by the AHJ (Requirement):

10.5.2.1 Protection Requirements

10.5.2.1.1 Wood constructed cooling towers or those towers utilizing combustible construction/fill material, exceeding 2000 cubic feet in volume, shall be protected by a fixed, automatic, deluge sprinkler system, designed to provide complete coverage for the fill, fan deck, and fan motor (Requirement).

10.5.2.1.2 Sprinkler design densities/criteria shall be per NFPA 214 (Requirement).

10.5.2.1.3 Cooling towers with fiberglass or PVC type fill shall be considered combustible and shall be protected by sprinklers unless the fill is Factory Mutual approved (or equivalent) for use as noncombustible (Requirement).

10.5.2.2 New cooling towers shall be listed by an approved testing agency (Requirement).

10.5.2.3 Testing - The entire fire protection system shall be tested under simulated fire conditions prior to acceptance and on an annual basis thereafter (Requirement).

10.6 Transformer/Switchgear Locations

10.6.1 Transformers, switch-gear, and associated electrical equipment shall be installed in accordance with the appropriate provisions of NFPA 70 and 29 CFR 1910 (Requirement).

10.6.2 Transformer installations shall require a hazard assessment by a qualified risk assessment/fire protection engineer as to the location/exposure/criticality (Requirement).

10.6.3 The need for and/or type of protection of the transformer(s) shall be determined by the assessment findings and in conjunction with the AHJ (Requirement).

10.6.4 The assessment shall utilize the criteria set forth in the current Factory Mutual Loss Prevention Data Sheet 5-4. (TRANSFORMERS and ANSI IEEE Standard 979) (Requirement).

10.6.5 Applicable NFPA codes shall also be used for guidance in the assessment process (Requirement).

10.7 Food Preparation Areas

Exhaust systems over cooking equipment shall be installed and protected in accordance with the appropriate provisions of NFPA 13, 17, 96, and local codes (Requirement).

10.7.1 Extinguishing Systems:

10.7.1.1 A complete, automatic, chemical fire extinguishing system shall be provided to protect exhaust hoods, duct systems, grease removal devices, and the surface of deep fat fryers, ranges, griddles, and broilers (Requirement).

10.7.1.1.1 The system shall be in accordance with NFPA 17A (Requirement).

10.7.1.1.2 Activation of the chemical system shall interrupt power and/or the fuel supply to the affected equipment, initiate the building fire alarm system, and send a signal to a central fire alarm control center (Requirement).

10.7.1.1.3 A trip device to manually activate the extinguishing system shall be installed away from the cooking equipment near the entrance to the food preparation area or in a major travel path (Requirement).

10.7.1.2 A Class K, wet chemical type, portable fire extinguisher (potassium acetate base) shall be installed near deep fat fryers that use combustible cooking media (animal or vegetable oils and fats) (Requirement).

10.7.1.3 An appropriate number of Class A water extinguishers and Class BC dry chemical extinguishers, base on the size of the area to be protected, shall be provided for protection of the building and areas not associated with deep fat fryers.

10.7.1.4 Storage Areas - Storage rooms or areas used in conjunction with food preparation shall be protected with automatic sprinklers (Requirement). (For limited areas where no more than six sprinkler heads are required, the water can be supplied from the domestic water system).

10.8 Laboratories

10.8.1 Laboratories shall be constructed and protected in accordance with the applicable provisions of NFPA 45 and 29 CFR 1910.119, and 29 CFR 1910.1450 (Requirement).

10.8.2 Laboratories not fitting the classification outlined in the above referenced standards, yet housing unique, critically important, or high value research equipment, shall conform to the provisions of paragraph 10.4 (Requirement).

10.8.3 The AHJ shall be consulted to determine which laboratories fall within this category to assure which fire protection features shall be applicable to the laboratories (Requirement).

10.8.4 Automatic sprinkler protection is required for all areas and shall be installed in accordance with NFPA 13 and Chapter 8 of this document (Requirement).

10.8.5 The sprinkler system shall be valved independently from other sprinkler systems (Requirement).

10.8.6 The zone valve shall be equipped with electrical supervision (Requirement).

10.8.7 Under floor smoke detection shall be provided in all new raised floors (Requirement).

10.8.8 Also, all construction under floor shall be of noncombustible material, including any ramps and/or stairs (Requirement). Use of wood or fire-retardant treated plywood is not acceptable.

10.8.9 Automatic smoke detection equipment capable of early warning shall be installed in all areas (Requirement).

10.8.9.1 Each installation shall be engineered for the specific area to be protected and meet the requirements of NFPA 72 (Requirement).

