Department of Energy
Washington, DC 20585

April 21, 2011

The Honorable Peter S. Winokur
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

This letter is to notify you that the Department of Energy (DOE) has completed Deliverable 5.5.1 for Defense Nuclear Facilities Safety Board Recommendation 2008-1, *Safety Classification of Fire Protection Systems*. Draft DOE Standard 1066-XX, *Fire Protection*, is attached. This draft standard, which incorporates specific design and operational criteria for sprinkler and other selected fire protection systems, has been submitted for DOE-wide review via RevCom.

If you have any questions, please contact me at (202) 586-5680, or you may contact James O'Brien of my staff, at (301) 903-1408.

Sincerely,

Andrew C. Lawrence

Andrew C. Lawrence
Director
Office of Nuclear Safety, Quality Assurance
and Environment
Office of Health, Safety and Security

Attachment

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This February 2011 draft was prepared by the Office of Nuclear Safety Policy and Assistance, has not been approved, and is subject to modification.

Project No. FIRP-0002

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NOT MEASUREMENT SENSITIVE

DOE-STD-1066-XX
Date

Supersedes
DOE-STD-1066-99

DOE STANDARD

FIRE PROTECTION

U.S. Department of Energy
Washington, DC 20585

AREA FIRP

FOREWORD

This U.S. Department of Energy (DOE) standard supersedes DOE Standard (STD)-1066-99[1] and is approved for use by DOE and its contractors. In 2011, the following fire protection directives were canceled and appropriate technical content was incorporated into this standard:

- DOE-STD-1088-95, *Fire Protection for Relocatable Structures*;
- DOE Guide (G) 420.1-3, *Implementation Guide for DOE Fire Protection and Emergency Services Programs for Use with DOE O 420.1B, Facility Safety*; and,
- DOE G 450-1.4 *Implementation Guide Wildland Fire Management Program for Use with DOE Order (O) 450.1, Environmental Protection Program.*

This standard now serves as the single document for criteria and guidance supporting implementation of DOE O 420.1C, *Facility Safety*. This standard also incorporates new criteria and guidance related to the design and operation of fire protection systems used in safety class and safety significant applications that were developed as part of the Department's response to Defense Nuclear Facility Safety Board Recommendation 2008-1, *Safety Classification of Fire Protection Systems.*

This standard was developed because national consensus standards and other design criteria do not comprehensively or, in some cases, adequately address special or unique fire protection issues at DOE facilities. A working group comprised of subject matter experts drawn from DOE, contractors, and industry was used to prepare the standard. Beneficial comments (recommendations, additions, deletions) and any pertinent data that may improve this document shall be sent to:

U.S. Department of Energy
Office of Nuclear Safety Policy and Assistance (HS-21)
1000 Independence Avenue SW
Washington, DC 20585.

DOE technical standards, such as this standard, do not establish requirements. However, all or part, of the provisions in a DOE standard can become requirements under the following circumstances:

(1) they are explicitly stated to be requirements in a DOE requirements document; or,

(2) an organization makes a commitment to meet a standard in a contract or in an implementation plan or program plan required by a DOE requirements document.

Throughout this standard, the word "shall" is used to denote actions that are to be performed if the objectives of this standard are to be met. If the provisions in this standard are made requirements through one of the two ways discussed above, the "shall" statements would become requirements. It is not appropriate to consider that "should" statements would automatically be converted to "shall" statements, as this action would violate the consensus process used to approve this standard.

[1] DOE-STD-1066-99 is available for reference in the Technical Standards Program archive at http://www.hss.doe.gov/nuclearsafety/ns/techstds/standard/archive.html

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1 INTRODUCTION

1.1 Purpose

The purpose of this standard is to facilitate implementation of requirements in Department of Energy (DOE) Order (O), DOE O 420.1C, *Facility Safety*, by providing criteria and guidance for a standard and acceptable approach to meet the DOE O 420.1C requirements for Fire Protection Programs. This document also addresses, in part and where appropriate, the relationship of fire protection requirements in DOE O 420.1C and the following DOE documents:

- 10 Code of Federal Regulations (CFR) Part 851, *Worker Safety and Health Program*
- DOE O 440.1B, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees*
- DOE Guide (G), DOE G 440.1-8, *Implementing Guide for Use with 10 CFR Part 851, Worker Safety and Health Programs*
- DOE O 151.1C, *Comprehensive Emergency Management System*

The above documents are available at the DOE Fire Protection website: http://www.hss.doe.gov/nuclearsafety/ns/fire/ and at the DOE Directives website http://www.directives.doe.gov/

This standard was developed because national consensus standards and other design criteria do not comprehensively or, in some cases, adequately address special or unique fire protection issues at DOE facilities.

1.2 Applicability

The provisions of this standard apply to the following:

- All departmental elements as identified in the scope of DOE O 420.1C and its respective contractor requirements document (CRD), DOE O 440.1B and 10 CFR 851; and,
- The purchase and lease, as well as the design and construction, of all DOE facilities erected, modified, or renovated after the effective date of this standard whether located on or off a DOE site.

This standard may not apply to non-government facilities or to facilities of other agencies on DOE sites where fire protection requirements are enforced by other government agencies. Unless specifically required by a DOE contract, directive, or regulation, provisions of this Standard provide guidance on acceptable methods to meet DOE requirements. Nothing in this Standard is intended to limit the application of other fire protection methods when unique situations or hazards warrant an alternate approach. Any alternate approach shall provide a level of safety equal to or greater than that achieved by conformance with this standard. Such alternate approaches shall be documented as approved by the authority having jurisdiction (AHJ), after consultation with a qualified fire protection engineer (FPE).

1.3 Overview of Standard

This standard is structured to be consistent with the organization of DOE O 420.1C as follows:

Section 2, General Fire Protection Requirements

Section 3, Fire Protection Program Administration

Section 4, Fire Protection Design

Section 5, Operations

Section 6, Emergency Response

Section 7, Facility Fire Protection Assessments

Section 8, Wildland Fire Management

Appendix E provides additional explanatory material, indicated as endnotes throughout the body of the Standard.. The other appendices contain detailed criteria and guidance for specific conditions, including criteria and guidance for fire protection systems used in safety significant (SS) and safety class (SC) applications.

1.4 Referenced Documents

DOE facilities and their associated fire protection features are subject to the applicable sections of the documents listed below as specified in DOE O 420.1C, Chapter 2.

Federal Documents

Public Law 100-678, *Compliance with Nationally Recognized Codes and Standards* 10 CFR 851, *Worker Safety and Health Program*

10 CFR 830, *Nuclear Safety Management*

10 CFR 851, *Worker Safety and Health Program*

29 CFR 1910, *Occupational Safety and Health Standards*

29 CFR 1926, *Safety and Health Regulations for Construction*

DOE Requirements and Guidelines

DOE O 151.1C, *Comprehensive Emergency Management System*

DOE O 231.1A, *Environment, Safety, and Health Reporting*

DOE O 251.1C, *Departmental Directives Program*

DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*

DOE O 420.1C, *Facility Safety*

DOE O 440.1B, *Worker Protection Program for DOE (Including the National Nuclear Security Administration) Federal Employees*

DOE Manual (M) 470.4-4A, *Information Security Manual*

DOE G 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for Use With DOE O 420.1, Facility Safety*

DOE G 440.1-8, *Implementing Guide for Use with 10 CFR Part 851, Worker Safety and Health Programs*

DOE Administrative Records Schedule 18, *Security, Emergency Planning, and Safety Records,* September 2010, Revision 2

Department of Energy Standards

DOE-HDBK-1169-2003, *Nuclear Air Cleaning Handbook*

DOE-STD-1137-2007, *Fire Protection Engineering Functional Area Qualification Standard*

DOE-STD-1189-2008, *Integration of Safety into the Design Process*

DOE-STD-3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*

DOE-STD-3024-1998, *Content of System Design Descriptions*

Other Criteria

American Society of Mechanical Engineers (ASME)

ASME B16.3, *Malleable Iron Threaded Fittings: Classes 150 and 300*

ASME B31.3, *Process Piping*

ASME, Boiler and Pressure Vessel Code

ASTM International

ASTM E-84, *Standard Test Method for Surface Burning Characteristics of Building Materials*

ASTM E-119, *Fire Tests of Building Construction and Materials Protection of Electrical Raceways*

ASTM E-136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*

ASTM D-323-008, *Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)*

National Fire Protection Association (NFPA)

