

TABLE OF CONTENTS

D40 GENERAL FIRE PROTECTION REQUIREMENTS..... 2

1.0 Application of this Chapter..... 2

2.0 Acronyms and Definitions..... 2

3.0 Codes and Standards (required unless otherwise indicated)..... 3

4.0 Construction..... 4

5.0 Design Documentation..... 9

6.0 Equipment/Piping Identification..... 12

7.0 Exposure and Natural Phenomenon Hazards Protection..... 12

8.0 Fire Detection and Alarm (D5030.90)..... 14

9.0 Fire Prevention Features..... 18

10.0 Installation and Testing..... 18

11.0 Life Safety Considerations..... 18

12.0 Pre-Emergency Planning Programs..... 19

13.0 Site Fire Department Access..... 20

14.0 Site Fire Protection Water Distribution..... 22

15.0 Special Fire/Explosion Hazards..... 22

D4010 FIRE SUPPRESSION..... 23

1.0 General..... 23

2.0 Design Requirements..... 23

D4010.50 SPECIAL FIRE EXTINGUISHING SYSTEMS..... 26

1.0 Special Fire Extinguishing Systems..... 26

D4030 FIRE PROTECTION SPECIALTIES..... 26

1.0 Portable Fire Extinguishers..... 26

D4050 COMMISSIONING FIRE PROTECTION AND LIFE SAFETY..... 26

1.0 Fire Protection Infrastructure..... 27

2.0 Water-Based Fire Suppression Systems..... 28

3.0 Clean Agent Extinguishing Systems..... 28

4.0 Chemical Extinguishing Systems..... 29

5.0 Fire Detection and Alarm Systems..... 29

6.0 Passive Fire Protection and Life Safety Features..... 29

7.0 Life Safety Features..... 30

ATTACHMENTS..... 31

PLEASE CONTACT THE ESM FIRE POC
for upkeep, interpretation, and variance issues

Section D40	Fire POC/Committee
--------------------	------------------------------------

The LANL Eng Standards are available at <http://engstandards.lanl.gov>

D40 GENERAL FIRE PROTECTION REQUIREMENTS

NOTE: This chapter's requirements have been numbered (e.g., Requirement 2-0001 appears after a paragraph). A separate document for LANL internal use captures and categorizes the basis for each (available from stdsweb@lanl.gov or chapter POC).

1.0 APPLICATION OF THIS CHAPTER

1.1 General

- A. The purpose of this chapter of the Engineering Standards Manual (ESM) is to provide design requirements for fire protection systems so that these systems prevent accidents and mitigate consequences; are free from hazard; are efficient, convenient, and adequate for good service; and are maintainable, standardized, and adequate for future expansion. Code requirements are minimum requirements that are augmented by the site-specific requirements in this chapter.
- B. All fire protection design, material, equipment, and installations shall comply with site-specific requirements in this Chapter of the ESM and others as applicable, most notably Chapter 1 General (especially Section Z10) and Chapter 16 IBC Program.
- C. Sprinklers: This chapter provides fire protection requirements and guidance for sprinkler piping systems and specialties downstream of the base of the riser, including the riser backflow preventer. Follow ESM Civil Chapter 3 for requirements upstream of the base of the riser, e.g., fire hydrants, post indicator valves, piping, etc.
- D. Refer to Subsection D4050 herein and ESM Chapter 15 Commissioning for expectations for testing and integrated commissioning of fire protection and life safety features.

2.0 ACRONYMS AND DEFINITIONS

Refer to ESM Ch. 1 Section Z10 for any not listed below.

Title	Description
AHJ	Authority having jurisdiction. The Los Alamos National Laboratory (LANL) Fire Marshal is the AHJ and owner of this ESM Chapter; however, engineering standard-related inquiries can be initially directed to the Standards Program Fire POC.
Design Agency	The organization performing the detailed design and/or analysis of a project or modification (see ESM Ch. 1 Section Z10)
Design Authority	The person or group responsible for the final acceptability of and changes to the design of a system or component and its technical baseline (typically the manager of Engineering Services). (see PD340)
ES-FP	LANL Fire Protection Group Office in Engineering Services
ESM	LANL Engineering Standards Manual
FM	Factory Mutual
HPR	Highly protected risk
IBC	International Building Code
IFC	International Fire Code
ITM	Inspection, test, and maintenance
LAFD	Los Alamos County Fire Department

Title	Description
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
UL	Underwriters Laboratories

3.0 CODES AND STANDARDS (REQUIRED UNLESS OTHERWISE INDICATED)

3.1 General

- A. ESM Chapter 1 Section Z10 addresses some of the required codes, standards, CFRs, and LANL Engineering Standards. It also addresses how they and the ESM are to be applied, including topics such as precedence of documents, clarifications and variances, code of record, design output requirements, and environmental qualification of equipment.
- B. Above and beyond the requirements of Z10, the LANL Fire Marshal, not the Chapter POC, must approve any amendments (clarifications, variations, etc.) to this chapter (Requirement 2-0001).

3.2 DOE (Department of Energy) (selected, required Orders, Guides, and Standards)

Comply with the following (version per ESM Chapter 1 Section Z10 and NNSA/LANL Contract):

- A. [DOE O 420.1](#), Facility Safety (in 420.1C: Att. 2, Chapter II) (*Chg 3 or later*) (Requirement 2-0002),
- B. [DOE-STD-1212](#), Explosives Safety (*2019 or later*) (Requirement 2-0003), and
- C. [DOE-STD-1066](#), Fire Protection (*2016 or later*) (Requirement 2-0004).

3.3 Building Code

- A. International Building Code (IBC), International Existing Building Code (IEBC), and the International Fire Code (IFC) (Requirement 2-0005).
 - 1. Follow ESM Chapter 16 ([IBC Program Section IBC-GEN, App A, LANL Building Code](#)) for LANL-required editions and amendments.
 - 2. Refer to the following sections of ESM Chapter 5 Structural for seismic design/analysis provisions:
 - a. Section I for DOE Natural Phenomena Hazard Mitigation Requirements and Designated Seismic Systems.
 - b. Section II for commercial/non-nuclear applications.
 - c. Section III for nuclear applications.
- B. Follow the most stringent among fire and life-safety requirements of the IBC, IFC, NFPA 101–Life Safety Code¹, and New Mexico and [LANL](#) amendments to these mandates (Requirement 2-0006), in accordance with ESM Ch. 1 Section Z10 precedence requirements.
 - 1. Doing so shall be considered to have met the “life safety” requirements of OSHA (29 CFR 1910) and worker safety and health expectations of 10 CFR 851.²

¹ Per ESM Ch 1 Section Z10 subsection on Codes and Standards (driven by NSEP-TP-1).

² Basis: 10 CFR 1910.35 and DOE-sTD-1066.2016 4.2.6.1. Also PD 1220.0 *Fire Protection Program*, Section 3.1.2, and J. Streit memo (EMref 24). EMref refers to a Standards Program internal filing system for hard-to-find references.

2. The LANL Fire Marshal is the Authority Having Jurisdiction (AHJ) for resolving conflict regarding what requirement is most stringent and any mutually-exclusive conflicts among these documents, contacting the Los Alamos Field Office when necessary (2-0007).
3. Where the above codes refer to AHJ or the Administration Authority for Fire Protection matters, refer to the LANL Fire Marshal.

3.4 Factory Mutual (FM)

- A. FM Property Loss Prevention Data Sheets shall be applied where specifically referenced by DOE-STD-1066. Other FM Data Sheets should be used as guidance in implementing highly protected risk (HPR) (Requirement 2-0010). Apply datasheets in whole or in part as warranted by the hazard or loss potential.
- B. Current data sheets are available at: <https://www.fmglobal.com/research-and-resources/fm-global-data-sheets>
- C. Review *XL GAPS Guidelines* (formerly Industrial Risk Insurers) for additional guidance.

3.5 NFPA (National Fire Protection Association)

- A. NFPA Codes and Standards (Requirement 2-0011)
 1. Refer to Attachment 1 of this Chapter for LANL-required editions and exceptions.
- B. *Listing of current NFPA codes and standards is available at: <http://www.nfpa.org/>; LANL users have access [here](#), non-LANL may register for free [viewer](#).*

Guidance: Refer to the Fire Protection Handbook and other guides.

3.6 Society of Fire Protection Engineers

Guidance: Fire Protection Engineering Handbook.

4.0 CONSTRUCTION

4.1 Project Conceptual Design Considerations (*Guidance*)

- A. Developing an effective fire protection design and maintaining an effective fire protection program at a new or modified facility requires consideration of a variety of fire protection topics at an early stage of any project. These considerations should be continuously revisited throughout the project with increasing attention to detail until the project is completed. These project considerations typically remain vital fire protection program elements through the useful life of the affected facility, and so will remain important beyond completion of a project after a facility construction project has been turned over to Operations.
- B. Following is a brief list of project-related fire protection considerations. Many of these are addressed in this chapter or other chapters of the ESM; however, the expertise of a fire protection engineering professional is vital to ensure that all relevant project aspects have been appropriately considered.
 1. Site and Civil Considerations: emergency vehicle and emergency responder notification/response time, proximity/availability and condition of fire-fighting water including fire hydrants, nearby hazards to emergency responders, emergency responder

access, emergency responder pre-incident planning, emergency responder facility familiarity training, contaminated water run-off mitigation.

2. Operations Considerations: material hazards, materials storage, process hazards, process utilities, operations procedures and training, facility safety analysis expectations.
3. Architectural Considerations: size, occupancy, construction materials, construction techniques, emergency egress, exposure hazards, security considerations, fire separation between areas.
4. Structural Considerations: materials of construction, fireproofing of structural elements, deflagration venting, flood/seismic/snow/wind design.
5. Mechanical/I&C Considerations: fire protection water supply, piped fire protection systems, pneumatic power and control systems, piped gasses, HVAC systems, smoke control and smoke management.
6. Electrical Considerations: system controls, detection and alarm, emergency lighting, primary and backup power, need for electrical equipment rated for hazardous locations.
7. Maintenance Considerations: equipment accessibility, frequency and methodology of required inspection/testing/maintenance (ITM), special equipment required to perform ITM.

4.2 Highly Protected Risk (HPR)

- A. *Guidance: Highly protected risk or "improved risk" is a class of industrial loss prevention criteria to address special or severe hazards, and the potential for significant property loss. LANL adopts a comprehensive management approach to this consistent with property insurance industry expectations that result in preferred insurance premium status. The design and construction aspects of this [excerpted from PD 1220.0 definition] are:*

1. *Substantial facility construction (i.e., fire-resistive and noncombustible), including interior fire-rated barriers and protection of openings, segregation of hazards and fire protection systems;*
2. *Adequate (of sufficient capacity and duration) and reliable fire protection water supplies;*
3. *Automatic sprinkler protection where necessary;*
4. *Proper protection of special hazards, including special extinguishing systems where appropriate, protection of process hazards, and protection of special occupancy hazards;*
5. *Supervision of facilities, including remote monitoring of fire protection systems; and*
6. *Control of and protection from severe fire exposures, including the aggregation of hazards posed by multiple tenants within a single facility, relocatable/temporary structures and wildland fire.*

The implementation of HPR is project, operations, and facility specific.