10.8.9.2 Smoke aspirations system shall be used for new or refurbished areas (Requirement).

10.8.9.3 The smoke detection system shall be connected to a locally sounding alarm and shall relay the alarm automatically to an approved central fire alarm control center (Requirement).

10.8.10 These areas shall be separated from the remainder of the facility by 1 hour fire-resistive construction (Requirement).

10.8.11 Record storage areas shall be separated from the remainder of the facility by 2 hour fire-resistive construction (Requirement).

10.8.12 Power cables in under floor spaces shall be either type Mineral Insulated, Metal Sheathed (MI), Metal Clad cable (MC), or Armored Cable (AC) cables or shall be installed in approved conduit or metallic tubing (Requirement).

10.8.13 Communication, data, and interconnecting cables shall be installed in approved conduit or metallic tubing or listed as approved for use in air plenums (Requirement). (**EXCEPTION**: Under floor spaces not meeting the above cabling requirements shall be provided with an automatic fire suppression system. Sprinklers should only be used if the floor is raised a minimum of 4 feet (1.219 meters) and the sprinklers have at least 18 inches (458 millimeters) clearance to blockage potential.

10.9 Trailers and Manufactured Homes

10.9.1 Construction Requirements:

10.9.1.1 Use of trailers and manufactured home units as offices or for housing electronic equipment shall be reviewed and approved by the AHJ prior to siting (Requirement).

10.9.1.1.1 All trailers and manufactured home units so used shall meet the appropriate construction, mechanical system, and electrical system installation requirements of ANSI 119.1 and 24 CFR 3280 (Requirement).

10.9.1.1.2 Trailer/mobile home complexes that exceed 2,500 square feet (232.25 square meters) shall meet all requirements for permanent structures listed in this document, local codes, and NFPA 80A (Requirement).

10.9.1.1.3 Requirements for smaller complexes shall be determined by the AHJ (Requirement).

10.9.1.2 Trailers and mobile home units arranged for occupancy shall comply with the interior finish concealed space and exit requirements of NFPA 101 (Requirement).

10.9.1.3 Trailers and mobile home units shall be located at least 25 feet (7.62 meters) from permanent buildings and at least 25 feet (7.62 meters) apart, unless joined to form a single complex.

10.9.1.3.1 Single complex trailers must be of the same hazard classification (Requirement).

10.9.1.3.2 Single complex trailers shall be treated as permanent structures (Requirement).

10.9.2 Fire Alarm Systems shall be installed as denoted in paragraph 9.3 (Requirement).

10.10 Tunnels

10.10.1 Tunnels shall be constructed and protected in such a manner as to prevent smoke, heat, and flame from being conveyed via the tunnel into occupied areas of a building in accordance with OSHA, local codes, and NFPA 101 (Requirement). Fire-rated construction will be used as much as possible at the junction of the tunnel and the building foundation or exterior wall.

10.10.2 Fire Protection - Where passive measures alone would be insufficient to mitigate the hazard, automatic water spray systems at unprotected building openings or tunnel-wide fire suppression systems shall be installed (Requirement).

10.10.3 Entrance Requirements - A sufficient number of portals as determined by the AHJ shall be provided in tunnel networks for emergency access and firefighting efforts (Requirement).

10.10.4 Occupancy - Tunnels shall not be utilized as office or storage space (Requirement).

10.11 Anechoic Chambers

10.11.1 Anechoic chambers shall be protected by a complete fixed-based extinguishing system, designed and installed by recognized national standards, consisting of one of the following systems (Requirement) (Note- FM Global Data Sheet 1-53, *Anechoic Chambers* should be consulted when providing protection to Anechoic Chambers):

10.11.1.1 Automatic wet-pipe sprinkler protection controlled by separate U.L. listed indicating control valves.

10.11.1.2 A total-flooding automatic-acting primary system with a back-up automatic reserve system, both activated by a detection system integral to the suppression component of the system.

10.11.2 Fixed extinguishing systems shall comply with the following conditions (Requirement):

10.11.2.1 Control rooms shall be separated from the chamber by partitions having a fire-resistance rating of at least one hour (Requirement).

10.11.2.2 Vision panels shall be no more than nine square feet (0.836 square meters) (Requirement).

10.11.2.3 Vision panels shall be wired glass in steel frames (Requirement).

10.11.2.4 Air conditioning systems or other chamber ducting shall be independent of main facility systems (Requirement).

10.11.2.5 Chambers shall be equipped with an approved smoke detection system if a water-based extinguishing system is utilized to protect the chamber (Requirement).