NFPA 1, *Fire Code*

NFPA 10, *Portable Fire Extinguishers*

NFPA 11, *Standard for Low, Medium, and High Expansion Foam Systems*

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*

NFPA 13, *Standard for the Installation for Sprinkler Systems*

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*

NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*

NFPA 22, *Standard for Water Tanks for Private Fire Protection*

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*

NFPA 30, *Flammable and Combustible Liquids Code*

NFPA 58, *Liquefied Petroleum Gas Code*

NFPA 70, *National Electric Code®*

NFPA 72, *National Fire Alarm and Signaling Code*

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*

NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilation Systems*

NFPA 101, *Life Safety Code®*

NFPA 101A, *Guide on Alternative Approaches to Life Safety*

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*

NFPA 241, *Standard for Safeguarding Construction, Alteration, Demolition Operations*

NFPA 256, *Standard Methods of Fire Tests of Roof Coverings*

NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities*

NFPA 400, *Hazardous Materials Code*

NFPA 484, *Standard for Combustible Metals*

NFPA 251, Standard Methods of Tests of Fire Resistance of Building Construction and Materials

NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*

NFPA 750, *Standard on Water Mist Fire Protection Systems*

NFPA 780, *Standard for the Installation of Lightning Protection Systems*

NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Material*

NFPA 901, *Standard Classifications for Incident Reporting and Fire Protection Data*

NFPA 1001, *Standard for Fire Fighter Professional Qualifications*

NFPA 1002, *Standard on Apparatus Driver/Operator Professional Qualifications*

NFPA 1143, *Standard for Wildland Fire Management*

NFPA 1144, *Standard for Reducing Structural Ignition Hazards from Wildfire*

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*

NFPA 1561, *Standard on Emergency Services Incident Management System*

NFPA 1620, *Standard for Pre-Incident Planning*

NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*

NFPA 1901, *Standard for Automotive Fire Apparatus*

NFPA 2001, *Clean Agent Fire Extinguishing Systems*

NFPA 2010, *Standard for Fixed Aerosol Fire Extinguishing Systems*

Nuclear Quality Assurance

ASME NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications*

Occupational Safety and Health Administration (OSHA)

OSHA 1910.156, *Fire Brigades*

Underwriters Laboratories (UL)

UL-586, *High Efficiency Particulate Air – Filter Units*

UL-900, *Test Performance of Air Filter Units*

International Code Council (ICC)

International Building Code

International Existing Building Code

International Fire Code

American Glovebox Society (AGS)

AGS-G006, *Standard of Practice for the Design and Fabrication of Nuclear Application Gloveboxes*

AGS-G010, *Standard of Practice for Glovebox Fire Protection*

1.5 Definitions

Acceptable – Considered by the authority having jurisdiction (AHJ) as adequate for satisfying the goals, performance objectives, and/or performance criteria.

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

Approved – Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction (AHJ) – An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure. In DOE, the Head of Field Element is the AHJ, but responsibility can be delegated to another federal official and routine activities can be delegated to a contractor.

Building Code Official (BCO) – The decision-making authority in matters concerning the building code. The DOE Head of Field Organization or designee is the final BCO, unless otherwise directed by the Cognizant Secretarial Officer.

Combustible – Any material that, in the form in which it is used and under the conditions anticipated, will ignite and burn or will add appreciable heat to an ambient fire. See ASTM E-136.

Combustible Liquid – Any liquid that has a closed-cup flash point at or above 100°F (37.8°C), as determined by the test procedures and apparatus set forth in NFPA 30. Combustible liquids are classified as Class II or Class III as follows: (1) Class II Liquid — any liquid that has a flash point at or above 100°F (37.8°C) and below 140°F (60°C); (2) Class IIIA — any liquid that has a flash point at or above 140°F (60°C), but below 200°F (93°C); and, (3) Class IIIB — any liquid that has a flash point at or above 200°F (93°C).

Criticality Incident – The release of energy as a result of an accidental self-sustained nuclear fission chain reaction.

Deactivation and Decommissioning (D&D) facilities – Those facilities that are undergoing deactivation, i.e., placed in a safe-shutdown condition and vacated, or are undergoing decommissioning to the ultimate endstate through decontamination, dismantlement or demolition.

Documented Safety Analysis (DSA) – An analysis of the extent to which a nuclear facility can be operated safely with respect to workers, the public, and the environment, including a description of the conditions, safe boundaries, and hazard controls that provide the basis for ensuring safety.

Emergency Services Organization – The site fire department, brigade, or other organization that performs any or all of the following functions: Fire Suppression; Hazardous Material (HAZMAT) Response; Emergency Medical Services; Technical Rescue; Confined Space Entry; Training; Off-site Assistance to Other Emergency Services Organizations (Mutual Aid); Inspection, Testing and Maintenance of Fire Protection Equipment or Apparatus; Facility Fire Prevention; and, Life Safety Inspections.

Equivalency – Equivalencies are alternative approaches that are equal to or better than the underlying requirement and are considered to be in compliance with the code or standard.

Exemption – Exemptions are defined in DOE O 251.1C, *Departmental Directives Program,* as the release of one or more requirements from a directive. Building codes, national fire codes, and a number of other national standards are required by 10 CFR 851 or DOE directives such as DOE O 420.1C. Deviations from these codes and standards are deviations from the DOE rule or order and shall follow the approval process for the rule or order. However, codes and standards of NFPA and the building code allow for an equivalent or alternate means of achieving compliance with the code or standard.

Fire – Unplanned destructive and uncontrolled burning, including explosions (detonation or deflagration), as manifested by any or all of the following: flame, heat or, smoke. Fire does not include the following unless they cause a fire or occur as a consequence of a fire: lightning or electrical discharge; rupture of a pressure vessel not caused by internal combustion; detonation of munitions; or, overheat (without damage to initiating material).

Fire Area – An area that is physically separated from other areas by space, barriers, walls, or other means in order to contain fire within that area.

Fire Barrier – A continuous vertical or horizontal construction assembly designed and constructed with a specified fire resistance rating to limit the spread of fire and that also will restrict the movement of smoke.

Fire Barrier Wall – A wall, other than a fire wall, having a fire resistance rating.

Fire Brigade – A group of people organized to engage in rescue, fire suppression, and related activities.

Fire Department – An organization providing rescue, fire suppression, and related activities, including any public, governmental, private, industrial, or military organization engaging in this type of activity.

Fire Prevention – The process of managing and regulating potential fire hazards (fuels and heat energy sources) and the mechanisms that bring them together to either eliminate the hazard(s) or reduce the risk associated with the hazard(s).

Fire Protection Assessment – A formal documented review conducted by DOE or contractors in accordance with DOE requirements that examines the essential fire protection elements as they relate to a specific facility or overall fire protection program.

Fire Protection Design Analysis – An engineering analysis during or preceding the preliminary design to establish fire protection design criteria, including applicable national codes and consensus standards.

Fire Protection Engineer – A graduate of an accredited engineering curriculum and having completed not less than four years of engineering practice, three of which were in responsible charge of diverse fire protection engineering work. If not such a graduate, an engineer should either: demonstrate a knowledge of the principles of engineering and have completed not less than six years engineering practice, three of which were in responsible charge of diverse fire protection engineering projects; be a registered professional engineer in fire protection; or meet the requirements for a Grade 11 or higher Fire Protection Engineer as defined by the Office of Personnel Management.

Fire Resistance Rating – The time, in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance with an approved test procedure appropriate for the structure, building material, or component under consideration.

Fire Wall – A fire division assembly with a fire resistance rating of three test hours or longer, built to permit complete burnout and collapse of the structure on one side without extension of fire through the fire wall or collapse of the fire wall.

Flammable Liquid – Any liquid that has a closed cup flash point below 100°F (37.8°C), as determined by the test procedures and apparatus set forth in Section 4.4 of NFPA 30, and a Reid vapor pressure that does not exceed an absolute pressure of 40 psi (76 kPa) at 100°F (37.8°C), as determined by ASTM D 323-008, *Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)*.

Glovebox – A sealed enclosure with viewing windows designed to separate the space in the enclosure from its surroundings and in which all items in the enclosure are handled using gloves that are sealed to ports in the enclosure walls.

Hazard Category (1, 2, 3) Nuclear Facilities – Hazard Category 1, 2, 3 nuclear facilities as defined in 10 CFR 830 are as follows: Hazard Category 1 has the potential for significant offsite consequences; Hazard Category 2 has the potential for significant onsite consequences beyond localized consequences; and, Hazard Category 3 has the potential for only local significant consequences.

Limited Supply Suppression System – A system installed in accordance with the applicable NFPA standards and having a limited quantity of suppression agent. These systems typically include carbon dioxide, dry chemical, other gaseous agents, or water.

Listed – Equipment, materials, or services included in a list published by an organization that is acceptable to the AHJ and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material or service meets appropriate designated standards or has been tested and found suitable for a specified purpose." This definition applies to products which are Underwriters Laboratories (UL) listed or FM Global approved.

Maximum Possible Fire Loss (MPFL) – The value of a facility or structure and its contents, excluding land value, within a fire area, unless a fire hazards analysis or fire protection

assessment demonstrates a lesser (or greater) loss potential. This assumes the failure of both automatic fire suppression systems and manual fire fighting efforts.