DOE-STD-1066 defines the minimum requirements for DOE HPR criteria, including following FM Datasheets when required or recommended. A graded approach is taken in the application of requirements that are more stringent than national codes and standards.

- B. HPR levels for fire protection are to be provided at LANL facilities (Requirement 2-0008).
- C. The LANL Fire Marshal is the AHJ for HPR criteria, and determines how to apply DOE-STD-1066 and when additional protection measures are warranted (Requirement 2-0009).

4.3 General Building Construction Requirements

- A. Fire resistance ratings for buildings shall be based on the IBC and NFPA 101 requirements for occupancy type, size, number of floors, adjacent exposures, etc., whichever is more restrictive (must evaluate both). (Requirement 2-0012)
- B. Minimum construction for LANL facilities, greater than 5,000 ft² in gross area, shall be IBC Type II-B or NFPA 220 Type II (000). (Requirement 2-0013)
- C. The use of Type III, IV, or V construction types for facilities less than 5,000 ft² in gross area requires approval of the LANL Fire Marshal. (Requirement 2-0014)
- D. Hazard Category 1, 2, or 3 facilities shall be a minimum construction of IBC Type II-B or NFPA 220 Type II (000). (Requirement 2-0015)

4.4 Construction Materials

- A. NFPA 101 and the IBC define restrictions on materials that are used for construction. Specific restrictions that are important to the discipline of fire protection engineering include the following:
 - 1. All materials that are to be used as part of a fire protection system, structure or component (SSC) shall be nationally-recognized testing laboratory (NRTL) listed for the specified use, where required to be listed by the governing code or standard, or by the LANL Fire Marshal (Requirement 2-0016).

Guidance: Interior finish materials restrictions (smoke developed and flame spread ratings) provide assurance that occupants of the structure will have a good chance to exit a building during a fire emergency. Flame spread rating restrictions help ensure that a fire will not spread with excessive speed. Smoke developed ratings help to ensure that occupants will be able to locate and reach exits.

Guidance: Fire rating requirements for interior and exterior walls define the robustness of the structure when exposed to an interior or exterior fire.
- B. Design approaches that differ from—and modifications of—a listed/approved assembly require recertification by the listing/approving agency or approval of a DOE O 420.1C and/or NFPA equivalency request prior to assembly or item being acceptable for use. (Requirement 2-0017).

4.5 Fire Areas (*Guidance*)

- A. Large structures, structures with multiple areas with different types of hazards, or structures with multiple types of occupancies (see Section 11.0, Life Safety Considerations) are often segmented into separate Fire Areas. A Fire Area is defined by fire-rated barriers. The purpose behind designating a Fire Area is to define the limits of a postulated fire starting within the Fire Area.

4.6 Fire Barriers

- A. Fire barriers and associated ratings shall be indicated on drawings to support on-going inspection and maintenance and to support future modification work (Requirement 2-0018)
- B. Where a wall or floor/ceiling is required as a fire barrier, its design shall have been tested in accordance with ASTM E119 (Requirement 2-0019).
- C. Additional requirements for fire barriers:
 - 1. If fire areas are utilized to minimize potential property loss or mission continuity loss in a structure, barriers shall have a fire rating of not less than two (2) hours, unless justified by the Fire Hazard Analysis (Requirement 2-0020).

2. If fire barriers are utilized to segregate or minimize large (i.e., greater than \$412 million baselined at CY2018 values) property loss potentials within a structure, barriers shall have a fire rating of not less than three (3) hours, unless justified by the Fire Hazard Analysis (Requirement 2-0021).
3. Occupancies within a structure shall be separated from other occupancies within the same structure as necessary to provide an increased level of life safety for the occupants in the structure from more hazardous areas, or otherwise comply with the requirements of the IBC and NFPA 101 (Requirement 2-0022).
4. Employ fire separation where necessary to separate the bulk of the structure from the passageways/stairways used to exit from the structure during an emergency to provide assurance that occupants will be able safely exit a building during a fire emergency per IBC and NFPA 101 (Requirement 2-0023).
5. Provide a fire-rated barrier when identified by a Hazards Analysis as needed to minimize the consequences of a fire within or outside of a facility (Requirement 2-0024).

4.7 Fire Barrier Penetrations, Openings, and Joints

- A. When a fire barrier is required for any reason, it shall be maintained in good condition for the lifetime of the facility (Requirement 2-0025).
- B. Penetrations, openings, and joints in a fire barrier shall be protected with materials, assemblies, or devices to maintain the fire barrier rating (Requirement 2-0026).
- C. Designs for building modifications involving new penetrations or openings shall indicate ratings of any fire barriers (Requirement 2-0027).

Guidance: Because the integrity of fire barriers must be maintained for the life-cycle of the facility, an inventory of facility fire barriers, penetrations, and opening protective assemblies/devices/ systems should be developed and subject to change control. This might take the form of barrier plans, penetration maps, or a database – commensurate with the quantity, complexity and expected rigor applicable to the barriers. Project drawings should include a table defining designated fire and smoke barriers including barrier construction material and any tested configuration reference, hourly fire barrier rating or smoke barrier rating, and specific items penetrating the barrier (location, size, and penetrating item). Note that the LANL Firestopping Master Specification Section 07 8400 (Article 1.4) requires that the firestopping Subcontractor provide a complete schedule of fire and smoke barrier opening locations, sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of the fire barrier assembly.
- D. Seals, or “through-penetration firestop assemblies,” shall be approved systems tested by UL, FM, or another nationally recognized testing laboratory in accordance with ANSI/UL 1479, *Fire Tests of Through-Penetration Firestops* or ASTM E814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops* (Requirement 2-0028).
- E. Fire-resistant joints (head-of-wall, bottom-of-wall, wall-wall, floor-wall, curtain wall, etc.) shall be approved systems tested in accordance with ASTM E 1966, *Standard Test Method for Fire-Resistive Joint Systems*; UL 2079, *Tests for Fire Resistance of Building Joint Systems*, or ASTM E 2307, *Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus* (as appropriate) (Requirement 2-0029).
- F. Where a fire door, fire damper or penetration seal that is not UL/FM approved is to be used in a fire barrier, it shall still be tested to support that it provides adequate fire protection, or it shall be reviewed and accepted by a fire protection engineer in the LANL Fire Protection Group (Requirement 2-0030).
- G. Ventilation Penetrations
 1. Ductwork penetrating and air transfer openings in fire barriers shall be equipped with a fire damper (Requirement 2-0031).

Guidance: Fire dampers are not required in certain situations, such as for air ducts penetrating fire barriers of ratings 1-hour or less in occupancies other than Group-H where automatic sprinklers are provided. Also important to note is that ducts are not permitted to penetrate walls of exit enclosures, such as interior exit stairways.

2. The design shall support fire damper installation in accordance with manufacturer's instructions, include provision of sufficient clearance around the fire damper for the fire damper to function correctly correct framing of the rough opening, and provide adequate access to permit inspection, testing and maintenance activities. (Requirement 2-0032).

Guidance: Also refer to SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.

3. Where ductwork penetrates a fire barrier but no fire damper is required, the penetration shall be provided with a through-penetration firestop system around the penetration (Requirement 2-0033).

4. To prevent travel of smoke, a listed smoke damper, or a combination fire/smoke damper, shall be used (Requirement 2-0034).

Guidance: Smoke dampers are to be installed where required by applicable codes and standards for duct penetrations of smoke barriers. The IBC, NFPA 90A, and NFPA 101 are the primary documents; but occupancy or industry specific standards such as NFPA 75 and 76 may also need to be considered, if applicable.

5. Refer to ESM Chapter 6, Section D3040 HVAC Distribution, for additional fire and/or smoke damper requirements.

H. Doors

1. Fire doors shall have the appropriate fire rating (reference NFPA 80, *Standard for Fire Doors and Other Opening Protectives*) to maintain the integrity of the barrier in which they are installed (Requirement 2-0035).
2. If a door must remain normally open, it shall be equipped with an appropriate mechanism to automatically close the door when there are fire conditions on either side of the barrier. This mechanism shall either be a fusible link allowing the door to close upon high temperatures, or an electromagnetic switch releasing the door upon smoke detection (in the vicinity of the door or area protection) or other initiating device actuation (e.g., manual pull stations, sprinkler system water flow indication, area heat detection). The release mechanism shall meet the requirements of the IBC and applicable NFPA code or standard for the specific application, e.g., NFPA 101 requires smoke detection release for required fire doors. Such mechanisms shall be UL listed, FM approved, or listed by another NRTL for the intended purpose (Requirement 2-0036).

I. Other Types of Penetrations

1. Piping, cable trays, electrical conduits, and wires penetrating fire barriers shall be sealed (Requirement 2-0037).

Guidance: Refer to UL Fire Resistance Directory, Volume II, or the FM Global [Approval Guide](#), or the listing guide of another NRTL, for listings of fire rated penetration seal assemblies.

A simple and acceptable fire barrier penetration seal that should be considered for sealing of grouted or sleeved concrete masonry units or concrete barriers is grout, filling the full thickness of the penetrated wall or floor.

2. Where structural steel penetrates a fire rated barrier, that configuration shall be reviewed by a fire protection engineer in the LANL Fire Protection Group to determine if additional fire protection measures are required (Requirement 2-0038).
3. Windows through a fire barrier shall be in accordance with NFPA 80, *Standard for Fire Doors and Other Opening Protectives* (Requirement 2-0039).

Guidance: Fire-resistant glazing in accordance with NFPA 80 can be used in an approved/listed assembly. Shutters or spray systems can be used to protect window openings in the event of a fire. Guidance is available from the LANL Fire Protection Group.

4. Where a conveyor penetrates a fire barrier, it shall be designed to maintain the fire rating of the barrier (Requirement 2-0040).

Guidance on how to accomplish this is available from the LANL Fire Protection Group.

5.0 DESIGN DOCUMENTATION

5.1 General

- A. Refer to Section Z10 of LANL ESM Chapter 1 for design output general requirements. This article (5.0) applies to design documentation created under Title II services for construction document (permitting package) production. Design documentation should not be confused with the shop drawings (i.e., working drawings) required by NFPA standards and produced by the fire protection vendor and installer, and provided as part of a submittal during construction. The design details below generally cannot be delegated or deferred to fire protection vendors or installers.
- B. **Preparing Structure, System, or Component (SSC) Drawings.** Comply with the LANL CAD Standards Manual and the applicable NFPA code or standard.
- C. **Seal design per** ESM Chapter 1 Section Z10 (*Design Output Submittals subsection*).