10.12 Highbays

10.12.1 Highbays are defined to be any space with a ceiling height of thirty (30) or more feet. These spaces represent fire protection challenges due to the heat and smoke dispersion over the potentially large distances, compounded by the unique and sometimes large fuel loads associated with the aerospace industry. Based upon studies conducted by the National Institute of Standards and Technology (NIST), fire protection for highbay spaces shall conform to the following (Requirement):

10.12.1.1 Spaces with ceiling heights less than 30 feet shall follow NFPA and manufacturers guidelines (Requirement).

10.12.1.2 Spaces with ceiling heights 30 to 60 feet shall be designed by a registered Professional Engineer, with principles and practices in fire protection, using NFPA and manufacturer's

guidelines, computer fire models such as FPETOOLS, LAVENT, Fire Dynamics and Smoke View (FDS-SV) or Hazard, and sound engineering judgment (Requirement).

10.12.1.3 Spaces with ceiling heights in excess of 60 feet shall be in accordance with Section 4.5 (Requirement).

11. FIRE PREVENTION PROCEDURES

11.1 General Fire Prevention

11.1.1 Per NPR 8715.3, NASA Center Directors are responsible for implementing an effective fire safety program at their Center.

11.1.2 The following references shall be utilized in the development of a Fire Prevention Program (Requirement):

11.1.2.1 Fire Inspection and Code Enforcement Manual (IFSTA)

11.1.2.2 Local Building and Fire Codes

11.1.2.3 National Fire Prevention Code (NFPA)

11.1.2.4 Fire Protection Handbook (NFPA)

11.1.2.5 Fire and Life Safety Inspection Manual (NFPA)

11.1.2.6 Occupational Safety and Health (29 CFR 1910, 29 CFR 1960 and 29 CFR 1926)

11.1.2.7 NASA Safety Standards (NASA)

11.1.2.8 Plans Examiner for Fire and Emergency Services Manual (IFSTA)

11.2 Fire Reporting and Documentation

11.2.1 The following documents shall remain on file for the periods shown (Requirement):

Note: The AHJ can extend this time if warranted.

11.2.1.1 Fire Prevention Inspections (2 Years)

11.2.1.2 Fire/Evacuation Drills (2 Years)

11.2.1.3 Plan Reviews (5 Years)

11.2.1.4 Fire Protection System Inspections (5 Years)

11.2.1.5 Fire (Incident) Reports (Indefinite)

11.2.1.6 Fire Investigation Reports (Indefinite)

11.2.2 Fires meeting the definition of "a close call" as defined by NPR 8715.3, “NASA General Safety Program Requirements,” shall be reported as specified in NPR 8621.1, “NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping” (Requirement).

11.2.3 All NASA Centers shall report to the National Fire Incident Reporting System (NFIRS) directly or via a local system (Requirement).

11.2.4 All fires shall be reported via the Incident Reporting Information System (IRIS) to the facilities emergency operations center and to NASA Headquarters, Safety and Assurance

Requirements Division, for lessons learned, and pattern development within NASA (Requirement).

11.2.5 A summary of each NASA Center's incidents and their findings shall be reported to the annual meeting of the Fire Protection Working Group for review and suggestions (Requirement).

11.3 Fire Investigation

11.3.1 The AHJ at each NASA Center shall designate person(s) responsible for the investigation of all fires at their facilities (Requirement).

11.3.2 The requirements in NPR 8621.1, “NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping,” and NFPA 921 shall be used in these investigations (Requirement).

11.3.3 Contacts for outside assistance shall be established (Requirement).

11.3.4 Security shall be notified of all fires that are suspicious in nature (Requirement).

11.3.5 Persons within NASA assigned the responsibility of determining origin and cause shall be trained at the level of NFPA 1033 with annual refresher training provided by independent parties or certified origin and cause instructors (Requirement).

11.4 Smoking Locations

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

11.4.1.1 Hot and warm zones of any hazardous material incidents.

11.4.1.2 10 feet of any non-maintained vegetation.

11.4.1.3 25 feet of any storage or transfer of flammable/combustible liquids.

11.4.1.4 50 feet of any explosives transfer or storage magazine.

11.4.1.5 200 feet of any storage or transfer of liquid oxygen.

11.4.1.6 3-5 feet of any general combustible storage.