Noncombustible – A material that, in the form in which it is used and under the conditions anticipated, will not ignite, support combustion, burn, or release flammable vapors when subjected to fire or heat.

Pre-Incident Plan – A document, owned and developed by a fire department, which provides information to responding personnel that will help them safely and effectively manage emergencies with available resources at a specific facility or area.

Pyrophoric Material – A substance capable of self-ignition on short exposure to air under ordinary atmospheric conditions.

Qualified Fire Protection Engineer – A fire protection engineer who meets criteria in DOE-STD-1137-2007, *Fire Protection Engineering Functional Area Qualification Standard* or is a registered professional engineer in the field of fire protection engineering.

Redundant Fire Protection System – A fire protection system that is designed and installed to function in the event of the failure of a primary fire protection system.

Relocatable Structure – Manufactured structures, mobile homes, trailers, and semi-trailers mounted on a chassis and designed for mobility. This term does not apply to trailers and cargo containers that are being used in the transportation mode for conveying materials while onsite, or to prefabricated buildings designed for permanent location. Structures not specifically identified herein shall be referred to the AHJ for categorization.

Variance – A deviation from 10 CFR 851. The process for requesting and approving variances from the provisions of 10 CFR 851 is delineated in the rule and in supplemental guidance promulgated by DOE.

2 GENERAL FIRE PROTECTION REQUIREMENTS

A comprehensive site and facility fire protection program shall be developed and maintained using applicable industry codes and standards (principally from the NFPA), as modified by DOE fire protection criteria.[1]

2.1 Fire Protection Policy Statement

The fire protection policy statement shall document the fire protection program expectations of senior DOE and contractor management. The fire protection policy shall include strategies to maintain an awareness of the importance of fire prevention features, such as housekeeping, unobstructed means of egress and control of sources of heat. Such policy statements shall not conflict with regulatory, DOE, or contractual obligations. For site emergency services organizations, this policy statement shall include fundamental statements regarding the level of service that DOE expects, as well as, the level of capability that the contractors intend to provide.[2]

2.2 Use of National Codes and Standards

The acquisition and construction of new facilities and significant modifications of existing facilities shall meet the applicable parts of the latest edition of the national model building code, and national consensus standards for electrical, fire, and life safety as supplemented by the following:[3]

2.2.1 Building Code

2.2.1.1 International Building Code (IBC). DOE shall utilize the technical requirements of the IBC as modified in this standard for all projects. The IBC is part of the ICC family of codes and is available for purchase through www.iccsafe.org/

2.2.1.2 Administrative functions shall be controlled by the site fire protection program and as required by other DOE orders and not by the administration chapter of the IBC

2.2.1.3 Hazard Category 1, 2 & 3 nuclear facilities shall be classified as Group H-4 occupancies unless sufficient levels of other hazardous materials require alternate classification of Group H occupancy.

2.2.1.4 Buildings that comprise Hazard Category 1, 2 & 3 nuclear facilities shall be of Type I or Type II construction.

2.2.1.5 The special industrial occupancy exception in the IBC shall not apply to Hazard Category 1, 2 & 3 nuclear facilities.

2.2.2 National Electric Code. DOE shall utilize the technical electrical requirements of the NFPA 70, *National Electric Code®*, in lieu of the technical electrical requirements of the ICC Electrical Code. The National Electrical Code is available through www.nfpa.org/

2.2.3 State and Local Codes. State and local codes represent important regional interests and conditions. As such, state and local building codes, shall also be followed to the maximum extent practicable. All performance-based design alternatives to any code requirement shall use the methodology described in the Society of Fire Protection Engineers (SFPE) *SFPE Engineering Guide to Performance-Based Fire Protection,* 2nd Edition, available through http://www.sfpe.org/ or other methodologies approved by the AHJ.

2.2.4 When national codes and standards are in conflict with other safety or security requirements, alternate designs should be utilized that remove the conflict while assuring that an equivalent (or greater) level of fire protection is maintained.

2.3 Highly Protected Risk Criteria

The fire protection program shall provide a level of fire protection that is sufficient to fulfill the requirements of the best protected class of industrial risks (commonly referred to as "Highly Protected Risk" or "Improved Risk").[4]

3 FIRE PROTECTION PROGRAM ADMINISTRATION

3.1 Documentation

3.1.1 The Fire Protection Program (FPP) shall document the overall program or management systems established to assign responsibilities and authorities, define policies and requirements, and provide for the performance and assessment of fire protection and emergency response activities.

3.1.2 Processes shall be established and implemented to identify record retention requirements to support the FPP.

3.1.3 FPP criteria and procedures shall be developed consistent with section 5.1 of this standard.

3.2 Program Self-Assessments

The principal objective of self-assessment is to verify the adequacy of or identify deficiencies in fire protection programs.

3.2.1 Programmatic self-assessments shall be performed under the supervision of a qualified fire protection engineer. Personnel conducting such assessments shall have an appropriate level of knowledge and experience in the application of fire safety codes and standards in diverse facilities.

3.2.2 Self-assessments shall, as a minimum, encompass the following elements of the FPP fire protection program[5]:

a. Comprehensiveness of the FPP;
b. FPP procedures and policies;
c. Compliance with fire protection-related statutory requirements, DOE Orders, and mandatory national consensus codes and standards;
d. Procedures for engineering design and review;
e. Procedures for maintenance, testing, and inspection of installed fire protection systems and features;
f. Fire protection engineering staff (number, qualifications, training);
g. Emergency Services Organizations including the Baseline Needs Assessment (BNA), staffing, training, and equipment;
h. Management support;
i. Documented exemptions, equivalencies or deviations;
j. Fire protection system impairment process;
k. Hot work process; and,
l. Documentation and record keeping.

3.2.3 Comprehensive self-assessments of FPP elements by DOE and contractors shall be made every three years.

3.2.4 A "model" assessment report is available at the following web site: http://www.hss.doe.gov/nuclearsafety/ns/fire/models/models.html.

4 FIRE PROTECTION DESIGN

4.1 Design Process

4.1.1 For new construction and major facility modifications, as defined in Section 4.2.2, design documents shall include fire protection criteria based on either a fire protection design analysis or fire hazards analysis (FHA). [6]

4.1.2 Fire protection design criteria shall be developed as early in the conceptual design phase as practicable and shall be updated throughout the design process. The technical baseline for fire protection systems shall be maintained throughout the life of the facility.

4.1.3 For Hazard Category 1, 2, or 3 nuclear facilities, the fire protection design process shall be in accordance with DOE-STD-1189-2008, *Integration of Safety into the Design Process*.

4.2 General Design Criteria

4.2.1 Design of new DOE facilities shall be based on the provisions of the applicable requirements of the Code of Federal Regulations (CFR), DOE directives, the model building codes, and the applicable NFPA and other national codes and consensus standards. The design and location of relocatable structures shall be in accordance with Appendix C.

4.2.2 When a significant modification to an existing facility occurs, as determined by the AHJ, the current editions of the codes and standards shall apply to the modification.

4.2.2.1 For Hazard Category 1, 2 or 3 nuclear facilities, any modification that substantially changes the existing safety basis shall be considered a significant modification or major modification.

4.2.2.2 For other than Hazard Category 1, 2 or 3 nuclear facilities, the modification levels defined in the International Existing Building Code shall be followed when determining the significance of modifications.

4.2.3 The design and construction of DOE facilities shall have a level of fire protection sufficient to fulfill the requirements of the best protected class of industrial risks (commonly referred to as "Highly Protected Risk" or "Improved Risk") and shall provide protection to achieve "defense-in-depth." Design requirements contained in FM Global datasheets shall be used as guidance for design activities and are available at http://www.fmglobaldatasheets.com.

4.2.4 Where redundant fire protection systems are required by DOE O 420.1C, they shall be designed so that a common mode of failure will not render both systems inoperable.

4.2.5 Facility Layout and Construction

4.2.5.1 Fire Area Determination: Facilities shall be subdivided into separate fire areas as determined by the FHA. Fire areas shall be separated from each other by fire barriers, spatial separation or other approved means.

4.2.5.2 Fire Barriers: Fire barriers used to separate hazards shall have adequate fire resistance to achieve the intended fire separation including protection of openings, and shall have minimum 2 hour fire resistance rating or higher if required by the IBC or be demonstrated as adequate by analysis documented in the FHA.

4.2.5.3 Structural Materials: Construction shall meet the requirements of Type I or Type II Construction as defined in the IBC. Structural materials shall be noncombustible.[7]

4.2.5.4 Roof Covering: Roof Coverings shall be Class A as described in NFPA 256, *Standard Methods of Fire Test of Roof Coverings.* Metal deck roof systems shall meet the requirements of Class I construction as defined in FM Data Sheet 1-31.