5.2 Calculations

- A. Provide source analysis, including hydraulic calculations for new or modified portions of the water supply distribution system. LANL will provide hydrant flow test data to support the effort. Also see Chapter 3, Section G30 Site Civil/Mechanical Utilities for additional requirements (Requirement 2-0041).
 1. Calculation methods are presented in the relevant NFPA standards (e.g., 22, 24) and the NFPA Handbook. *Guidance: For hydraulic calculations associated with nuclear facility sprinkler systems, consult with the Design Authority to identify additional requirements, if any.*
- B. Provide hydraulic calculations for fire suppression systems to be installed in the facility. One or more proposed design areas for hydraulically remote portions of the new or modified facility, or facility addition. Calculations are to provide supporting evidence that the proposed fire suppression system demands can be adequately supplied and the means required to provide it (e.g., fire pumps, looped mains, larger orifice sprinkler heads, or other special system configurations) (Requirement 2-0042).
 1. Calculation methods are presented in relevant NFPA codes (e.g., 13, 14), and software to conduct the calculations in accordance with these methods is available.
 2. Determine the hazard classification based on the provided owner's information certificate and applicable standards.
 3. Refer to Subsection D4010 for hydraulic calculation requirements.

Guidance: For hydraulic calculations associated with nuclear facility sprinkler systems, consult with the Design Authority to identify any additional requirements.
- C. Based on the occupancy classification and use of the space(s), provide occupant loads and egress capacities along the means of egress in the area of work, and beyond, depending on the potential impact. Both the IBC and NFPA 101 methods and requirements shall be followed (Requirement 2-0043).

- D. Provide fire alarm system calculations (voltage drop, battery load calculations) a new fire alarm system is designed or an existing system is modified. The purpose of the calculations is to provide design direction to the fire alarm vendor. Determine the need and location of remote fire alarm control panels or notification appliance booster panels, the need to increase the size of batteries, and the need to provide additional fire alarm control panel cards or auxiliary systems (Requirement 2-0044). Refer to Section 8.3 for associated requirements.
- E. Provide calculations for all special hazard and other fire protection systems, such as clean agent, inert gas, foam, smoke exhaust, smoke pressurization, etc. (Requirement 2-0045).

Guidance: The level of detail at the design stage is typically is to establish feasibility of the approach, and locations of major equipment and primary features. If final layout and calculations will be provided by the installation vendor, and determine size and locations of major equipment. It is recommended that complex systems, such as smoke control be fully designed with supporting calculations with the building design package.

- F. For new or modified roadways, if fire department access roads cannot be provided in strict compliance with this chapter's requirements (*Section 13.0*), provide a swept path analysis based on worst-cast responding Los Alamos Fire Department apparatuses to support the roadway and paving design (Requirement 2-0046).

5.3 Drawings

Provide a design drawing package as required to meet project-specific requirements. Include the following as they apply. When in doubt, contact the LANL Fire Protection Group.

- A. Provide a code analysis as part of the drawing package. At a minimum consider the information under ESM Chapter 4, *Architectural*, Section B-C GEN General Architectural (*Article 7.3 Project Design Data*). Make the level of detail commensurate with the level of alteration or scope of the project; at a minimum, identify the codes of record and applicable standards, the occupancy classification (IBC and NFPA), and level of alteration (IEBC) and classification of rehabilitation work category (NFPA 101) (Requirement 2-0047).
- B. Provide plan view life safety drawings demonstrating the compliance of the means of egress, and other fire protection or life safety features, unless shown on other discipline sheets in an approved manner (Requirement 2-0048).
 - 1. Indicate the occupancy and use classification, the occupant load factor, and the occupant load of all spaces.
 - 2. Provide the egress capacity of the components of the means of egress, including aisles, corridors, doors, ramps, and stairs. It is not necessary to provide this for small spaces (e.g., individual offices, storage rooms) with low occupant loads relative to the egress capacity of a standard door.
 - 3. Provide maximum, common path, and dead-end travel distances and respective travel paths where necessary to verify and demonstrate compliance of the means of egress.
 - 4. Indicate the areas, aisles, and/or paths to be provided with emergency lighting.
 - 5. Indicate the location, type, and rating of fire and smoke walls, barriers, and partitions; horizontal assemblies; and fireproofed structural members.
 - a. Also include details for all fire-resistive assemblies, such as columns; beams; floor, floor-ceiling, and roof-ceiling assemblies; fire walls, barriers, and partitions; firestop assemblies; fire-resistive joints; fire dampers; fire-resistive duct; and any other special assemblies.

Guidance: Firestop and fire-resistant joint systems are often determined during construction, but Title II still needs to confirm feasibility and constructability of providing firestop and fire-resistant joints, based on the arrangement of fire-rated assemblies and penetrating items. This is most often achieved by identifying basis-of-design systems that would work for the design.

6. Indicate the location, type, class, and rating of required fire extinguishers; noting the type of mounting, cabinet, and signage, where also necessary.
- C. Provide fire protection/suppression drawings and details that adequately communicate the desired fire protection/suppression design and its required performance (Requirement 2-0049).
1. Provide plan view drawings to show the location and type of the fire protection water service, system control risers, floor control risers, antifreeze loops, test headers, fire department connections, fire pump rooms, standpipes/risers, and other system components as required by the project. Indicate the areas and/or spaces to be or not to be provided with fire protection/suppression. Indicate ancillary exterior areas to also be provided with fire protection/suppression (e.g., loading docks, combustible eaves, etc.). Provide sufficient building detail to support preparation of shop drawings of the fire protection/suppression systems, including but not limited to wall types, ceiling heights, and structural details. System layout and detailed design per NFPA 13 for shop drawings shall be provided if the work will not be subcontracted to a fire sprinkler installer (i.e., LANL self-perform).

Guidance: The requirement for shop drawings or plans to be submitted prior to installation (as a construction submittal) for special fire extinguishing systems is, in general, left to discretion of the AHJ (i.e., LANL Fire Marshal). Consult with the LANL Fire Protection Group when developing requirements or design documentation.

2. Provide section views to indicate ceiling types and configuration and to support shop drawing preparation.
 3. Provide riser diagrams to indicate arrangement of multi-floor and multi-zone systems.
 4. For modifications or additions to existing systems, provide drawings and details of the existing system to indicate hydraulic remoteness from the system control riser and support hydraulic calculations.
 5. Based on owner's information certificate (provided by LANL), indicate project-specific fire protection/suppression criteria, including occupancy (hazard) classifications, high-rack storage commodity classes, etc. (required by NFPA 13).
 6. Indicate other utilities that may impact the layout and design of fire protection/suppression systems to coordinate with other building systems. Indicate locations and sizes of fire protection/suppression mains and risers when necessary to prevent conflicts, note constraints, or meet other requirements of the project.
- D. Provide fire alarm drawings and details that adequately communicate the desired fire alarm design and its required performance (Requirement 2-0050).

Guidance: In general new installations or changes to an existing building fire alarm system will require procuring services from a fire alarm vendor or installer to create shop drawings and as-built drawings, confirm appropriate components, perform calculations, and modify the fire alarm control panel programming. Additionally, modifications to interfacing systems, building layout, room numbering, or other details captured by the fire alarm as-built (record) drawings will require procuring services from a fire alarm vendor/installer to update the fire alarm as-built (record) drawings to the new conditions. This requirement will need to be captured by the design documentation.

1. Provide plan view drawings to show the location and identification of fire alarm control panels, notification appliance booster panels, amplifiers, annunciator panels, and all interfaced systems and emergency control functions. Indicate areas to be provided with occupant notification (audible, visual, or both), and the expected ambient sound pressure levels or required alarm sound pressure levels based on use, operations, and equipment to be present in the spaces. Indicate areas to be provided with automatic fire detection and the types to be provided. Indicate requirements for manual fire detection and any special systems. Indicate location of fire protection/suppression systems. Provide sufficient building detail to support preparation of working plans of the fire alarm system, including but not limited to wall types, ceiling heights, and structural details. System layout and detailed design per NFPA 72 for shop drawings shall be provided if the work will not be subcontracted to a fire sprinkler installer (i.e., LANL self-perform).
2. Provide section drawings where necessary to indicate ceiling type and configuration, when necessary to support working (shop) drawing preparation, or design and layout of detection systems.
3. Provide riser diagrams to indicate configuration and segmentation of circuits throughout the facility. Project specific performance requirements regarding number or segmentation (with isolation modules) of circuits, circuit class, survivability level, number and location of panels, and other details shall be described.
4. For modifications or additions to existing systems, provide drawings and details of the existing system to indicate relation to existing portions and support calculations.
5. Provide an input/output matrix to describe the required functional performance of the fire alarm system, and its interfaced systems and emergency control functions.
6. Provide detailed design documentation regarding specialized detection systems, risk-analyses, and performance-based detection or notification.

6.0 EQUIPMENT/PIPING IDENTIFICATION

- A. See NFPA 13, ESM Chapter 1 Section 200, and Chapter 6 Mechanical Section D10-30GEN for requirements.

7.0 EXPOSURE AND NATURAL PHENOMENON HAZARDS PROTECTION

- A. Adjacent Relocatable Structures: DOE-STD-1066, and NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, shall be used to determine acceptance criteria for separation from permanent structures that might represent exposure hazards (Requirement 2-0051).
- B. Separation distance between hazardous equipment and structures: NFPA 30, *Flammable and Combustible Liquid Code*, and other applicable NFPA codes, standards and recommended practices, such as NFPA 70 and NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, shall be used to determine required distances (Requirement 2-0052).

Guidance: Hazardous Equipment (e.g., oil-filled transformers, diesel generators, etc.): The required separation distance to protect a structure or nearby equipment from adjacent hazardous equipment typically depends on the type and size of the associated fire hazard, and on the construction of the building. Also consider the guidance of FM Global Loss Prevention Data Sheets, XL GAPS Guidelines, and other similar insurance industry guidelines, to determine appropriate separation distances and fire protection. Oil run-off issues are also addressed as fire protection concerns in the same data sheet – e.g., oil run-off that exposes a different, unaffiliated structure downhill from a transformer, or lack of oil collection resulting in environmental contamination concerns (e.g., into the soil, into a

canyon with wildland fire issues, etc. LANL Fire Protection Group is available to provide additional guidance.