11.4.1.7 Surplus scrap yards.

11.4.1.8 Lumber storage yards.

11.4.1.9 Active airport ramp, taxiway, or runway.

11.4.1.10 On building/structure roofs

11.5 Fire Safety Education

11.5.1 Fire/Evacuation Drills

11.5.1.1 Fire drills shall be conducted annually in all facilities occupied by ten or more persons (Requirement).

11.5.1.2 Fire drills shall be conducted and evaluated by persons knowledgeable in fire and life safety (Requirement).

11.5.1.3 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 (Requirement).

11.5.1.4 Emergency plans shall include contingencies for all phases of operations including mission essential operations (Requirement).

11.5.1.5 These plans shall be reviewed and approved by the AHJ (Requirement).

11.5.2 Fire Safety Education

11.5.2.1 Fire Safety Education Programs shall be available to all occupants (Requirement).

11.5.2.2 At a minimum, all new employees shall receive an introduction to emergency systems within thirty days of employment that includes how to activate the emergency services 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 (if applicable) (Requirement). Other safety equipment training can be done in conjunction with this training.

11.5.2.3 Each Center/facility shall establish and maintain a comprehensive fire safety education/awareness program (Requirement).

11.5.3 Fire Extinguisher Training

11.5.3.1 Personnel that are required to use fire extinguishers shall be instructed in their use in accordance with OSHA 1910.38 (Requirement).

11.5.3.2 The training shall include all fire extinguishers which they may reasonably be expected to encounter (Requirement).

11.5.3.3 Persons who have not been trained in extinguishers shall not be instructed to use them (Requirement).

11.5.3.4 Training shall include a hands-on exercise under the same conditions which they would be expected to encounter in the work place (Requirement).

11.5.3.5 The training shall be supervised by a fire extinguisher instructor from the fire service (Requirement).

11.5.3.6 Industry Refresher Training shall be conducted in accordance with OSHA requirements (Requirement).

11.5.4 Fire Prevention Week - Centers are encouraged to take an active role in fire prevention week including jointly participating in surrounding community activities. NASA Public Affairs should be contacted in the promotion of NASA contributions to fire safety through science.

11.6 Housekeeping

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. In order to minimize fire hazards in the workplace, the following housekeeping requirements shall be followed (Requirement):

11.6.1 Large waste cans should be avoided in favor of small cans, which shall be emptied at regular intervals into a larger can in a safe remote location (Requirement).

11.6.2 Smoking material shall not be disposed of in waste cans until 12 hours have past since it was last used (Requirement).

11.6.3 Dumpsters and recycle bins shall not be stored closer then 10 feet from a structure with a fire rated wall and 15 feet from any other nonrated structure including towers (Requirement).

11.6.4 Hazardous materials may not be disposed of in general waste dumpsters.

11.6.5 Hazardous materials shall be disposed of in accordance with environmental regulations (Requirement).

11.6.6 Metal lids or doors should be provided and, if provided, shall be kept closed when not in use (Requirement). (**EXCEPTION**: large bulk open top dumpsters).

11.6.7 Paper in excess of that necessary to perform a task shall be removed (Requirement). Papers needed, which are awaiting actions, should be stored within cabinets until needed.

11.6.8 Recycle paper storage bins shall not be stored in hallways or stairwells (Requirement).

11.6.9 Bulk storage of recycled paper waiting processing shall be stored in outside containers (Requirement). Bulk paper may be stored within a structure in an AHJ approved location.

11.6.10 Approved (UL/FM) waste cans shall be provided in areas where oily waste and/ or flammable/combustible finishes are used or found (Requirement).

11.6.10.1 These cans shall be emptied daily or anytime the self-closing lid will not close (Requirement).

11.6.10.2 Areas where these cans may be needed include, but are not limited to, printing shops, vehicle repair shops, parts cleaning areas, and machine shops.

11.6.10.3 The size of the container will be determined by the volume of material being generated and the frequency of disposal.

11.6.11 No stock item, furniture, equipment, interior decoration, vehicle, debris, or other substantial physical object shall be placed or stored temporarily or permanently in a path of emergency travel (corridor, exit door, stairway, and point of exit discharge), without the approval of the AHJ (Requirement).

11.6.12 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) (Requirement).

11.6.12.1 Combustible dust shall not be removed by air pressure (Requirement).

11.6.12.2 Vacuum is the preferred method since airborne combustible dust may create an explosive atmosphere.

11.6.12.3 When air pressure must be used, all sources of ignition (pilot lights, on/off electric motors, hot work, etc.) shall be removed and the space must have adequate ventilation (Requirement).