4.2.5.5 Interior Finishes: Interior Finishes in Hazard Category 1, 2, and 3 nuclear facilities and radiological facilities, shall be Class A as defined in NFPA 101.

4.2.6 Building Services

4.2.6.1 Ventilation Systems: Ventilation systems shall be designed and installed in accordance with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilation Systems*. Ventilation systems which do not recirculate air (e.g., once through systems) do not require shutdown from duct smoke detectors, unless determined by the FHA as necessary to prevent the spread of fire or for emergency management.

4.2.6.2 Transformers: Transformers installed inside buildings shall be dry type, with no combustible dielectric fluids. Outside transformers shall be located and protected in accordance with FM Datasheet 5-4.

4.2.6.3 Lightning Protection: The need for lightning protection shall be determined in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems* unless modified by the fire hazard analysis (FHA). If lightning protection is required, it shall be installed in accordance with NFPA 780.

4.2.6.4 Drainage: Where high value property or critical process equipment is subject to flooding from the discharge of automatic sprinkler systems and/or use of manual hose streams, protection against water damage shall be provided by one or more of the following methods:

a. Floor drains;
b. Pits, sumps and sump pumps;
c. Equipment pedestals; and,
d. Other acceptable alternatives.

4.2.7 Life Safety:

4.2.7.1 Life safety provisions shall be provided for all facilities in accordance with NFPA 101, Life Safety Code© (LSC). Performance based designs, in accordance with Chapter 5 of NFPA 101, may be applied to support equivalency requests in which strict compliance with the LSC is not practical.

4.2.7.2 For business occupancies, the methods outlined in NFPA 101A, *Guide on Alternative Approaches to Life Safety*, may be applied to support equivalency requests in which strict compliance with the LSC is not practical.

4.2.8 Fire Protection Systems and Equipment

4.2.8.1 Water Supply: A reliable and adequate water supply and distribution system shall be provided for fire suppression as required by DOE O 420.1C.[8] The water supply shall be designed to meet the following combined demands: 1) largest single fire suppression system; 2) 500 gpm fire hose streams; and, 3) uninterruptable domestic and process demands. The water distribution system shall be designed to prevent a single failure from causing the system to fail to meet its demand. Design features shall include looped and gridded distribution piping with sectional

valves, redundant supplies (pumps and tanks or elevated water sources) and indicating type valves with valve supervision (e.g., tamper switches or locks and seals).

4.2.8.2 Fire Pumps: Fire Pumps, including controllers, shall be designed and installed in accordance with NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*. Pumps shall be sized so they meet the system demand without exceeding 120% of rated capacity. Redundancy can be provided by two 100% capacity pumps or, where demands vary greatly for multiple suppression system supplied by the pumps, redundancy can be provided by three 50% capacity pumps. The system of pumps and drivers shall be designed such that loss of primary electrical power will not prevent the system meeting the design demand.

4.2.8.3 Tanks: Fire water tanks shall be designed and installed in accordance with NFPA 22, *Standard for Water Tanks for Private Fire Protection*.

4.2.8.4 Water Supply Mains: Supply mains shall be designed and installed in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*.

4.2.8.5 Automatic Sprinkler Systems: Automatic sprinkler systems shall be designed and installed in accordance with NFPA 13, *Standard for the Installation for Sprinkler Systems*.[9]

a. Due to the potential for facility occupancy changes or room occupancy changes within the facility, occupancy classification for the sprinkler system shall not be less than an Ordinary Hazard Group 1.

b. Hydraulically designed sprinkler systems shall be designed for a supply pressure of at least 10 percent, but not less than 10 psi, below the water supply curve to provide a pressure margin to accommodate minor system modifications, or degradation of the water supply and sprinkler systems that may occur over time.

c. Sway bracing for seismic supports of sprinkler piping shall be based on the site-specific acceleration criteria in accordance with NFPA 13.

4.2.8.6 Standpipe and Hose Systems: Standpipes shall be installed in all structures having three levels or more above or below grade. Standpipes shall be designed and installed per NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*.

4.2.8.7 Water Spray Systems: Where water spray systems are provided, they shall be designed and installed in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*.

4.2.8.8 Special Suppression Systems: When automatic sprinkler or water spray protection systems cannot be safely employed, or need to be supplemented, the decision to install another type of fire suppression system shall be based on engineering analysis performed by a fire protection engineer. The analysis shall consider, in addition to initial design and installation cost, the long term cost of inspecting, testing and maintenance of the system over its useful life, especially where access for the performance of increased IT&M activities may be difficult due to security or radiological concerns.[10]

a. Where foam systems are provided, they shall be designed and installed in accordance with NFPA 11, *Standard for Low, Medium, and High Expansion*

Foam Systems, or NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*.

b. Where carbon dioxide systems are provided, they shall be designed and installed in accordance with NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*.

c. Where dry or wet chemical extinguishing systems are provided, they shall be designed and installed in accordance with NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, or NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*.

d. Where water mist fire protection systems are provided, they shall be designed and installed in accordance with NFPA 750, *Standard on Water Mist Fire Protection Systems*.

e. Where clean agent fire extinguishing systems are provided, they shall be designed and installed in accordance with NFPA 2001, *Clean Agent Fire Extinguishing Systems*.

f. Where fixed aerosol fire extinguishing systems are provided, they shall be designed and installed in accordance with NFPA 2010, *Standard for Fixed Aerosol Fire Extinguishing Systems*.

4.2.9 Fire Detection and Alarm Systems

A fire alarm system shall be provided for DOE facilities, to monitor fire suppression and detection systems, to notify occupants, to perform safety functions and to notify the emergency responders. The system shall be designed and installed in accordance with NFPA 72, *National Fire Alarm and Signaling Code*.[11]

4.2.9.1 Circuits and Pathways: Fire Alarm System circuits and pathways shall be designed and installed with the performance characteristics described in this section in accordance with NFPA 72. All pathways shall be designed with Pathway Survivability Level 1, unless an FHA or other appropriate design documentation indicated a higher survivability level is required.

a. Signaling line circuits (SLC) provided for communication between individual fire alarm control panels (FACPs) and from panels to the main fire alarm control station shall be designed as Class X. SLCs that provide communication between FACPs shall be designed as Class B, Class A or Class X as determined by an FHA or other appropriate design documentation.

b. Initiating Device Circuits (IDC) and SLC connecting initiation devices, such as detectors, monitor modules and manual pull stations shall be designed as Class B.

c. Notification Appliance Circuits (NAC) connecting notification appliances with the FACP shall be designed to be Class B.

4.2.9.2 Initiation Devices: The selection, location, and spacing of initiating devices shall be in accordance with NFPA 72. The response time requirements of detection devices shall be as determined by an FHA or other appropriate design documentation. Manual fire alarm pull stations shall be provided, in accordance with NFPA 72, when required by an FHA or other appropriate design documentation.

4.2.9.3 Notification Appliances: Notification appliances shall be designed and installed in all occupied areas in accordance with NFPA 72. When a public address system or

other voice notification is provided and that system is demonstrated to be as reliable as the fire alarm system (e.g., backup power supply, circuit and speaker supervision) additional fire alarm notification appliances may be reduced or eliminated. Visual alarm devices shall be designed and installed for all areas accessible to the public and all high ambient noise areas, in accordance with NFPA 72.

4.3 Process Fire Safety

4.3.1 Gases: Facilities for the storage and distribution of flammable and other hazardous compressed gases shall be designed in accordance with NFPA standards.[12]

4.3.2 Flammable and Combustible Liquids: Facilities for the storage and distribution of flammable and combustible liquids shall be designed in accordance NFPA 30, *Flammable and Combustible Liquids Code.*

4.3.3 Combustible Dusts: Facilities that use or create combustible dusts shall be designed in accordance with NFPA 654, *Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids.*

4.3.4 Combustible Metals: Facilities that store, use, or process combustible metals shall be designed in accordance with NFPA 484, *Standard for Combustible Metals.*

4.4 DOE-Specific Facilities and Systems

4.4.1 Facilities Containing Radioactive and other Hazardous Materials

4.4.1.1 Facilities containing radioactive materials shall be designed and constructed in accordance with NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Material.* If the facility contains surface contamination or if the fire could result in the release of radioactive material, the fire suppression water shall be contained, monitored and treated as necessary. The containment system shall be capable of collecting sprinkler discharge for a minimum of 30 minutes.[13]

4.4.1.2 Additional fire protection features shall be determined based on the FHA in concert with the Documented Safety Analysis (DSA). If any fire protection features are determined in the DSA to be SS or SC, the design and operating criteria of Appendix A shall be implemented.[14]

4.4.2 Gloveboxes, Hot Cells and Canyons

4.4.2.1 Hot cells and canyons shall be constructed of non-combustible or fire-resistive material to prevent fires from spreading into or out of the hot cell or canyon. If oil filled windows are necessary for radiation shielding, they shall be protected with automatic sprinklers in accordance with NFPA 13 criteria for windows.