- C. Wildland Fire: NFPA 1144, *Standard for Reducing Structure Ignition Hazards from Wildland Fire*, and the International Wildland-Urban Interface Code (ICC), shall be used to determine how to evaluate the degree of wild land fire hazard for a particular facility. For explosives facilities, use DOE-STD-1212 to determine special requirements for their protection (Requirement 2-0053).
1. As a minimum, a 10-foot-wide space around buildings shall be maintained clear of all trees. In more heavily forested areas, a 50-foot-wide space around buildings shall be maintained clear of trees (several isolated trees may be acceptable), and the next 50 feet beyond shall be thinned. In less heavily forested areas, less clearing/thinning may be acceptable. Consult LANL Fire Protection Group for guidance (Requirement 2-0054).
 2. *Guidance: Los Alamos County has a dry climate, intense and frequent lightning storms, and steep terrains all of which contribute to increased wild land fire hazard. NFPA 1144 also provides different strategies that can be used to reduce wild land fire threat, including establishing fire breaks around facilities (by thinning or eliminating vegetation around the facility), providing fire resistive construction for new structures, ensuring appropriate roadways for emergency vehicle access, etc.*
- D. Lightning: All explosives facilities, all facilities with a significant replacement value and facilities of significant programmatic importance shall be equipped with lightning protection in accordance with the most stringent of the following (Requirement 2-0055):
- NFPA 780, Standard for the Installation of Lightning Protection Systems,
 - UL 96A, Installation Requirements for Lightning Protection Systems, and
 - Lightning Protection Institute (LPI) Standard No. LPI-175 Standard for the Design – Installation – Inspection of Lightning Protection Systems.
1. Refer to ESM Chapter 7 Section D5090 for lightning protection system requirements, including how to determine when lightning protection systems are required.
 2. ESM Chapter 7 Section D5090 references NFPA 780 Appendix L for performing a risk assessment to determine whether a lightning protection system is required.
 3. The LANL Fire Marshal may require a lightning protection system for some applications regardless of the outcome of the risk assessment. The determination of significant programmatic importance and other relevant factors will be made by the LANL Fire Marshal, and facility and programmatic management prior to subcontracting for design services (Requirement 2-0056).
 4. Also reference LANL Master Specification Section 26 4100 series on lightning protection and DOE-STD-1212 (also DOE-STD-1020).
- E. Seismic: Per NFPA 110 paragraph 7.11.6, "... [Emergency power systems, or EPS], transfer switches, distribution panels, circuit breakers, and associated controls shall be capable of performing their intended function during and after being subjected to the anticipated seismic shock." (Requirement 2-0057)
1. As such, these items, as applicable to a given project, are Designated Seismic Systems (DSS). Refer to ESM Chapter 5 Section I (paragraph 1.7) for details pertaining to design and documentation requirements for DSS. Also, DSS that are/have active components are subject to Special Inspection and Testing as described in Chapter 16–IBC Program (see Section IBC-IP and its Attachment B Tables 1705.12 and 1705.13).

8.0 FIRE DETECTION AND ALARM (D5030.90)

8.1 General

- A. Provide a fire alarm system if required by the *International Building Code*; NFPA 101, *Life Safety Code*; or LANL PD 1220, *LANL Fire Protection Program*, based on the occupancy classification (Requirement 2-0058).
- B. Provide a fire alarm system in every building or structure of such size, arrangement, or occupancy that a fire itself might not provide adequate warning to occupants (Requirement 2-0059).
- Guidance: Coordinate fire alarm system selection with the LANL Fire Protection Group.*
- C. Design fire alarm system to meet the applicable requirements of the following codes and standards and this Chapter of the LANL Engineering Standards Manual (Requirement 2-0060):
1. NFPA 72, *National Fire Alarm and Signaling Code*.
 2. NFPA 70, *National Electrical Code*.
 3. NFPA 101, *Life Safety Code*.
 4. NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*.
 5. ASME A17.1, *Safety Code for Elevators and Escalators*
 6. ASME A17.3, *Safety Code for Existing Elevators and Escalators*
 7. NECA 305, *Standard for Fire Alarm System Job Practices* (ANSI).
- D. Use the materials and installation methods described in the following LANL Master Specification Section (Requirement 2-0061):
1. Section 28 4600, *Fire Detection and Alarm*
- E. For new or extensively renovated facilities, provide addressable fire alarm systems (Requirement 2-0062).
- F. For additions or modifications to existing systems consult with the LANL Fire Protection Group to ascertain the appropriate alarm system technology to use. This will determine the arrangement of the system and the features that must be specified for the control panel alarm initiating devices, notification appliances, and accessory equipment. Record of this consultation shall be retained by the project (Requirement 2-0063).
- G. Provide fire alarm systems with the following NRTL listed fire alarm components as required by NFPA 72 and as necessary for a complete system (Requirement 2-0064):
1. Fire alarm control panel (FACP) to initiate sequences of operation for fire detection, notification, building system control, and fire suppression functions (Requirement 2-0065).
 2. Conduit and wiring to connect the FACP to alarm initiating devices, notification appliances and auxiliary equipment (Requirement 2-0066).
 3. Manual fire alarm station at each exit from each floor (Requirement 2-0067).
 4. Area smoke or thermal detectors where required by any NFPA code or standard, the IBC, ASME A17.1 (elevators), or DOE O 420.1C. Note that, with the exception of special facilities such as computer rooms, area smoke or thermal detectors are not usually required in areas that are protected with automatic sprinkler systems (Requirement 2-0068).
- Property protection guidance: Area smoke or thermal detection may be provided throughout a fire area as part of a 'redundant fire protection system' required for the protection of a large property loss potential (i.e., greater than \$177 million baselined to CY2018 values) per DOE O 420.1C II 3.c (2)(d), and PD 1220. A fire hazards analysis (FHA) will document the requirements for and the type of fire protection SSCs needed to provide a 'redundant fire protection system.'*

5. Duct smoke detectors and air handling systems shutdown relays where required by NFPA 90A and NFPA 72. Where duct smoke detectors are installed in difficult to access locations, a remote test device and indicator light shall be provided in an accessible location (Requirement 2-0069).
 6. Connections to sprinkler waterflow/pressure alarm switches (Requirement 2-0070).
 7. Connections to sprinkler system control valve and pressure supervisory devices (Requirement 2-0071).
 8. Sounder and synchronized signal strobe combination notification appliances (Requirement 2-0072).
 9. Supervision for Knox key box (GFE, as specified by the LANL Fire Marshal) (Requirement 2-0073).
 10. Elevator recall/shunt relays (if the building has an elevator) as required by ASME A17.1 (Requirement 2-0074).
 11. Fire/smoke door releasing functions (Requirement 2-0075).
 12. Battery standby capable of operating the fire alarm system under maximum standby load (system functioning in a non-alarm condition with supervisory and trouble signals operating) for 24 hours, and at the end of that period operating all alarm notification appliances for not less than 10 minutes (Requirement 2-0076).
 13. Digital alarm communicator transmitter (DACT) to send point-identified alarm, supervisory, and trouble signals to the LANL Proprietary Fire Alarm System (Requirement 2-0077).
 14. Conduit and GFE cable from the FACP to building's main telecommunications room (Requirement 2-0078).
 15. Manual transfer switch and receptacle powered by a different branch circuit or panel at the fire alarm control panel and any supplementary panels provided with independent power to support alternative power connections during outages (Requirement 2-0079).
 16. Surge protection for line power circuits serving the fire alarm system and surge protection and/or isolation modules for initiation, notification, and signaling circuits that extend beyond the building or are otherwise exposed to lightning (Requirement 2-0080).
 17. Surge suppression devices and isolation modules shall be installed in locations that are readily accessible from grade level to allow routine investigation, maintenance and replacement (Requirement 2-0081).
- H. In general, each building that warrants a fire alarm system shall have its own fire alarm control panel. For building complexes or buildings with auxiliary structures, the decision shall be determined with input from the LANL Fire Protection Group; considering complexity, reliability, and size of initiating device and notification appliance circuits/zones (Requirement 2-0082).
- I. Digital alarm communicator transmitter (DACT) reporting format to the LANL Proprietary Fire Alarm System shall be "Contact ID" capable of encoding specific point identification (Requirement 2-0083).

8.2 Functional Requirements for Addressable Systems

- A. The system shall identify any off normal condition and log each condition into the system database as an event (Requirement 2-0084).
1. The system shall automatically display on the control panel the first event of the highest priority by type. The priorities and types shall include alarm, supervisory, and trouble.
 2. The system shall have a queue operation, and shall not require event acknowledgment by the system operator. The system shall have a labeled, color-coded indicator for each type of event.
 3. The user shall be able to review each event by selecting scrolling keys.

4. New alarm, supervisory, or trouble events shall sound a silenceable audible signal at the control panel.
- B. Operation of any alarm-initiating device shall automatically (Requirement 2-0085):
 1. Update the control/display as described above.
 2. Sound all alarm signals and strobe lights throughout the building, fire area, or designated evacuation zone.
 3. The fire alarm evacuation tone shall be the ANSI S3.41, *Audible Emergency Evacuation Signal*/three-pulse temporal pattern (equivalent to NFPA 72 three-pulse temporal).
 4. Visually and audibly annunciate the alarm condition at the fire alarm control panel.
 5. Operate the alarm relay and initiate the transmission of a point-identified alarm signal to the LANL Proprietary Fire Alarm System over a digital alarm communicator system.
 6. Operate the associated emergency control functions and auxiliary devices as required by applicable codes, standards, and project design documents.
- C. Activation of a supervisory signal-initiating device shall (Requirement 2-0086):
 1. Update the control/display as described above.
 2. Visually and audibly annunciate the supervisory condition at the fire alarm control panel.
 3. Operate the supervisory relay and initiate the transmission of a supervisory signal to the LANL Proprietary Fire Alarm System over a digital alarm communicator system.
- D. The fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the fire alarm control panel. Any opens, grounds or derangement of system wiring and shorts across alarm horn/strobe wiring shall automatically (Requirement 2-0087):
 1. Update the control/display as described above.
 2. Operate the trouble relay contacts to initiate the transmission of a trouble signal to the LANL central station over a digital alarm communicator system.
 3. Visually and audibly annunciate a general trouble condition, on the FACP. The visual indication shall remain on until the trouble condition is repaired.

8.3 System Design and Documentation

- A. Fire alarm systems shall be both designed and installed by fire alarm contractors that are experienced in their proper design, application, installation, and testing (Requirement 2-0088).
- B. Design Agency shall provide performance specifications based on LANL Master Specification Section 28 4600 (Requirement 2-0089).
- C. The fire alarm subcontractor shall provide the services of a qualified fire alarm designer who is factory trained for the FACP to be installed on the project (Requirement 2-0090).
- D. The fire alarm designer shall assure the completeness and correctness of the fire alarm system design by preparing and submitting the following for review by the LANL Fire Protection Group (Requirement 2-0091):
 1. Shop drawings of the FACP indicating location of components, interconnection of components and connections to alarm initiating, indicating, and auxiliary circuits.
 2. Fire alarm riser diagram showing new and existing alarm initiation circuits, alarm appliance circuits, input/output functions, and communications connections. Show all new and existing fire alarm devices and the corresponding room numbers. Refer to Example Drawing [ST-D5030-2](#).