11.6.12.4 Vacuum equipment shall be equipped with explosion proof motors (Requirement).

11.6.13 Scrap piles of combustible materials shall have fire lanes between piles at least 12 feet wide (Requirement).

11.6.14 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 (Requirement).

11.6.15 Hallways, doorways, stairwells, and lobbies shall be kept free of trash and debris and not be used for storage (Requirement).

11.6.16 Contractors, including construction contractors, shall remove and safely dispose of waste material and debris resulting from their operations on a daily basis (Requirement).

11.6.17 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 (Requirement).

11.6.17.1 The minimum frequency of cleaning will be daily for stoves and hoods, weekly for filters, and semi-annual for ducts and fans.

11.6.17.2 No stove or grill shall be used without the filter in place (Requirement).

11.6.18 A minimum of a 25 foot clear area shall be maintained between facilities, including trailers and boxcars, and combustible brush land (Requirement).

11.6.19 A 50 foot clear area shall be maintained between facilities and densely wooded areas (Requirement).

11.6.20 Closets, storage rooms, file rooms, and the like require a high degree of housekeeping to maintain commodities in proper containers and neatly stacked.

11.6.21 Combustible wastes shall not be allowed to accumulate within or adjacent to facilities (Requirement).

11.6.22 Rags contaminated with flammable or combustible liquids shall be kept in tightly covered, properly identified metal or polyurethane containers when not being used (Requirement).

11.6.22.1 The containers shall be emptied at least daily and always before occupants leave the area (Requirement).

11.6.23 Mops and other cleaning materials shall only be stored in janitorial closets or storage areas (Requirement).

11.6.24 The use of free-burning foams and plastics is prohibited except when no satisfactory substitute is available and use is approved by AHJ.

11.6.25 Electrical appliances, which have been modified or that are nonstandard in any way, shall not be used (Requirement).

11.6.26 All electrical appliances shall be unplugged when not in use, except when the appliance is controlled by an internal power switch (Requirement).

11.6.27 Only UL listed or FM approved coffee makers, refrigerators, crock pots, toasters, and microwaves shall be permitted for general office food preparation provided the electrical system is capable of supporting the load needed for these items (Requirement). Toaster ovens are not approved for use.

11.6.28 Portable space heaters are prohibited unless permitted and approved by the AHJ or Center policy. Permits shall be issued for validated medical reasons or during heating system outage (Requirement).

11.7 Fire Prevention Inspections

11.7.1 Fire prevention inspections shall be conducted by persons trained to recognize fire-related problems (Requirement).

11.7.2 Fire prevention inspections are done with a written document developed for each inspection and maintained as outlined in paragraph 11.2 (Requirement).

11.7.3 The frequency and the time of inspections shall be determined by the AHJ (Requirement), however the following is a recommended guide in developing a schedule:

11.7.3.1 Quarterly Inspections:

11.7.3.1.1 Mission essential

11.7.3.1.2 High dollar value

11.7.3.1.3 High life load (greater than 300 people)

11.7.3.1.4 Moderate to high risk hazardous storage or process

11.7.3.1.5 High fire/smoke/explosion potential

11.7.3.2 Semi-Annual Inspections:

11.7.3.2.1 Routine daily business

11.7.3.2.2 Moderate dollar value

11.7.3.2.3 Moderate life load (Less than 300 people)

11.7.3.2.4 Moderate risk hazardous storage or process

11.7.3.2.5 Moderate fire/smoke development

11.7.3.3 Annual Inspections:

11.7.3.3.1 Not normally occupied

11.7.3.3.2 Low dollar value

11.7.3.3.3 No or low life load (less than 10 people)

11.7.3.3.4 Low risk hazardous storage or process

11.7.3.3.5 Low fire/smoke development

11.7.4 The facility manager shall be given a copy of the inspection report and he/she shall be responsible for correcting deficiencies including following work orders through until complete (Requirement).

11.7.5 To ensure correction of noted deficiencies, re-inspection shall be done within 30 days of initial inspection (Requirement).

11.7.6 The use of Fire Department personnel to conduct these inspections is encouraged when it will not prevent them from performing emergency duties as outlined in Chapter 12. This will present the opportunity for Fire Department personnel to update pre-fire plans at the time of inspection.

11.7.7 A fire inspection should be used as a fire safety education tool first and foremost. Only as a last resort should it be used as a compliance order.

11.8 Hot Work

11.8.1 Open fires are prohibited except when a Permit is issued by the Fire Services or Safety Official.

11.8.2 The use of matches, lighters, and candles as substitutes for flashlights is prohibited.

11.8.3 Welding and cutting and open flame operations conducted outside a designated shop requires a permit issued by the Fire Services or Safety Official. As a minimum, the permit issuing official shall ensure that a fire watch is provided by the requester on all welding, cutting, open flames, and other hot work requiring a permit (Requirement).