4.4.2.2 New gloveboxes shall be designed, constructed and protected in accordance with American Glovebox Society (AGS) standards AGS-G006, *Standard of Practice for the Design and Fabrication of Nuclear Application Gloveboxes*, and AGS-G010, *Standard of Practice for Glovebox Fire Protection.*

4.4.2.3 Fire detection and suppression requirements shall be based on the FHA and DSA. If any fire protection features are determined in the DSA to be SS or SC, the design and operating criteria of Appendix A shall be implemented.

4.4.2.4 When inerting is used as a substitute for required automatic fire suppression systems, the level of inerting shall be sufficient to prevent ignition of the material(s) present.[15]

4.4.3 Nuclear Confinement Ventilation System Fire Protection

Fire protection in or around confinement ventilation systems in nuclear facilities shall be designed to accomplish the following objectives: 1) prevent fires from affecting the operation of the ventilation system; 2) protect the filtration function; and, 3) prevent the release of material that has accumulated on filters.[16]

4.4.3.1 Filter Assembly Construction: High efficiency particulate air (HEPA) filters used in nuclear ventilation exhaust systems shall be listed as a High Efficiency Particulate Air Filter Unit in accordance with UL 586, *High Efficiency Particulate Air – Filter Units*. Nuclear duct entrance filters and prefilters located upstream or made part of final HEPA filter exhaust plenums shall be listed in accordance with UL 900, *Test Performance of Air Filter Units*. Filter enclosure assemblies shall be of noncombustible construction.

4.4.3.2 Location of Final Filter Assembly Ventilation System Equipment: Final Filter assemblies and associated duct work and fans shall be protected against exposure fires capable of affecting the operation of the filtration system. Filter assemblies and associated fans located inside buildings shall be separated from all other parts of the building by 2-hour fire-rated construction. Buildings and the room/enclosure around the filter assembly and fans shall be provided with appropriate fire protection systems. Filter assemblies and associated fans located on the roof of the buildings they ventilate, shall be protected against exposure fires either by fire barriers or spatial separation.

4.4.3.3 Walk-in Filter Plenums: Filter plenum enclosures shall only be used for ventilation control equipment. The storage and accumulation of combustible materials, as well as combustible and flammable liquids in any quantity, shall not be permitted. In addition, the storage of spare filters inside the filter plenum shall not be permitted.

4.4.3.4 Electrical Equipment: Electrical equipment inside the filter assembly shall be limited to that necessary to monitor and control the process. All electrical equipment located in the filter plenum shall comply with NFPA 70 and all electrical wiring located in the filter enclosure shall be in metal conduit.

4.4.3.5 Combustible Gases or Vapors: When operations or processes involve combustible gases or vapors, the concentration of the gases or vapors inside the final filter plenum shall not exceed 25 percent of their lower flammable limit. Additionally, for these operations, fixed combustible gas detection shall be provided in the final filter enclosure set to sound an alarm at 25 percent of the lower flammable limit. These alarms shall be transmitted to a continuously attended location.

4.4.3.6 Pyrophoric Metals: When operations or processes involve pyrophoric materials that may subject the final filter plenum to the pyrophoric dust particles, a method to remove the dust particles before reaching the final filter enclosure, such as a prefilter, duct entrance filters, or fire screens shall be installed between the source of the material and the final filters.[17]

4.4.3.7 Fire Detection: When required by the FHA, heat detectors shall be provided in ducting prior to final filter enclosures. Heat detectors shall also be provided in the final filter enclosures. Airflow shall be considered when determining detector location. Detectors shall be arranged to detect a fire in the first stage of HEPA

filters. This could require detectors on both the upstream and downstream side of the first stage of HEPA filters.[18]

4.4.3.8 Temperature Control from Fire Exposure: Filters shall be protected from overheating to prevent filter weakening and potential ignition in the event of a fire in the area or the equipment being ventilated. This cooling shall be accomplished by one or more of the following: 1) automatic sprinkler protection in the ventilated area/equipment; 2) sufficient cooling with dilution air; or, 3) automatic sprinkler or water spray protection in the filter assembly inlet duct.[19]

4.4.3.9 Filter Plugging: Filters shall be protected from excessive pressure drops across the filter media from plugging by soot and smoke particles from a fire in the area or equipment. This plugging shall be controlled by suppressing the fire and by provided filters upstream of the final HEPA filters.[20]

4.4.3.10 Isolation Dampers: To prevent the release of radioactive material accumulated on the filters resulting from a filter fire, air tight isolation dampers shall be provided in the inlet and outlet ducts to provide isolation. These dampers shall be able to be operated remotely.

4.4.3.11 Fire Suppression of HEPA Filter Fires: The provisions of 4.4.3.1 and 4.4.3.8 are intended to prevent HEPA filter media form being ignited. If the consequences of a fire in the filter media are deemed unacceptable in the DSA, means shall be provided to mitigate the fire. The primary fire protection objective for suppressing filter fires as established in 4.4.3 shall be to prevent an unacceptable release of radioactive material accumulated on the filters. If the FHA determines that isolation of the assembly described in 4.4.3.10 is insufficient to prevent release (e.g., the filter fire is deemed severe enough to breach the filter assembly enclosure prior to suffocation from isolating any inlet air), sprinkler or water spray protection shall be provided.[21]

5 OPERATIONS

5.1 Criteria and Procedures

5.1.1 Site-specific Requirements

Site-specific requirements that form the basis for the FPP shall be documented and be based on: site size; operation complexity; property value and mission; geography and climate; and, external support facilities available (e.g., emergency response, service contractors).

5.1.2 Staff, Organization, Training, Roles and Responsibilities: Criteria and procedures shall be developed to establish the necessary staffing levels, organizational structure, training requirements, and roles and responsibilities necessary to implement the FPP.

5.1.3 Inspection Testing and Maintenance (ITM)

5.1.3.1 The ITM program for fire protection features, apparatus and equipment shall be based on the latest applicable codes and standards, such as those established by the NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, and NFPA 72, unless an alternative has been approved by the AHJ.

5.1.3.2 The organizations responsible for ITM of fire protection features shall maintain system inspection and test records according to Section 11.4 of DOE Administrative Records Schedule 18, "Security, Emergency Planning and Safety Records". If not specifically addressed in Schedule 18, the records shall be maintained for a minimum of three review cycles. In addition, responsible authorities shall retain records of all ITM procedures for as long as such equipment remains in service.

5.1.4 Use and Storage of Combustible, Flammable, Radioactive and Hazardous Materials

5.1.4.1 The FPP shall identify the baseline standards applied to manage the fire safety risks associated with the use and storage of combustible, flammable, radioactive and other hazardous materials. The Hazardous Materials Program shall comply with NFPA 400, *Hazardous Materials Code*.Combustible control programs shall be established for nuclear, radiological, high hazard, explosive and mission critical facilities if the DSA or the FHA determines normal housekeeping is insufficient. [22]

5.1.4.2 Procedures necessary to implement the established controls shall be developed and enforced.

5.1.5 Fire Protection System Impairments

5.1.5.1 Procedures shall be developed for assessing the operability of fire protection related structures, systems and components and for implementing compensatory measures determined by qualified FPE, based on the significance of the impairment to the fire protection performance objectives. The procedures shall meet the requirements within NFPA 25 as a minimum.

5.1.5.2 The ITM program shall include a fire protection system impairment program, which, at a minimum, shall consist of: the process for approving and initiating impairments; tracking of impairments; and, reporting to DOE when impairments exceed DOE field element-established criteria for reporting and recording (e.g., date, location, nature of impairment, corrective action taken, closure date, etc.).

5.1.6 Fire Prevention Measures: Procedures for control of hot work (e.g., welding, cutting, brazing, and grinding) shall be developed and implemented. Controls of other potential ignition sources, such as space heaters, open flames, cooking and temporary electrical equipment, shall be established when required by site-specific conditions.

5.2 Implementation

5.2.1 Staffing

5.2.1.1 Qualified fire safety professionals (fire protection engineers, fire department management personnel, fire fighters and technicians) shall be available to develop, implement and maintain fire protection and emergency response activities.[23]

5.2.1.2 Site and facility fire safety and emergency response training and qualifications shall be based upon established industry criteria, such as those promulgated by the NFPA, and as supplemented by DOE fire safety criteria. As an alternative to DOE directives or applicable NFPA standards, emergency services organization officers and personnel may additionally meet the minimum requirements for training and certifications as established by the state or local jurisdiction, provided those state and local requirements are substantially equivalent and approved by the AHJ.[24]

5.2.2 Design Reviews

The design process shall include appropriate reviews by a qualified FPE of plans and specifications, design changes, and acceptance testing and commissioning of fire protection features.