3. System input/output matrix showing the system actions in response to alarm, supervisory, and trouble conditions. Refer to Example Drawing [ST-D5030-2](#).
4. Floor plan drawings of fire alarm layout, conduit, and wiring. Show location of all fire alarm appliances, conduit layout, quantity, and type of wires in each conduit, and interface with other systems for functions such as central station signaling, fan shutdown, damper operation, and elevator recall.
5. Terminal-to-terminal field wiring diagrams for alarm initiating, indicating and auxiliary circuits; detail the interfaces with other systems; indicate labeling of each fire alarm system conductor.
6. Conductor size calculations for each alarm initiating, indicating, and auxiliary circuit; limit voltage drops so that they do not exceed the FACP manufacturer's limitations for the most remote device on each circuit.
7. Battery load calculations for the FACP and any remote power supply panels and selection of proper battery size, including specified design margin.
8. Audible alarm signal calculations, or confirmation via testing at the commissioning phase, for all spaces demonstrating that the design complies with NFPA 72 requirements of alarm signal a minimum of 15 dB above ambient at all locations, but not over 110 dBA at any location.
9. Selection of initiating, indicating, and auxiliary devices compatible with the FACP.
10. As-built drawings showing all changes to design documents.

8.4 Installation

- A. Install fire alarm systems in accordance with NECA 305, *Standard for Fire Alarm System Job Practices* (ANSI) (Requirement 2-0092).
- B. The FACP DACT will be connected as follows (Requirement 2-0093):
 1. The installer shall run three (3) telecommunication cables, provided by LANL (currently CAT 5E), from the DACT to the telecommunications room/closet indicated in the design drawings.
 2. *The DACT will be connected to two separate dedicated telephone lines (numbers). Submit a request for the phone numbers to the Fire Alarm Team of the LANL Fire Protection Group. Telecommunications on and off site is moving away from analog lines. The medium and technology used for the FACP DACT signal reaching the LANL Proprietary Supervising Station is subject to change.*

8.5 Acceptance Testing and Inspection

- A. Inspect and test installed fire alarm system in accordance with Project's version of LANL Master Specification [28 4600 Fire Detection and Alarm](#) and NFPA 72 (Requirement 2-0094). Use an inspection and testing form compliant with NFPA 72 and acceptable to the AHJ (Requirement 2-0095).
- B. Notify the LANL AHJ (Fire Marshal) 10 days in advance of the final acceptance testing and inspection. Final acceptance inspection and testing must be witness by the LANL AHJ. Furnish a written statement to the AHJ stating that the system has been installed in accordance with approved plans and tested in accordance with the manufacturer's specifications and the appropriate NFPA requirements (Requirement 2-0096).
- C. Provide the Record of Completion in accordance with NFPA 72 upon successful acceptance test and inspection (Requirement 2-0097).

9.0 FIRE PREVENTION FEATURES

- A. Fire prevention features shall be part of the project plans and specifications just as fire protection systems would be (Requirement 2-0098).
1. **Combustion Safeguards on Fuel-Fired Equipment.** Follow NFPA 85, *Boiler and Combustion Hazards Code*, and NFPA 86, *Standard for Ovens and Furnaces*.
 2. **Heating Equipment for Hazardous Areas.** In hazardous (electrically classified) areas, specify heating equipment suitable for these areas. Use indirect fired heating equipment or heat exchangers. Also see NFPA 85.
 3. **Electrical Equipment for Hazardous Areas.** Follow NFPA 70, *National Electrical Code*; NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*; and NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*. Also follow UL/ANSI 913 where applicable.
 4. **Laboratories.** Follow NFPA 30 and 45, *Standard on Fire Protection for Laboratories Using Chemicals*, for fire protection requirements applicable to laboratories using chemicals. Follow NFPA 115 for laser laboratories and operations.
 5. **Diking/Drainage for Liquids.** Design for safe containment of 110 percent of the capacity of the largest tank. Design shall consider diking, diversionary diking, drainage to catch tanks, or drainage to a safe location. Also see NFPA 30; NFPA 801, *Standard for Fire Protection for Facilities Handling Radiological Materials*; and NFPA 15 annex.
 6. **Prevention of Potentially Contaminated Firefighting Water Run-off.** Follow NFPA 801 for the design capacity of collection, containment and/or retention features. Firefighting water shall include both the anticipated quantity of sprinkler discharge and concurrent manual hose streams deployed by the fire department.
- B. Fire prevention best practices should also be incorporated into the design approach (Requirement 2-0099).
1. **Fail-Safe Process Design.** Design process equipment to fail safely. For example, heat sources off, feed valves closed, agitation systems running, cooling water valves open, and ventilation on. Fail-safe settings and the interlocks that occur upon failure of process equipment will vary with every process.
 2. **Process Monitoring and Interlocks.** Monitor all parameters of a process that could contribute to fire or explosion. Parameters to be considered include but not be limited to pressure, temperature, flow, concentration, agitation, liquid levels and positions of doors and dampers.
 3. **Programmatic Combustible Loading.** Design buildings and processes to enable keeping combustible loading at the minimum necessary for normal operations.

10.0 INSTALLATION AND TESTING

- A. **System Impairment Process.** Follow Criterion 733, Fire Protection System Impairment Control Program, in the LANL Operations and Maintenance (O&M) Manual (Requirement 2-0100).
- B. **Inspection, Testing, and Maintenance (ITM) Criteria.** Follow the inspection, testing, and maintenance criteria outlined in Section 700 of the LANL O&M Manual (Requirement 2-0101).

11.0 LIFE SAFETY CONSIDERATIONS

- A. For explosives facilities, comply with additional life safety requirements in DOE-STD-1212 (Requirement 2-0102).

- B. Emergency lighting and marking of the means of egress shall be provided as required by IBC and NFPA 101 (Requirement 2-0103). Refer to the ESM Electrical Chapter for additional requirements.

Guidance:

1. *Once the occupancy has been identified, IBC and NFPA 101 specify the life safety features required for the occupancy. These features ensure that occupants of the building will have sufficient early warning and sufficient exits to facilitate safe egress from the building.*
2. *Pay special concern to:*
 - a. *Travel distance from any part of the building to the nearest exit;*
 - b. *Maximum allowed dead end corridor allowed in the building; and*
 - c. *The portion of exit access that is traversed before two separate and distinct paths of travel to two exits are available (common path of travel).*

The limits associated with these features vary by occupancy, and vary for any occupancy type depending on whether or not the building is sprinkler-protected. Where sprinklers are provided, the allowed distances related to exit access, generally increase. The presence of sprinklers provides twofold assurance: first, that a fire will be promptly controlled, limiting fire and smoke spread; and second, that the exit pathway will remain protected long enough to get occupants safely out of the building.

12.0 PRE-EMERGENCY PLANNING PROGRAMS

- A. Coordinate with LANL FP Group to provide documentation to LAFD describing a new facility or changes to an existing facility so that the Pre-Incident Plans can be kept up to date. Provide documentation and coordinate facility walkthroughs once construction is substantially complete and in advance of requesting the certificate of occupancy (Requirement 2-0104).

Guidance: The Los Alamos County Fire Department (LAFD) develops and maintains Pre-Incident Plans for important LANL facilities, to aid fire fighters in responding to a facility fire.

Guidance: Generic guidance on fire water run-off is somewhat addressed in DOE-STD-1066 (§ 4.2.5.4 in 2012), and NFPA 801, Standard for Fire Protection for Facilities Handling Radioactive Materials, § 5.10 "Drainage." The DOE has also issued a draft document entitled, "Guidance for Estimating Fire Suppression System Run-off Volume in DOE Nuclear and Hazardous Substance Locations." Additionally, the Pre-Incident Plans for each facility address some aspects of firewater run-off. Where there is no specific requirement for fire protection water run-off control at a facility (i.e., required by a Documented Safety Analysis), the facility must monitor firefighting water run-off and will be required to clean up any resulting contamination. Ensure that Facility Management is aware when a design change might affect fire protection-related water run-off.

- B. Coordinate with LANL FP Group and/or Emergency Management Division (EMD)-Emergency Preparedness (EP) to provide up-to-date information on any changes to an existing facility's physical hazards or hazard configuration, so that Pre-Incident Plans and emergency planning can be updated. Provide documentation and coordinate facility walkthroughs once construction is substantially complete and in advance of requesting the certificate of occupancy (Requirement 2-0105).
- C. For new or significantly modified facilities, especially those with an Emergency Planning Hazards Assessment (EPHA), coordinate with the LAFD through ES-FP and the FOD to ensure that LAFD personnel are provided with appropriate tours (Requirement 2-0106).

Guidance: Fire fighters may encounter a variety of different physical hazards at LANL facilities, including radiological, chemical, cryogen, laser, etc.

- D. Evacuation plans/diagrams, in accordance with the CAD Standards Manual, STD-342-300, are required in each facility at LANL, unless specifically exempted by ES-FP and the FOD. When facility configurations are changed the evacuation plans/plans shall also be changed. Coordinate with

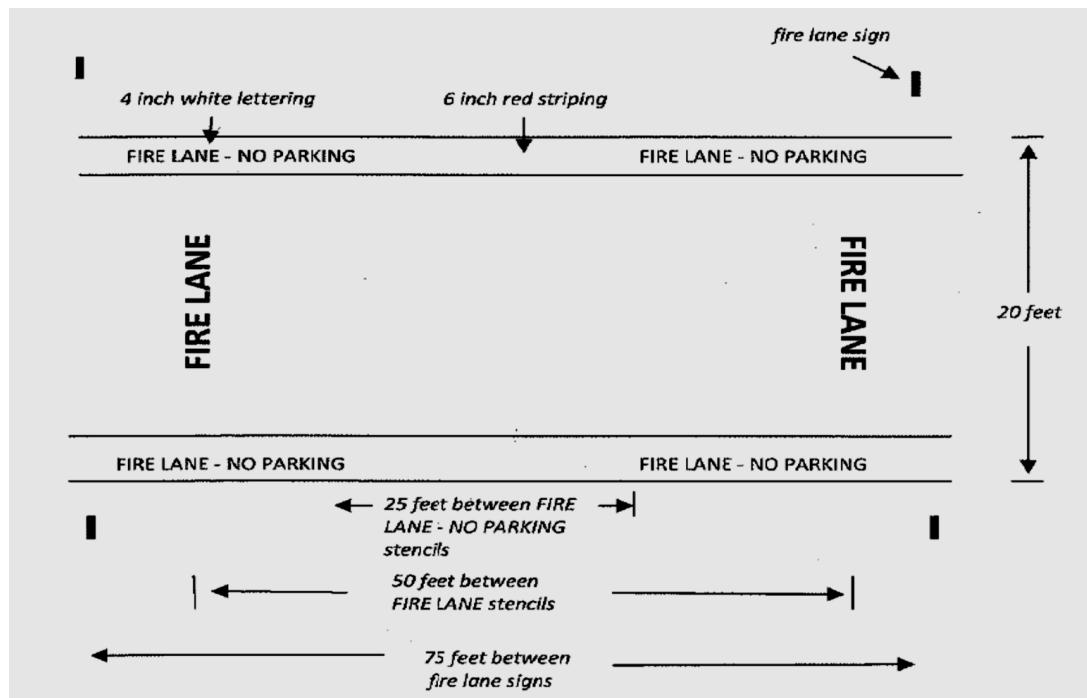
Facility Management for evacuation plans/diagrams. Coordinate with EMD-EP for emergency plans/procedures (Requirement 2-0107).