11.8.4 Permitting officials, fire watchers, welders, and their apprentices shall be familiar with and trained to the requirements provided in NFPA 51B, 29 CFR 1910.252 and 1910.253 (Requirement).

11.8.5 When fire systems are required to be deactivated for welding, cutting, open flames or other hot work, it is imperative that the systems be turned back on as soon as possible.

11.8.6 The permitted location of welding, cutting, open flames, or other hot work shall not be changed or altered (Requirement).

11.8.7 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 issued (Requirement).

11.8.8 Use of tar pots requires a permit issued by the Fire Services or Safety Official.

11.8.9 Tar pots shall not be located within 20 feet of a facility or shall be protected from the facility by a barrier standing 4 feet above and to all sides of the pot that are exposed the building (Requirement).

11.8.10 Rope barriers shall be provided to keep unrelated personnel 20 feet from the tar pot (Requirement).

11.8.11 The user shall verify that the lid will close tight and that it will be constantly attended from 30 minutes prior to operations until 30 minutes beyond (Requirement).

11.9 Flammable and Combustible Liquids

11.9.1 All storage cabinets for flammable and combustible liquids shall comply with NFPA 30, have UL/FM seal, and be painted a highly visible yellow, with 4 inch red lettering stating, "Flammable - Keep Fire Away" (Requirement).

11.9.2 Where deemed appropriate by the AHJ, a Flammable/Combustible Liquid Storage Permit shall be obtained and prominently displayed on the outside of the cabinet (Requirement).

11.9.3 All storage buildings, sites, and designated rooms for flammable and combustible liquids shall be identified as such in accordance with NFPA 30, and placarded per NFPA 704 (Requirement).

11.9.4 Bulk storage of flammable and combustible liquids shall be in compliance with the requirements of NFPA 30, and with the approval of Fire Services or Safety Official (Requirement).

11.9.4.1 Only approved containers or portable tanks shall be used (Requirement).

11.9.4.2 Storage of containers shall be on pallets or approved shelves (Requirement).

11.9.4.3 Outside storage areas shall have a minimum of one fire hydrant within 500 feet (Requirement).

11.9.4.4 The outside storage site shall be graded to allow drainage away from any buildings (Requirement).

11.9.4.5 Outside storage shall be on pallets separated by 5 feet from all other pallets (Requirement).

11.9.5 Storage of flammable and combustible liquids with a flash point of 200 °F or less shall comply with the following (Requirement):

***EXCEPTION**: single dispensers of common cleaning materials*

11.9.5.1 Spray cans shall be stored in accordance with NFPA 30 and AHJ regulations (Requirement).

11.9.5.2 Frangible containers are prohibited for use in handling flammable and combustible liquids except when approved in writing by the Fire Services or Safety Officials. In general, a total quantity of 1 gallon of flammable/combustible liquids may be stored in flammable containers per permitted storage cabinet. This quantity can be increased per NFPA 45 for laboratory areas requiring frangible container storage based on liquid purity requirements.

11.9.5.3 Flammable or toxic materials shall be used only in areas where adequate ventilation is provided (Requirement).

11.9.5.4 Provisions shall be made to prevent vapors from accumulating in confined spaces (Requirement).

11.9.5.5 Electrical equipment shall be listed/approved for the appropriate hazard Class & Division per NFPA 70 (Requirement).

11.9.5.6 Flammable liquid storage cabinets shall be located only in "No Smoking" areas and at least 15 feet from egress routes unless otherwise approved by the AHJ (Requirement).

11.9.5.7 Flammable liquid storage cabinets shall not have combustible material stored in, on, or near them (Requirement).

11.9.5.8 All flammable liquids which require refrigeration shall be stored in refrigerators or freezers that are NFPA 45 and FM/UL approved/listed (Requirement).

11.9.5.9 Food shall not be stored in refrigerators with flammable liquids (Requirement).

11.9.5.10 Flammable and combustible liquid storage cabinet venting bungs shall remain in place, unless the cabinet is connected to a singular vented system piped to the outside (Requirement).

11.9.5.11 The flammable and combustible liquids that need to be separated because of incompatibility shall be in approved cabinets which are clearly identified; i.e., "Acids Only," "Bases Only," "Oxidizer Only," or other appropriate label (Requirement).