5.2.3 Variances, Exemptions, and Equivalencies

Field Elements and contractors shall have a process for the development, review and approval of variances, exemptions, and equivalencies in accordance with applicable rules, directives, and standards .[25] Table 5.1 summarizes approval authorities:

Table 5.1 Deviation Approval Authority

Source of Requirement	Name of Deviation	Approval Authority	Concurrence	Exceptions
10 CFR 851	Variance	Under Secretary	HSS , CTA	De minimis
DOE O 420.1C	Exemption	Program Secretarial Officer	HSS (except NNSA), CTA	
DOE O 420.1C	Equivalency	Program Secretarial Officer	HSS (except NNSA), CTA	
National Fire Codes	Equivalency	Field Element Manager	Subject Matter Expert	May be delegated
National Fire Codes	Exemption	Program Secretarial Officer	HSS (except NNSA), CTA	De minimis
Building Code	Equivalency	Field Element Manager	Subject Matter Expert	May be delegated
Building Code	Exemption	Program Secretarial Officer	HSS (except NNSA), CTA	

Note:
1. De minimis deviations do not require a variance but shall be addressed in the FHA or other documentation.
2. Documented requests for relief shall be developed by a qualified fire protection engineer and submitted through the AHJ to the appropriate reviewing authority.
3. Variances to Standards invoked by 10 CFR 851 shall be processed as variances to 10 CFR 851.

5.2.4 Delegated Authority

5.2.4.1 DOE O 420.1C assigns the responsibilities for the AHJ, to the DOE heads of field elements under advisement of a qualified FPE as the subject matter expert unless otherwise directed by the Program Secretarial Officer.

5.2.4.2 The heads of field elements may designate a contractor as the site's AHJ to act as DOE's representative for routine activities.[26] This approval authority shall not extend to DOE's approval of exemptions to DOE orders, standards, and mandatory codes and standards such as those promulgated by the NFPA.

5.2.4.3 Site AHJ activities shall be documented and available for DOE review.

5.2.4.4 DOE shall retain the right to override decisions of the contractor's fire official, including the interpretation and application of DOE orders, guides, standards, and mandatory codes and standards.

5.2.4.5 For the purposes of enforcing the adopted building code at sites, the head of the DOE field element shall be designated as the BCO. The DOE head of the field element may delegate to the contactor responsibility for routine activities, but not the responsibility for approving exemptions to building code requirements.

5.3 Leased Facilities

5.3.1 Prior to signing any lease agreement, DOE heads of field elements shall:

a. Perform a fire protection assessment of the facility to verify the adequacy of life safety and fire protection features of the space, including limiting the loss of government-owned equipment to limits established by DOE and potential mission interruption. This review may use a graded approach, depending on DOE and joint tenant occupancy classifications.

b. Communicate to the owner, all fire protection deficiencies within the facility/structure. It is imperative that those deficiencies that potentially impact life safety, and DOE-owned equipment and associated mission be tracked until their resolution and that corrective action effectiveness is verified.Define the way in which fire protection deficiencies within the leased space will be processed and funded before occupancy (such as installing special extinguishing systems to address a DOE value or safety thresholds), or after occupancy (such as general maintenance upgrades).

c. Participate with the local jurisdiction's fire department to ensure a pre-incident plan is in place.

d. Participate with the local jurisdiction on coordination of evacuation plans.

e. Define the frequency of DOE/owner-conducted fire protection assessments. A graded approach may be taken to establish the frequency. In general, the owner would be responsible for "offsite" leases in accordance with local jurisdictions and the contractor for "onsite" leases.

f. Specify in the lease agreement the DOE/owner responsibilities for ITM of facility fire protection systems in accordance with local jurisdiction building and fire code requirements. In general, the owner would be responsible for "offsite" leases and the contractor for "onsite" leases.

g. Verify that the leased building's hazardous materials control areas, as defined in the building code, have been documented. Where applicable, the lease agreement shall specify the way in which the maximum allowable quantities of hazardous material

defined in the building code will be apportioned to the DOE contractor and to any other tenants in the building.

h. Verify that all fire protection assessments and ITM records are accessible to the local AHJ, the owner and DOE contractor.

5.4 D&D Facilities

5.4.1 The need for fire protection features in facilities and structures slated for D&D shall be governed by the consequences of a fire to the public, workers, and fire fighters, as well as the potential release of hazardous and radiological materials while the facility is in the D&D process. A D&D FHA shall be developed for facilities undergoing transition to D&D status, including "Cold & Dark." (See Appendix D)

The D&D FHA shall address the following:

a. Facility construction, including interior finish;
b. Fire protection features, their status, and plans for deactivation;
c. Potential need to restore system to service for D&D;
d. Facility hazards;
e. The removal of combustibles, including flammable or combustible liquids;
f. Periodic monitoring;
g. Appropriate signage showing status of facility and FP systems;
h. Securing the facility from unauthorized entry;
i. Requirements for performance of D&D activities;
j. Maintaining worker safety;
k. FD notifications; and
l. Other pertinent information as necessary.

5.4.2 Firefighting procedures shall be developed and maintained in conjunction with efforts governing fire department procedures in general. DOE and contractor management shall be kept routinely informed if fire department emergency operations for these special circumstances represent deviations from the norm. FHAs shall reflect unique fire-fighting strategies when rapid intervention may not be possible (moderation controlled areas) demolition activities have made the facility unsafe for entry in the event of fire, and when fixed fire protection systems may no longer be in-service, or of limited value.

6 EMERGENCY RESPONSE

Emergency response capabilities shall be provided as required by DOE O 420.1C.
A comprehensive, multi-faceted emergency response capability can be achieved in a number of ways. These include: onsite emergency services organizations, such as the fire departments and fire brigades that currently exist at many DOE sites; offsite fire departments; or, a combination, of both that can be relied upon to meet emergency response objectives.

6.1 Baseline Needs Assessment

6.1.1 The Baseline Needs Assessment (BNA) shall be developed as required by DOE O 420.1C to include organizational responsibilities, collateral duties, facility hazards, response time requirements, personnel levels, required apparatus and equipment, and mutual aid agreements.[27]

6.1.2 The BNA shall address compliance with the NFPA codes and standards and other requirements that define the character of its mission and responsibilities.[28]

6.1.3 If an onsite fire department or fire brigade will be relied upon to provide complete emergency services, the full scope of its capabilities including: mission responsibilities, personnel, apparatus, equipment, facilities, programs, and incident reporting shall be delineated in a BNA.

6.1.4 If offsite emergency services organizations (non-DOE) are relied upon completely to satisfy the emergency response requirement, the emergency services needs compared to the services available by the offsite organization shall be defined. [29]

6.1.5 If a combination of onsite and offsite emergency services organizations are relied upon, a comprehensive emergency response capability shall be demonstrated based on a combination of the efforts described above. [30]

6.1.6 The BNA shall also include a review of fire department activities and permitted practices that may negatively impact response time or result in reduced staffing to site emergency calls. [31]

6.1.7 Information related to the site emergency services organization, such as the number of emergency responders, number and types of apparatus, and response time shall be incorporated into the site emergency plans, the FHAs, and the DSAs. These plans shall clearly establish a minimum level below which compensating safeguards and/or the restriction of hazardous operations shall be applied. [32]

6.1.8 Emergency response records shall conform to DOE reporting requirements in DOE O 231.1A, *Environment, Safety, and Health Reporting*, and shall be based on standard fire incident reporting practices, such as the National Fire Incident Reporting System (NFIRS) or NFPA 901, *Standard Classifications for Incident Reporting and Fire Protection Data*.

6.2 Fire Department Resources

6.2.1 Fire Stations

6.2.1.1 DOE site fire stations, where provided, shall be designed consistent with the requirements specified in Section 4 of this standard. [33]

6.2.1.2 Fire stations shall be provided with automatic sprinkler protection.

6.2.1.3 Sleeping quarters shall be protected with quick response sprinklers, smoke detection and carbon monoxide (CO) detection that are connected to transmit local alarms and to the site central reporting location.