13.0 SITE FIRE DEPARTMENT ACCESS

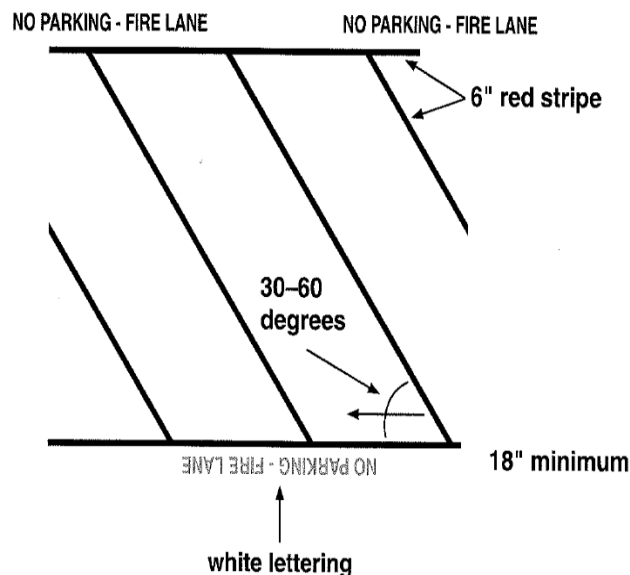
- A. Provide fire department access roads to buildings, fire hydrants, fire department connections, and related equipment in accordance with NFPA 1, *Fire Code*, and the IFC, *International Fire Code*, and the applicable standards (e.g., NFPA 13, 14, 20, and 24)(Requirement 2-0108).
- B. The LANL Fire Marshal has the authority to modify the requirements for fire department access roads for buildings or structures that do not present a significant fire hazard, loss potential, interruption or impact to DOE programs, fire exposure to other facilities, or impact to safety, the public, or environment (Requirement 2-0109).
- C. Plans for paved, temporary, and alternative surface (i.e., other than concrete or asphalt) shall be submitted to the LANL Fire Protection Group for approval prior to installation (Requirement 2-0110).
 - 1. Alternative surface fire lanes shall be designed by a professional engineer registered in the State of New Mexico (Requirement 2-0111).
- D. LANL-specific design criteria are as follows. Fire department access roads shall:
 - 1. Have a minimum inside turning radius of 30 feet and a minimum outside turning radius of 50 feet (Requirement 2-0112); and
 - 2. Be designed to support a fire apparatus with a total weight of 83,500 pounds and an axle weight of 63,000 pounds (Requirement 2-0113).
- E. The LANL Fire Marshal may permit hose lay distances to be increased from the IFC required 150 feet up to 450 feet for facilities protected with automatic sprinklers or with other mitigating factors (Requirement 2-0114).
- F. Fire department access roads shall be marked as fire lanes (Requirement 2-0115):
 - 1. Within vehicle parking lots,
 - 2. Along alleys or roadways that are not designated or marked as a LANL street or road,
 - 3. Within 15 feet of a fire hydrant or fire department connection; and
 - 4. When determined necessary by the LANL Fire Marshal to identify their location, prevent their obstruction, or prevent obstruction of fire protection equipment.
- G. Fire lanes shall be marked on both sides, unless permitted otherwise; with signs, curb markings, road surface markings, or a combination thereof as follows (Requirement 2-0116):
 - 1. Signs shall be metal construction, 12-inches wide by 18-inches high, reflective, with red lettering on a white background of one of the following:
 - a. FIRE LANE – NO PARKING, or
 - b. NO PARKING – FIRE LANE.

Signs shall be mounted at seven (7) feet above the road surface, at both ends of the fire lane and at a maximum 50-foot interval. The interval may be increased to 75 feet when combined with curb or roadway markings.

2. Curbs shall be painted red along the entire length with "FIRE LANE - NO PARKING" in 4-inch high, white letters at a 25-foot maximum interval.
3. Road surface markings shall consist of "FIRE LANE – NO PARKING" in 4-inch, white letters inside the stripe at a 25-foot maximum interval along the edge of the road. This shall be supplemented with either:
 - a. Option 1: 6-inch wide red stripes either along the edge of the roadway and collinear with the letters and "FIRE LANE" in 10-inch high, red or white letters marked in the roadway, at 50-foot intervals, and oriented to be read from the direction of fire department arrival as shown immediately below, or



- b. Option 2: Outlined, diagonal hatching filling between the letters along edges of the roadway of 6-inch red stripes along the edges of the road and between the edges at 18-inch spacing and angle between 30 and 60 degrees as shown below.



- H. The marking of fire lanes shall be subject to approval by the LANL Fire Marshal. The type of fire lane marking that is advisable is dependent on the type, width, and arrangement of the fire department access road, i.e., parking lot with or without islands, roadways with or without curbs, loading dock and equipment room location, availability of parking, expectations for snow clearing, and maintainability (Requirement 2-0117).

14.0 SITE FIRE PROTECTION WATER DISTRIBUTION

- A. Refer to the General Chapter, Section Z10 Subsection Z1020, and the Civil Chapter, Subsection G3010, for site requirements.

Guidance: The LANL combined fire protection and potable (i.e., domestic) water supply distribution system is considered to operate as a public utility. NFPA 24 is not applicable to these portions of the water supply distribution system, including the fire hydrants supplied by the system. The standard is applicable to the lead-in to the automatic sprinkler or standpipe riser, and distribution systems solely for the purposes of providing fire protection water to risers and/or fire hydrants. Dedicated fire protection water distribution systems are found at TA-35, LANSCE, and TA-55, among others.

- B. Nuclear only: Refer to DOE-STD-1066 Appendix A for design, material, construction, quality assurance, and inspection, testing and maintenance (ITM) requirements associated with safety significant (SS) and safety class (SC) fire protection water supplies (Requirement 2-0118).

15.0 SPECIAL FIRE/EXPLOSION HAZARDS

- A. Special fire and explosion hazards include but are not limited to the following (Requirement 2-0119):

1. Warehousing. Follow NFPA 13.
2. Gloveboxes, Hot Cells and Filter Plenums. Follow DOE-STD-1066, *Fire Protection*; NFPA 801; AGS-G010, *Standard for Practice for Glovebox Fire Protection*; and DOE-HDBK-1081, *Primer on Spontaneous Heating and Pyrophoricity*. Also follow NFPA codes relevant to the hazard including, but not limited to, NFPA 30, NFPA 45, and NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities*.

Guidance: The requirements for fire protection within gloveboxes and similar experimental or process enclosures, including fire extinguishing or fixed inerting systems, shall be determined and documented within a Fire Hazards Evaluation (FHE) prepared in accordance with NFPA 801 and AGS G010 (consult with ES-FP for FHE requirements).

3. Flammable and Combustible Materials. Follow relevant NFPA codes, including, but not limited to NFPA 30 and the NFPA codes on flammable gases, oxidizers, peroxides, and combustible metals.
4. Explosive materials. Follow DOE-STD-1212, Explosives Safety, and NFPA 495, *Explosive Materials Code*.
5. Paint Spraying/Coating. Follow NFPA 30, NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, and NFPA 34, *Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids*.
6. Tank Storage of Liquids. Follow NFPA 30 and the appropriate NFPA codes for tank protective systems, including NFPA 15 and NFPA 16.
7. Information Technology Occupancies. Follow NFPA 70, and NFPA 75, *Standard for the Fire Protection of Information Technology Equipment*, for computing and data processing occupancies; and follow NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities*, for telecommunications occupancies.

Also follow FM Global Datasheet 5-32, *Data Centers and Related Facilities*, for computing and data processing occupancies (Requirement 2-0120).

D4010 FIRE SUPPRESSION

1.0 GENERAL

- A. This section provides requirements/guides for sprinkler system piping downstream of the base of the system riser. This section addresses wet pipe, dry pipe, and pre-action sprinkler systems. For deluge and other special-hazard systems, refer to Subsection D4010.50 *Special Fire Extinguishing Systems*, below.

2.0 DESIGN REQUIREMENTS

- A. Provide a complete automatic fire suppression system for a new or modified structure where (Requirement 2-0121):
 1. The maximum possible fire loss (MPFL) exceeds \$5.9 million (baselined to CY2018 values) (structure and equipment replacement, post-fire clean-up, and post-fire recovery costs);
 2. The size of the protected structure exceeds 5,000 sq. ft. of floor area;
 3. Determined necessary by the LANL Fire Protection Group due to the mission importance of the structure;
 4. Required by a safety basis document (for example, to prevent loss of safety functions or provide defense-in-depth); or
 5. Required in response to significant life safety hazards.

Guidance: LANL Fire Protection Group decision on the need for automatic fire suppression system protection should be made prior to subcontracting design services. Such a suppression system need not be an automatic fire sprinkler system if approved by the LANL Fire Marshal.

- B. For asset/property protection, multiple fire protection approaches, such as an automatic fire suppression system and a fire detection and alarm system, must be provided in areas where the MPFL exceeds \$177 million (baselined to CY2018 values; refer to DOE-STD-1066) (Requirement 2-0122).
- C. For asset/property protection, fire areas must be established such that the MPFL for each fire area does not exceed \$412 million (baselined to CY2018 values). Fire area walls or other separation approaches may be used to meet this requirement; refer to DOE-STD-1066 (Requirement 2-0123).

- D. Provide a hydraulically designed automatic sprinkler system per NFPA 13, *Standard for the Installation of Sprinkler Systems* (Requirement 2-0124).
1. The minimum required shall be the NFPA 13 hazard classification shall be based on the Owner's Certificate and any applicable industry- or occupancy-specific standards, and will be documented by the project requirements document (Requirement 2-0125).
 2. Minimum hose stream allowance shall be 250 gpm, except for nuclear facilities where it shall be 500 gpm (Requirement 2-0128).
 3. The LANL Fire Marshal will require an increase in the minimum required hazard classification and/or outside hose stream allowance when: 1) the area could be subject to change to a more hazardous use or occupancy classification, 2) the facility is a radiological or nuclear facility, 3) the facility is of high value, 4) the facility is important to the LANL mission or operations, 5) the facility Fire Hazard Analysis (FHA) prescribes it, or 5) there are other reasons to provide additional capacity in the infrastructure or additional protection to property (i.e., HPR) (Requirement 2-0129).
 4. The minimum design area for an automatic sprinkler system shall be 1,500 square feet unless bounded on all sides by either a 2-hour fire-rated interior barrier or exterior walls (Requirement 2-0124).
 5. Hydraulically designed systems shall be designed at least 10 psig or 10% (whichever is greater) below the water supply curve (Requirement 2-0125).
- E. Provide a separate fire protection service line (i.e., lead-in) into the building, except as approved otherwise by the LANL Fire Marshal (Requirement 2-0130).
- F. Provide backflow preventers on all new fire protection system risers and upstream of fire protection systems containing foam or anti-freeze solutions where connected to a potable water source (Requirement 2-0131).
1. The means provided to forward-flow test the backflow preventer shall be a test header with at least one 2-1/2" hose valve per 250 gpm of system demand water flow, unless approved otherwise by ES-FP (Requirement 2-0206).
 2. Refer to the ESM Mechanical Chapter, Section D20 subsection on Cross Connection Control, for additional requirements.
- G. Anti-freeze sprinkler systems shall be filled with TYCO-LFP antifreeze, a manufacturer pre-mixed freeze protection solution designed and listed for use in wet pipe sprinkler systems (Requirement 2-0132).
- H. Where concealed spaces are formed by non-combustible construction but contain significant levels of combustible materials (cable trays, combustible insulation, piping carrying flammable/combustible liquids, etc.), fire protection shall be provided in the space using the same requirements in NFPA 13 for combustible concealed spaces (Requirement 2-0133).
- I. In consultation with the LANL Fire Protection Group, provide sprinkler system with a minimum number of control valves and system zones. Provide floor control assemblies to zone individual floors of buildings with three or more stories. Provide outside stem and yoke (OS&Y) valves with a tamper switch (Requirement 2-0134).
- J. Sprinkler systems shall be monitored by a fire alarm panel in accordance with NFPA 72 and shall report locally and remotely to the LANL Proprietary Fire Alarm System (Requirement 2-0135).