11.9.5.12 Only FM/UL approved safety containers that meet NFPA and OSHA requirements shall be used (Requirement).

11.9.6 Vehicles (loaded or empty) used for transporting flammable and combustible liquids shall not enter any building unless specifically approved by the AHJ (Requirement).

11.9.7 Vehicles and engines shall not be fueled or defueled inside a building, except when approved by the Fire Services or Safety Official (Requirement).

11.9.8 Any vehicle or engine being fueled or defueled inside a building shall be properly bonded and grounded (Requirement).

11.9.9 The storage, possession, or use of flammable and combustible liquids (other than safety approved solvents) is prohibited except for non-substitute essential applications approved by the Fire Services or Safety Official.

11.9.10 The user of such liquids shall develop an approved technical operating procedure for applications, precautions, and storage in accordance with OSHA 1910.1200 (Requirement).

11.9.11 A copy of the procedure shall be readily available in the work area (Requirement).

11.9.12 All construction contractors performing work shall comply with all of the requirements for storage and use of flammable and combustible liquids contained in this handbook as well as applicable OSHA regulations and NFPA codes (Requirement).

12. FIRE SERVICE OPERATIONS AND REQUIREMENTS

12.1 General

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/training, and a fire suppression force to minimize losses in the event of a fire. This chapter pertains to the fire service operations element of a fire protection program including command and control, fire fighting, emergency medical service (EMS), rescue and hazardous materials response.

12.1.1 Each NASA Center Director's responsibilities for fire service operations and firefighting are provided in NPR 8715.3, Chapter 5.

12.1.2 The fire department shall be equipped with a sufficient amount of first-line and reserve firefighting vehicles to combat anticipated fires (Requirement).

12.1.3 Personnel staffing shall be authorized by the local individual who is the AHJ (Requirement). Fire service operations may be provided by:

12.1.3.1 NASA contractor

12.1.3.2 Civil Service employees

12.1.3.3 Other local fire departments

12.1.3.4 Fire brigade

12.1.3.5 Any combination of the above

12.1.4 Hazardous Materials - The wide spread 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 services, extinguish the fire, and contain the materials. Once these actions have been accomplished, the involvement of the fire department reverts to a support role. Recovery, neutralization, cleanup, and disposal of hazardous materials are accomplished by trained experts in the related field.

12.1.5 The AHJ shall be notified by the Senior Fire Officer when staffing levels or the minimum amount of firefighting vehicles needed to support the NASA mission fall below the number needed to operate adequately in time of emergency (Requirement).

12.2 Incident Management System

12.2.1 Each NASA Center/facility shall adopt, implement, train in the use of, and utilize an Incident Management System in accordance with HSPD5, NIMS, and, NFPA 1561 when managing any emergency or disaster (Requirement).

12.2.2 Specific responsibilities shall be identified in each NASA Center's Emergency Preparedness Plan required by NPR 8715.2, “NASA Emergency Preparedness Plan Procedural Requirements” (Requirement).

12.3 Local Fire Service Support

When fire suppression, rescue, EMS, and/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 (Requirement). In many cases, NASA or NASA contractor personnel augment local fire service responses primarily through information coordination efforts.

12.4 NASA Contractor or Civil Service Fire Service Operations

12.4.1 Contractor(s) shall be held responsible for contract compliance (Requirement).

12.4.2 Civil Service and contracted fire departments at each NASA Center/facility shall develop and implement a written Fire Service Operations Plan that ensures compliance with applicable NFPA, OSHA, FAA, and/or NASA documents (Requirement).

12.4.3 The Fire Service Operations Plan shall include the following (Requirement):

12.4.3.1 Mission Statement

12.4.3.2 Management Plan:

12.4.3.2.1 Organizational Structure and Lines of Communication

12.4.3.2.2 Occupational Safety and Health Plan

12.4.3.2.3 Self inspection/Self audit process

12.4.3.2.4 Training and Certification Plan

12.4.3.3 Operations Plans:

12.4.3.3.1 Emergency Response Plan

12.4.3.3.2 Minimum Staffing Plan

12.4.3.3.3 Vehicle Maintenance and Refurbishment Plan

12.4.3.3.4 Physical Fitness Plan

12.5 Fire Brigades

Where Industrial Fire Brigades are established and operated at a NASA Center/facility, the brigades shall, as a minimum, comply with this standard, NFPA 600, NFPA 1081, and OSHA 29 CFR 1910.156 (Requirement).

12.6 Communications

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/facility shall be provided and operated by qualified operators that meet the requirements of NFPA 1061 and 1221 (Requirement).