6.2.1.4 Fire stations shall be located so as to minimize response time. [34]

6.2.2 Fire Department Apparatus

6.2.2.1 Fire department apparatus shall reflect site-specific response requirements. [35]

6.2.2.2 Fire apparatus shall meet the requirements specified in NFPA 1901, *Standard for Automotive Fire Apparatus*.

6.2.2.3 Reserve apparatus, if utilized, shall be properly maintained and equipped to provide its intended response capabilities if first-line apparatus is out-of-service. [36]

6.2.3 Fire Department Staffing

6.2.3.1 The minimum number of trained fire fighters necessary to begin interior structural fire-fighting shall be consistent with NFPA 1710, *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments*, NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program* implementation and OSHA 1910.156, *Fire Brigades*. [37]

6.2.3.2 The minimum number of personnel required for fire fighting, hazardous material incidents, specialized rescue, or other related events, shall be based on NFPA guidelines, pre-incident fire planning where possible, and the judgment of trained and experienced incident commanders. [38]

6.2.3.3 Support or oversight personnel, as well as escorts for access to areas with classified material, shall be provided when offsite emergency responders are deployed. [39]

6.2.4 Emergency Communications

6.2.4.1 Reliable communication systems shall be established as specified in NFPA 1710.

6.2.4.2 Emergency radio communication shall be compatible with other organizations involved with emergency response, as specified in NFPA 1710, NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems* and NFPA 1561, *Standard on Emergency Services Incident Management System*.

6.2.5 Training Certification and Drills

6.2.5.1 Training of emergency responders shall be based on existing requirements, such as those used by the state in which the site is located and those delineated in 29 CFR Parts 1910, *Occupational Safety and Health Standards*, and 29 CFR 1926, *Safety and Health Regulations for Construction*, as well as criteria specified in NFPA 1001, *Standard for Fire Fighter Professional Qualifications*. In addition, emergency responders shall be provided with sufficient site-specific training and familiarization necessary to effectively respond to the unique conditions that characterize DOE facilities as required by DOE O 151.1C *Comprehensive Emergency Management System*. [40]

6.2.5.2 Drills and exercises shall be structured to emphasize realistic scenarios and feature standard fire department tactical evolutions. Such drills shall also be scheduled, as

appropriate, during weekends and evening shifts when normal activities are reduced.

6.2.5.3 Adequate facilities shall be provided for training consistent with the training requirements identified above. [41]

6.2.5.4 Fire fighters and fire department officers shall be certified under state programs when available, or when such programs are not available through independent certification processes when approved by the head of the DOE field element.[42]

6.3 Pre-Incident Planning

6.3.1 Pre-incident plans shall be developed based on NFPA 1620, *Standard for Pre-Incident Planning*, with input from the site fire protection engineering staff, as well as emergency responders.

6.3.2 Pre-incident fire plan documents or comparable electronic versions shall be developed in accordance with standard practices within the emergency services community and DOE expectations, as reflected in published guidelines. [43]

6.4 Fire-Fighting Activities Involving Special Considerations

6.4.1 Procedures on fire-fighting activities involving special hazards shall be developed and maintained. The FHAs and DSAs shall reflect fire-fighting strategies where rapid intervention may not be possible (e.g., moderation controlled areas) and where fixed fire protection systems may no longer be available as in D&D facilities. See Appendix D for additional information.

6.4.2 Access to classified matter during an emergency shall be documented after the emergency and individuals who were provided access complete nondisclosure forms as required by DOE Manual (M) 470.4-4A, *Information Security Manual*.

7 FACILITY FIRE PROTECTION EVALUATIONS

7.1 Fire Hazards Analysis

The purpose of a Fire Hazard Analysis (FHA) is to conduct a comprehensive assessment of the risk from fire in a facility to ascertain whether the fire safety objectives are met.

7.1.1 FHAs shall be developed as required by DOE O 420.1C. These requirements apply to planned facilities, as well as significant modifications to existing facilities, as determined by the AHJ (see Section 4.2.2).[44]

7.1.2 When the FHA is preceded by a fire protection design analysis for new construction or major facility modifications, the design analysis shall be of sufficient detail to identify design criteria for meeting the fire safety objectives. Detailed criteria and guidance for FHAs is provided in Appendix B.

7.1.3 All approved variances, equivalencies and exemptions to DOE directives, along with all supporting information, shall be provided or referenced in the FHA.

7.1.4 Documentation of the basis for approved relief shall be reviewed during each FHA update to verify that conditions have not changed and the justifications are still valid.

7.2 Facility Fire Protection Assessments

The principle objective of a fire protection assessment is to aid in the improvement of the facility fire protection program. This is accomplished through the identification and correction of deficiencies, and the effective communication of lessons learned from the assessment.

7.2.1 Facility assessments shall be performed under the supervision of a qualified FPE. Personnel conducting such assessments shall have an appropriate level of knowledge and experience in the application of fire safety codes and standards in diverse facilities.

7.2.2 The scope of facility-related contractor self-assessments shall include the following:

a. Fire protection of SC and SS equipment;
b. Life safety considerations;
c. Fire protection of critical process equipment or programs;
d. Fire protection of high-value property;
e. Fire suppression equipment;
f. Fire detection and alarm systems and equipment;
g. Water runoff;
h. Facility fire prevention planning documents (evacuation plan/fire wardens extinguisher training);
i. Emergency response capability, including fire apparatus accessibility to a facility;
j. Completeness of FHA or other documented assessment of fire hazards;
k. Fire barrier requirements and integrity;
l. Completeness of fire loss potential determination;
m. Fire safety training;
n. Potential for toxic, biological and /or radiological incident due to fire; and,
o. Status of previous findings and tracking until resolution.

7.2.3 Fire protection assessments shall be performed at the frequency as defined in DOE O 420.1C.

7.2.4 A "model" assessment report is available at the following web site:

http://www.hss.doe.gov/nuclearsafety/ns/fire/models/models.html

7.3 Compensatory Measures

When modifications are necessary to correct significant fire safety deficiencies, interim compensatory measures (such as fire watches or fire patrols) shall be provided until the modifications are complete in accordance with the site's fire protection program. Compensatory measures shall be initiated without delay commensurate with the finding and at the discretion of the AHJ.

8 WILDLAND FIRE MANAGEMENT

8.1 Wildland Fire Management Program

A Wildland Fire Management Program shall be developed to include the full range of activities and functions necessary to plan, prepare, and respond to potential fires in accordance with NFPA 1143, *Standard for Wildland Fire Management* and NFPA 1144, *Standard for Reducing Structural Ignition Hazards from Wildfire.*

8.2 Land Management Program

The development and implementation of the Wildland Fire Management Program shall be coordinated with site land management planning.

APPENDIX A
SAFETY SIGNIFICANT AND SAFETY CLASS FIRE PROTECTION SYSTEM SPECIFICATIONS

This appendix provides design and operational criteria and guidance for fire protection systems used in safety class (SC) and safety significant (SS) applications.

Section A.1 provides general design criteria for any type of fire protection system that is used in SC and SS applications. This information is derived from and essentially repeats requirements and guidance contained in DOE Order (O) 420.1C, *Facility Safety,* and DOE G 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for Use With DOE O 420.1, Facility Safety.*

Section A.2 describes current plans for issuing specific design and operation criteria for wet pipe sprinkler systems.

Section A.3 describes current plans for design and operation criteria for water supply systems.

Section A.4 provides specific design and operation criteria for fire barriers.

In addition, this appendix includes two attachments: A-1 provides details on typical water supply arrangements, and A-2 provides example Technical Safety Requirements (TSRs) for fire protection systems used in SC or SS applications.

A.1 General

General design criteria for SC and SS systems specified in Chapter I of DOE O 420.1C are applicable to fire protection systems utilized in SS and SC applications.

Designation of a sprinkler system, water supply, fire barrier or other fire protection system as safety-related means this system is essential to protect the public and / or the worker from a nuclear accident involving fire. This system, therefore, necessitates a more reliable performance than a general service system provided to meet property or building occupant life safety requirements. To achieve high reliability, the requirements of the relevant National Fire Protection Association (NFPA) standards, building code and highly protected risk criteria shall be considered as minima. Design, operation and testing of safety-related systems should normally exceed these requirements.

A.1.1 System Function and Critical Characteristics

The SC and SS function of the fire protection system is defined in the Documented Safety Analysis (DSA) of the facility (typically in Chapter 4 of the DSA). In accordance with DOE-STD-3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses,* Chapter 4 of the DSA should specify "the reason for designating the structures, systems and components (SSC) as a safety-class SSC, followed by specific identification of its preventive or mitigative safety function(s) as determined in the hazard and accident analysis. Safety functions are top-level statements that express the objective of the SSC in a given accident scenario." DOE-STD-3009 also discusses the inclusion of "pertinent aspects" of the SC and SS system in Chapter 4 and states that "pertinent aspects are considered to be those that directly relate to the safety function (e.g., diesel generator load capacity, time to load if critical)."

A.1.1.1 In addition to having the "pertinent aspects" of the system in the DSA, it is a good practice to include more detailed information on design or operational criteria critical to proper operation of the safety system. The combination of the pertinent aspects and this additional detailed information are "critical characteristics" of the system.

A.1.1.2 The critical characteristics shall be documented in a configuration-controlled system design document. This information can also be included in a system design description document developed in accordance with DOE-STD-3024-98, *Content of System Design Descriptions*.