- K. The design of suppression systems for the protection of high efficiency particulate air (HEPA) filters shall include testing features that do not require wetting of the filter media (Requirement 2-0136).
- L. The LANL Fire Protection Group will provide water flow test data upon request.
- M. Prepare fire suppression system drawings in accordance with the LANL Drafting Standards Manual and applicable NFPA installation standards (Requirement 2-0137).
- N. Provide an initiating alarm device (sprinkler system flow or pressure switch) for each area and floor of the building protected by sprinklers, as determined in consultation with ES-FP, to assist the Fire Department in determining the location of a fire during an emergency (Requirement 2-0138).
- O. Nuclear:
1. Sprinkler systems designated by documented safety analyses as safety significant (SS) or safety class (SC) are subject to additional design, material, construction, quality assurance (QA), and inspection, testing and maintenance (ITM) requirements of DOE-STD-1066 Appendix A (Requirement 2-0139).
 2. Quality Assurance shall also comply with ESM Chapter 1 General and SD330, *LANL Quality Assurance Program*. Comply with the editions of ASME NQA-1 and NQA-1a cited therein.
 3. Seismic design shall comply with ESM Chapter 5 Structural. For "high-hazard nuclear (i.e., SDC-3)," ESM Ch. 5 Section III must be met.
- Guidance: Consider use of ASME B31E, Standard for the Seismic Design and Retrofit of Above-Ground Piping Systems, for "low-hazard nuclear (i.e., SDC-1 and -2)."*
- P. The anticipated operation, or inadvertent operation and failure, of the sprinkler system must not result in the loss of function of designated SC or SS (nuclear) systems, structures or components (SSCs) (Requirement 2-0140).
- Q. Standpipe requirements for standpipe system piping downstream of the base of the system riser:
1. Provide standpipe systems when required by the NFPA Codes or the IBC. Also provide in structures with extensive or complex interior layouts, or in structures where exterior doors cannot be held in the open position due to security or ventilation/radiation safety requirements (Requirement 2-0141).
 2. Design and install standpipe systems in accordance with IBC and NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems* (Requirement 2-0142).
 3. Consultation with the LANL Fire Protection Group and the Los Alamos Fire Department (LAFD) on the type and performance of a new standpipe system is required, with final approval by the LANL Fire Marshal (Requirement 2-0143).
- R. Refer to the following LANL Standards Master Specifications and Details [here](#) (Requirement 2-0144).
1. Master Specification 21 1313, *Wet-Pipe Sprinkler Systems*.
 2. Master Specification 21 1316, *Dry-Pipe Sprinkler Systems*.
 3. Master Specification 21 1319, *Preaction Sprinkler Systems*.
 4. Fire Protection Drawings [ST-D4010-1](#), *Sprinkler System Riser Details*.

D4010.50 SPECIAL FIRE EXTINGUISHING SYSTEMS

1.0 SPECIAL FIRE EXTINGUISHING SYSTEMS

- A. Provide special extinguishing systems to protect hazards that cannot be adequately protected by automatic sprinklers alone. Select the most appropriate combination of detection, extinguishing agent, and extinguishing system design for the hazard (Requirement 2-0147).
- B. Follow as applicable NFPA 11, 11A, 12, 15, 16, 17, 17A, 69, 750, 2001, and other applicable NFPA codes, standards, and recommended practices (2-0148).

Guidance: The requirement for drawings or plans for special fire extinguishing systems is, in general, left to discretion of the AHJ (i.e., LANL Fire Marshal). Consult with the LANL Fire Protection Group when developing requirements or design documentation.

- 1. Do not install new Halon 1301 systems, but maintain any existing systems in accordance with NFPA 12A (2-0149).
- C. Follow, as applicable, the following LANL Standards Master Specifications available [here](#) (Requirement 2-0150)
 - 1. Master Specification Section 21 1326, *Deluge Fire Suppression Sprinkler Systems*
 - 2. Master Specification Section 21 2200, *Clean Agent Fire-Extinguishing Systems*

D4030 FIRE PROTECTION SPECIALTIES

1.0 PORTABLE FIRE EXTINGUISHERS

- A. Fire extinguisher types, locations, and signage shall be in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*, the applicable building and fire codes (i.e., IBC, IFC, NFPA 1, and NFPA 101); and applicable occupancy, equipment, or industry specific standards (Requirement 2-0151).
- B. Information on proposed fire extinguishers shall be reviewed by the project point of contact in the LANL Fire Protection Group prior to purchasing and installation.

Guidance: Fire extinguishers are typically furnished by the using group and installed by LANL craft. Alternately, fire extinguishers may be furnished by the Project for new facilities.

- C. Follow the LANL Master Specification [10 4400](#), *Fire Protection Specialties* (Requirement 2-0152).

D4050 COMMISSIONING FIRE PROTECTION AND LIFE SAFETY

This section provides a general summary of commissioning requirements and expectations for new and modified fire protection and life safety systems, structures and components (SSCs) installed with LANL buildings and facilities (Requirement 2-0153). This article is intended to augment the basic expectations described in ESM Chapter 15 Commissioning, provide alignment with Chapter 16 IBC Program, and provide consistency as recommended within NFPA 3, *Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems*, and NFPA 4, *Standard for Integrated Fire Protection and Life Safety System Testing*. NFPA 3 and NFPA 4 describe a framework for the commissioning and integrated testing processes for the following active and passive fire protection and life safety SSCs to ensure conformity with the design intent:

- (1) Infrastructure supporting building fire protection and life safety SSCs
- (2) Fixed fire suppression and control systems
- (3) Fire detection and alarm systems, including occupant notification

- (4) Remote alarm transmission to the LANL proprietary fire alarm system
- (5) Smoke control and management systems
- (6) Normal, emergency and standby power systems
- (7) Explosion prevention and control/relief systems
- (8) Fire-resistant and smoke-resistant assemblies
- (9) Opening protective and through-penetration firestop systems
- (10) SSCs protecting commercial cooking operations
- (11) Elevator systems
- (12) Means of egress SSCs
- (13) Spill collection/containment, water run-off control features
- (14) Process control and safety SSCs
- (15) Access control SSCs

Note: In the following, "Contractor" shall be taken to mean the Subcontractor or subtier Subcontractor performing the work for LANL.

1.0 FIRE PROTECTION INFRASTRUCTURE

- A. Fire protection water supply storage tanks shall be inspected and commissioned in accordance with NFPA 22, *Standard for Water Tanks for Private Fire Protection*, and applicable AWWA standards for potable water storage tanks (Requirement 2-0154).
 1. Tank manufacturer/erector and/or representative shall document inspection and commissioning results within an inspection report (Requirement 2-0155).
- B. Fire protection pumps and associated appurtenances (piping, valves, pressure maintenance pumps, controllers, fuel systems, battery systems, testing devices, enclosures, etc.) shall be inspected and commissioned in accordance with NFPA 20, *Standard for Installation of Stationary Pumps for Fire Protection* (Requirement 2-0156).
 1. Documentation of commissioning results shall include a Contractor's Material and Test Certificate for Private Fire Service Mains (suction and discharge piping to/from the fire pumps), a Contractor's Material and Test Certificate for Fire Pump Systems (one for each pump), and manufacturer's certified pump test characteristic curve for validating as-installed performance (Requirement 2-0157).
- C. Fire protection water supply distribution systems and associated appurtenances (block valves, pressure reducing valves, control valves and fire hydrants) shall be inspected and commissioned in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and their Appurtenances*, and applicable AWWA standards for potable (i.e., domestic) and combined potable/fire water systems where applicable (Requirement 2-0158).
 1. Testing shall include verification of available fire flow in comparison with original design calculations (Requirement 2-0159).
 2. Documentation of commissioning results shall include a Contractor's Material and Test Certificate for Private Fire Service Mains (Requirement 2-0160).

Guidance: The LANL combined fire protection and potable (i.e., domestic) water supply distribution system is considered to operate as a public utility. NFPA 24 is not applicable to these portions of the water supply distribution system, including the fire hydrants supplied by the system. The standard is applicable to the lead-in to the automatic sprinkler or standpipe riser, and distribution systems solely for the purposes of providing fire protection water to risers and/or fire hydrants. Dedicated fire protection water distribution systems are found at TA-35, LANSCE, and TA-55, among others.

- D. Fire department access roadways and associated fire lane marking and signage shall be inspected in accordance with NFPA 1, *Fire Code*, and the *International Fire Code* criteria for "Fire Department Access" (Requirement 2-0161).
 - 1. Inspection shall include verification of intended fencing, gates, Knox key box, fire hydrant, fire department connection (FDC) and apparatus accessibility (Requirement 2-0162).

2.0 WATER-BASED FIRE SUPPRESSION SYSTEMS

- A. Automatic sprinkler systems (wet-pipe, dry-pipe, preaction, deluge) shall be inspected and commissioned in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems* (Requirement 2-0163).
 - 1. Documentation of commissioning results shall include a Contractor's Material and Test Certificate for Underground Piping (lead-in piping), a Contractor's Material and Test Certificate for Above Ground Piping, and a listing of the sprinklers installed within the facility (posted at the spare head cabinet) (Requirement 2-0164).
 - 2. The type and quantity of factory-premixed anti-freeze solution shall also be posted at the control valve of any anti-freeze sub-system (Requirement 2-0165).
- B. Water spray fixed systems shall be inspected and commissioned in accordance with NFPA 15, *Standard for the Installation of Water Spray Fixed Systems* (Requirement 2-0166).
 - 1. Documentation of commissioning results shall include a Contractor's Material and Test Certificate for Underground Piping (lead-in piping) and a Contractor's Material and Test Certificate for Water Spray Systems (Requirement 2-0167).
 - 2. Also provide a listing of the spray nozzles installed within the facility (posted at the spare head cabinet) (Requirement 2-0168).
- C. Automatic foam-water sprinkler systems shall be inspected and commissioned in accordance with NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems* (Requirement 2-0169).
 - 1. Documentation of commissioning results shall include a Contractor's Material and Test Certificate for Underground Piping (lead-in piping) per NFPA 24, a Contractor's Material and Test Certificate for Above Ground Piping, and a listing of the sprinklers installed within the facility (posted at the spare head cabinet) (Requirement 2-0170).
 - 2. Also provide documented confirmation of the compatibility of the foam concentrate, foam concentrate storage tank, foam proportioning devices, piping, valves, and sprinkler heads/spray nozzles (Requirement 2-0171).
- D. Standpipe systems shall be inspected and commissioned in accordance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems* (Requirement 2-0172).
 - 1. Documentation of commissioning results shall include a Contractor's Material and Test Certificate for Underground Piping (lead-in piping), and a Contractor's Material and Test Certificate for Above Ground Piping (Requirement 2-0173).