12.7 Aircraft Operations

Each NASA Center/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 for the flight crews during aircraft emergencies, per FAA Part 139 and NFPA 403 (Requirement).

12.8 Fire Stations

12.8.1 Each fire station located at NASA Centers/facilities shall be designed, constructed, and maintained to allow the fire department to effectively fulfill its assigned mission(s) and to provide firefighters with a safe working environment orientated to their operational needs (Requirement), including:

12.8.1.1 A training and education center to provide firefighters an environment conducive to learning manipulative and technical skills (Requirement).

12.8.1.2 A dining room with tables and chairs, stove and oven, refrigerator, sink, dishwasher, counter space, and cabinet storage (Requirement).

12.8.1.3 Furnished day room and recreational area (Requirement).

12.8.1.4 Sleeping accommodations with individual or crew cubicle, clothing racks, nightstands, lockers, drapes, individual lighting, and carpeting (Requirement).

12.8.1.5 Physical fitness room equipped with proper exercise equipment (Requirement).

12.8.1.6 Storage area(s) for extinguishing agents, equipment, and materials, including personal protective equipment (PPE) (Requirement).

12.8.1.7 Bays to house assigned fire apparatus and support vehicles (Requirement).

12.8.1.8 Administrative space (Requirement).

12.8.1.9 Heating and air conditioning (Requirement).

12.8.1.10 Fire Alarm Communications Center for those NASA Centers/facilities that assign this function to the fire department (Requirement).

12.8.1.11 Compliance with applicable portions of NFPA 1500 (Requirement).

12.8.1.12 Maintenance/repair area(s) for facility, apparatus, and/or equipment, including personal protective equipment (PPE) (e.g. sink(s), washer, and dryer) (Requirement).

12.8.1.13 Emergency Operations Center (e.g. primary or alternate site) for those NASA Centers/facilities that assign this function to the fire department (Requirement).

12.8.1.14 Compliance with applicable portions of NFPA Fire Protection Handbook (Requirement).

12.9 Response Time and Distance

12.9.1 For NASA Centers/facilities, the AHJ shall establish response times to various facility locations to ensure that the fire response arrives in a timely manner in order that appropriate action(s) are taken to mitigate the emergency situation (Requirement).

12.9.2 For a fire department emergency response, the turnout time shall be no longer than 1 minute (Requirement).

12.9.3 Unannounced station bunker drills shall be performed to ensure compliance with the standard (Requirement).

12.9.4 Annual time/distance response assessments from station(s) to major facilities shall be conducted and recorded to ensure capability to reach the scene in a timely manner (Requirement).

12.10 Pre-fire Planning

12.10.1 Each NASA/Center/facility shall implement a pre-fire plan program (Requirement).

12.10.2 Pre-fire plans shall be prepared on facilities with a current replacement value in excess of $500,000 or more than 10,000 square feet of floor space (Requirement).

12.10.3 Pre-fire plans shall also be required for each type aircraft that is based at the Center or regularly frequents the Center (Requirement).

12.10.4 While NFPA 1620 (facilities) and NFPA 424 (aircraft) shall be referenced, the minimum required data for a pre-fire plan is as follows (Requirement):

12.10.4.1 Facility Pre-fire Plans:

12.10.4.1.1 Facility number, type, occupancy, and fire loading (Requirement).

12.10.4.1.2 Square footage and number of floors (Requirement).

12.10.4.1.3 Location of water supply, connections, and valves (Requirement).

12.10.4.1.4 Facility hazards, laboratories, flammable storage, or other potential hazards (Requirement).

12.10.4.1.5 Approach access and fenced areas (Requirement).

12.10.4.1.6 Water available, determined by fire flow (Requirement).

12.10.4.1.7 Type of fire systems, locations of water and utility shut-off valves (Requirement).

12.10.4.1.8 Single line drawing with NFPA 170 symbols (Requirement).

12.10.4.1.9 Forcible entry and air tools required to gain entry (Requirement).

12.10.4.1.10 Specialized facility features (Requirement).

12.10.4.1.11 Approximate number of occupants (day/night) (Requirement).

12.10.4.2 Aircraft Pre-fire Plans:

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

12.10.4.2.2 Type of Aircraft (Requirement).

12.10.4.2.3 Optimum vehicle positions (ARFF vehicles) (Requirement).

12.10.4.2.4 Approach to entry points on aircraft (Requirement).

12.10.4.2.5 Predesignated rescue duties (Requirement).

12.10.4.2.6 Other factors pertaining to aircraft fire fighting (Requirement).