3.0 CLEAN AGENT EXTINGUISHING SYSTEMS

- A. Carbon dioxide (CO₂) extinguishing systems shall be inspected and commissioned in accordance with NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems* (Requirement 2-0174).
 - 1. Installing vendor and/or manufacturer's representative shall document inspection and commissioning results within an inspection report, including enclosure integrity testing results (Requirement 2-0175).
- B. Clean agent (e.g., FM 200, Inergen, Argonite, Novec 1230, etc.) extinguishing systems shall be inspected and commissioned in accordance with NFPA 2001, *Standard on Clean Agent Extinguishing Systems* (Requirement 2-0176).

1. Installing vendor and/or manufacturer's representative shall document inspection and commissioning results within an inspection report, including enclosure integrity testing results (Requirement 2-0177).

4.0 CHEMICAL EXTINGUISHING SYSTEMS

- A. Dry chemical extinguishing systems shall be inspected and commissioned in accordance with NFPA 17, *Standard for Dry Chemical Extinguishing Systems* (Requirement 2-0178).
 1. Documentation of commissioning results shall include a Dry Chemical System Acceptance Test Report prepared by the installing vendor and/or manufacturer's representative, including confirmation of any auxiliary functions/controls test results (Requirement 2-0179).
- B. Wet chemical extinguishing systems shall be inspected and commissioned in accordance with NFPA 17A, *Standard for Wet Chemical Extinguishing Systems* (Requirement 2-0180).
 1. Documentation of commissioning results shall include a Wet Chemical System Acceptance Test Report prepared by the installing vendor and/or manufacturer's representative, including confirmation of any auxiliary functions/controls test results (Requirement 2-0181).

5.0 FIRE DETECTION AND ALARM SYSTEMS

- A. Fire detection and alarm systems shall be inspected and commissioned in accordance with NFPA 72, *National Fire Alarm and Signaling Code* (Requirement 2-0182).
 1. Documentation of commissioning results shall include a Record of Completion (Requirement 2-0183).
 2. Commissioning shall include proper integration and functionality of the control unit and remote power supply panels, battery load demands, all initiating devices, notification appliances and features (e.g., emergency responder microphones), auxiliary functions (e.g., elevator controls, HVAC controls, fire door release, smoke dampers, process interlocks, smoke management systems, etc.), NFPA 72-compliant electrical supervision of fire suppression systems and equipment, remote annunciators, and alarm transmission to the LANL proprietary fire alarm system (Requirement 2-0184).

6.0 PASSIVE FIRE PROTECTION AND LIFE SAFETY FEATURES

- A. Fire-resistance-rated walls, floor/ceiling systems, barriers and partitions shall be inspected to confirm that they are in accordance with the *IBC*, NFPA 101, *Life Safety Code*, and NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, and the design drawings and specifications (Requirements 2-0185).
- B. Spray-applied and mastic and intumescent fire-resistant materials and coatings, respectively, utilized as components of a fire-resistant barrier are subject to Special Inspection and Testing as described in Chapter 16 – IBC Program (Requirement 2-0186).
- C. Firestop assemblies and fire-resistant joints in high-rise buildings or in buildings assigned to Risk Category III or IV are subject to Special Inspection and Testing as described in Chapter 16 – IBC Program., (Requirement 2-0187).
- D. Smoke barriers and partitions, and associated air leakage limiting firestop assemblies and fire-resistant joint systems shall be inspected to confirm that they are in accordance with the *IBC* and NFPA 101, *Life Safety Code*, and the design drawings and specifications (Requirement 2-0188).
- E. Fire doors, windows and glazing systems within fire- and smoke-resistant barriers shall be inspected in accordance with the *IBC*, NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, and NFPA 101, *Life Safety Code*, and the design drawings and specifications (Requirement 2-0189).

1. Door hardware, access control and other security features are verified to be consistent with fire door assemblies and life safety means of egress requirements (Requirement 2-0190).
- F. Fire dampers, smoke dampers, and combination fire/smoke dampers within fire- and smoke-resistant barriers shall be inspected in accordance with the *IBC*; NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilation Systems*; NFPA 80, *Standard for Fire Doors and Other Opening Protectives*; and NFPA 101, *Life Safety Code*, to confirm conformity to the design drawings and specifications (Requirement 2-0191).
1. Where dampers cannot be provided within ductwork for operational reasons (e.g., exhaust systems), external duct wrap systems shall be inspected in accordance with NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists and Noncombustible Particulate Solids*, to confirm conformity to the design drawings and specifications (Requirement 2-0192).
- G. Electrical, mechanical, and other penetrations into and through fire- and smoke-resistant barriers shall be inspected to verify that specified listed/approved through-penetration firestop systems have been properly installed and labeled in accordance with the *IBC*; NFPA 101, *Life Safety Code*; and NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls* (Requirement 2-0193).
- H. Spill collection (e.g., oil-filled transformer basins) and fire suppression water run-off containment/collection features shall be inspected to confirm conformity to the design drawings and specifications (e.g., NFPA 15, *Standard for the Installation of Water Spray Fixed Systems*, NFPA 30, *Flammable and Combustible Liquids Code*, NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, etc.) (Requirement 2-0194).

7.0 LIFE SAFETY FEATURES

- A. Portable fire extinguishers shall be inspected (i.e., location/spacing, accessibility, rating, compatibility with hazards, and signage) in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*, to confirm conformity to the design drawings and specifications (Requirement 2-0195).
- B. Means of egress features (i.e., exit access paths, exit enclosures, horizontal exits, stairs, and doors) shall be inspected in accordance with the *IBC* and NFPA 101, *Life Safety Code*, to confirm conformity to the design drawings and specifications (Requirement 2-0196).
- C. Access control and other security features shall be verified to be consistent with life safety means of egress requirements (Requirement 2-0197).
- D. Emergency lighting and exit signage shall be inspected in accordance with the *IBC* and NFPA 101, *Life Safety Code*, to confirm conformity to the design drawings and specifications. Battery-operated units shall be tested to confirm illumination levels and duration satisfy NFPA 101 Sections 7.9 and 7.10 performance requirements (Requirement 2-0198).
- E. Emergency power systems supporting life safety-related systems and features shall be inspected and commissioned in accordance with the *IBC*, NFPA 101, *Life Safety Code*, and NFPA 110, *Standard for Emergency and Standby Power Systems*, and the design drawings and specifications (Requirement 2-0199).
1. Installing vendor and/or manufacturer's representative shall document inspection and commissioning results within an inspection report (Requirement 2-0200).
- F. Smoke control and management systems shall be inspected and commissioned in accordance with the *IBC*, NFPA 101, *Life Safety Code*, NFPA 92, *Standard for Smoke Control Systems*, and/or NFPA 204, *Standard for Smoke and Heat Venting*, to confirm conformity to the design drawings and specifications (Requirement 2-0201).
1. Commissioning shall be performed under the direction and supervision of the Engineer of Record (Requirement 2-0202).
 2. Commissioning shall be documented within an inspection report (Requirement 2-0203).

3. Smoke control and management systems are subject to Special Inspection and Testing as described in ESM Chapter 16, IBC Program (Requirement 2-0204).
4. Training shall be offered and delivered at the discretion of the Los Alamos Fire Department on the manual operation controls for any new or modified Smoke Control System (Contact LANL Fire Protection Group to schedule and arrange) (Requirement 2-0205).

ATTACHMENTS

Attachment 1. Adopted Editions of NFPA Fire Protection Codes, Standards, and Recommended Practices

RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	06/28/99	Fire Protection requirements from the Architectural and Mechanical Facilities Engineering Standards, Volumes 4 and 6, incorporated into this chapter.	James Gourdoux, <i>FWO-FP</i>	Dennis McLain, <i>FWO-FE</i>
1	11/18/02	Changed FEM to LEM. Complete revision and addition of endnotes.	Julia Wood, <i>FWO-FP</i>	Kurt Beckman, <i>FWO-SEM</i>
2	10/27/06	Administrative changes only. Fire Alarm Systems subsection moved from Ch 7 D5030. Organization and contract reference updates from LANS transition. IMP and ISD number changes based on new Conduct of Engineering IMP 341. Master Spec number/title updates. Other administrative changes.	Julia Wood, <i>ER-FP</i>	Kirk Christensen, <i>CENG</i>
3	6/18/08	Added IFC, NM IBC amendments, most stringent concept. Protection loss threshold was \$1M. Occupancy analysis for IBC and NFPA. Added 420.1-3, deleted STD-1062. Other minor changes.	Julia Wood, <i>EO-FP</i>	Kirk Christensen, <i>CENG</i>
4	11/21/13	Incorporated DOE O 420.1C and DOE-STD-1066-12, commissioning expectations. Resolved PFITS 2011-504 CA2. Other minor changes.	Jim Streit, <i>FP-DO</i>	Larry Goen, <i>ES-DO</i>
5	04/05/18	Added seismic requirements, need to identify fire barriers on drawings (4.5/6), interfaces to IBC. Implemented PFITS 2013-2393-CA3 regarding mods to listed equipment (at 4.3) and others. Periodic review and update.	Jim Streit, <i>FP-DO</i>	Larry Goen, <i>ES-DO</i>
6	02/05/21	Updated dollar limits to DOE O 420.1C Chg 3. Invoked DOE-STD-1066-2016. Added NFPA code/standard edition attachment. LANL Fire Protection Division (FP-DO) became LANL Fire Protection Group (ES-FP). Clarified role of the LANL Field Office for code conflicts, equivalencies, and exemptions. Required listed antifreeze to address IM-2019-1083 #7. Added requirements for fire-resistant joints in Part 4.6. Expanded requirements for design documentation for Title II services. Provided guidance when Light Hazard and Ordinary Hazard Group 1 occupancy classifications may be used. Clarified which portions of water supply system to apply NFPA 24. Added local requirements for backflow preventer forward-flow test headers, fire department access roads, and the marking of fire lanes. Added reference to Requirement Log at each requirement. Updated emergency management reference to EMD-EP.	Keenan Dotson, <i>ES-FP</i>	Jim Streit, <i>ES-DO</i>