A.1.2 Support Systems

Supporting systems shall be identified. It is good practice to include this information in a configuration controlled system design document. This can also be referenced in a system design description developed in accordance with DOE-STD-3024-98. Refer to DOE G 420.1-1 for further information regarding supporting systems.

A.1.3 Design Criteria

General design criteria for SC and SS systems specified in Chapter I of DOE O 420.1C, are applicable to fire protection systems utilized in SS and SC applications.

Additionally, Chapter II of DOE O 420.1C requires that fire protection for DOE facilities, sites, activities, design, and construction meet or exceed applicable building codes and NFPA codes and standards.

DOE-STD-1189, *Integration of Safety into the Design Process*, provides criteria for identifying SC and SS systems and criteria for the seismic design of SSCs, including fire protection systems.

A.1.4 Approach and Process for Preparing Fire System Safety-Related Design

In developing the design for fire protection systems utilized in SS and SC applications the requirements in DOE O 420.1C and criteria in DOE-STD-1189 shall be followed. DOE G 420.1-1 provides additional implementing guidance. Examples of documents that support the fire protection system design include the FHA, DSA and design documents identified in the DOE-STD-1189 (e.g., preliminary and final hazard assessments, and preliminary and final documented safety assessment).

A.2 Wet Pipe Automatic Sprinklers

A.2.1 Safety Function and Critical Characteristics of the Wet Pipe Sprinkler System

A.2.1.1 Safety Function

The SC and SS function of the wet pipe sprinkler system is defined in the DSA of the facility (typically in Chapter 4 of the DSA). This may include information regarding the size and type of fires that the system is designed for, along with any specific considerations that may be required for the system to perform its intended function. For example, automatic water-based fire suppression systems are generally intended to limit fire spread, but not necessarily extinguish it (unless special hazards are considered).

If the safety analysis determines that emergency responder actions to complete extinguishment are a part of the SC or SS function, this should be identified as it could impact the design by adding alarm/ notification components.

Additionally, conditions under which the sprinkler system is to remain operable to prevent or mitigate analyzed events (e.g., seismic and loss of power events) should also be documented. The NFPA-related design requirements should also be identified in the System Design Description.

A.2.1.2 Critical Characteristics

The critical characteristics of the system should be included in a configuration controlled document (e.g. design document) including, as appropriate:

- Hydraulic performance requirements (sprinkler density, pressure, flow rate);
- Design to accommodate the potential for multiple fires when required by the DSA
- System Construction Materials;
- Component design lifetimes and any environmental condition limitations,
- Potential for inadvertent actuation; and,
- Seismic requirements.

This information may also be included in the System Design Description.

A.2.2 System Boundary for the Wet Pipe Sprinkler System

A.2.2.1 The boundary of the SC or SS wet pipe sprinkler system should be defined in a way that makes clear which components are to be classified within the system. A boundary for sprinklers is typically determined at the system control valve or at the underground lead-in post indicator valve (PIV).

A.2.2.2 All piping should be designed for the maximum expected pressure and design basis accident conditions. Alternatively, the designer shall demonstrate that failure of the piping or components not credited to be SC or SS will not reduce functionality of the credited system. For example, for failure of a non-credited pressure gauge the designer can include water discharged from the broken gauge in the required flow rate, and total water needed in the water supply.

A.2.3 Support Systems for the Wet Pipe Sprinkler System

Examples of support systems (beyond the water supply system) may include the freeze protection system, alarm devices and associated trim, and pressure monitoring systems. As stated in the general criteria in DOE G 420.1-1, support systems shall be designed, fabricated, erected, and tested to standards and quality requirements commensurate with their importance to safety. The support systems shall be classified as equal or superior to the classified wet pipe sprinkler system if they are essential to the sprinkler system performing its safety function.

Details supporting implementation of DOE O 420.1C and DOE G 420.1-1 for the freeze protection system, alarm devices and associated trim, and water pressure monitoring system gauges are provided below.

A.2.3.1 Freeze Protection Systems

As a general rule, a sprinkler system will be protected from freezing by the facility's heating system. Isolated areas where sprinklers are subject to freezing during normal operations may require additional protection or methods such as an anti-free loop, additional heating, or monitoring, to prevent freezing or to warn of freezing temperatures.

A.2.3.1.1 Where reliance is placed upon building heat to prevent sprinkler freezing, the design shall address monitoring the building and/or individual areas of the building for the loss of building heat during freezing weather. The monitoring system shall be classified at the same level as the sprinkler system.

A.2.3.1.2 Small or individual areas where sprinklers are subject to freezing during normal operations may rely upon one or more of the following freeze protection methods:

a) The use of anti-freeze loops or water circulation systems. The freeze protection systems that form an integral part of the sprinkler system (e.g. anti-freeze loop, water recirculation) shall be designed, fabricated erected, and tested to the standards consistent with that provided for the sprinkler system, unless the provisions of A.2.3.2.1 are met.

b) Freeze protection using additional heating of the space, additional building insulation, or heat tracing. The freeze protection system shall be classified at the same level as the safety sprinkler system, unless the provisions of A.2.3.2.1 are met.

A.2.3.1.3 The freeze protection or building heating system does not need to be classified at the same level as the safety sprinkler system, provided:

a) The loss of the freeze protection or building heating system can be promptly detected by a monitoring system classified at the same level as the sprinkler system, and;

b) An analysis is performed to determine the elapsed time between the loss of freeze protection or building heating system and the potential for sprinkler freezing. Information from the analysis shall be used as input into the development of Limiting Conditions for Operation in Technical Safety Requirements that would address responses to loss of building or area/room heat during freezing weather.

A.2.3.1.4 The operability of the freeze protection system and/or monitoring system shall be included as a Limiting Condition for Operation in the Technical Safety Requirements. The LCO shall specify compensatory actions to be taken to ensure operability of the sprinkler system upon loss of the freeze protection system during subfreezing weather.

A.2.3.1.5 In most cases, the freeze protection system should be classified at the same level as the safety sprinkler system. Examples of appropriate freeze protection systems may

include heating the space, heat tracing, building insulation, anti-freeze and water circulation. An alternative option is to have the sprinkler system monitored by a low temperature alarm system that is classified at the same level as the safety sprinkler system in conjunction with the appropriate TSR's Limiting Conditions for Operation (LCO). This requirement should ensure that compensatory actions are taken to warrant the operability of the sprinkler system upon loss of the freeze protection system during subfreezing weather.

A.2.3.1.6 The freeze protection system should be designed, fabricated, erected, and tested to the standards consistent with those provided for the sprinkler system.

A.2.3.1.7 The freeze protection system does not need to be designed to preclude system failure given a single active component failure (even at the SC level) if the facility owner can justify that there are adequate design features and/or controls to ensure that failure of the freeze protection would provide indication of its inoperability, and would not immediately impact operability of the sprinkler system. For instance, because of system failure alarms and compensatory measures, malfunctions are detected and corrected before the piping freezes. The operability of the freeze protection system should be included as an LCO in the TSRs.

A.2.3.2 Alarm Devices

Water flow indicating devices and associated trim support the wet pipe sprinkler system by indicating that the system has operated. A flow alarm is commonly achieved by a water pressure alarm switch that is pressurized when the alarm check valve is unseated long enough to register an alarm. In general, the alarm will alert locally, as well as remotely, to summon emergency responders.

A.2.3.2.1 These devices do not normally perform a safety function in that this equipment is not required for the sprinkler system to perform its safety function (deliver water to the fire). However, the sprinkler system should be designed to be able to deliver water to the fire at the full volume and pressure required, with failure of these devices in any orientation (fail open/closed, pipe rupture).

A.2.3.3 Water Pressure Monitoring System

A water pressure monitoring system (sensors and associated local and/or remote indicating system) may support a wet pipe sprinkler system by providing notification when system water pressure is below minimal allowable levels. This equipment should be classified the same level as the sprinkler system it supports and should be designed, fabricated, erected, and tested to standard industrial practices supplemented by additional quality assurance (QA) provisions consistent with that provided for the sprinkler system.

A.2.4 Design Criteria for the Wet Pipe Sprinkler System

The following provides a summary of the requirements, criteria and guidance for new SS, and SC wet pipe automatic sprinkler installations. These are in addition to the criteria for sprinkler systems identified in DOE O 420.1C and Section 4 of this standard (DOE-STD-1066).

A.2.4.1 Safety Significant Design Criteria for Wet Pipe Sprinkler Systems

In addition to the criteria for general use, the following additional design requirements/guidance is applicable for wet pipe sprinkler systems used in SS applications.

A.2.4.1.1 The following sprinkler components should not be used:

a) On/off sprinklers;

b) Mechanical slip fittings; and

c) Cast Iron fittings (fittings should be a minimum of Malleable Iron per ASME B16.3, *Malleable Iron Threaded Fittings: Classes 150 and 300* where additional fitting strength is required).

A.2.4.1.2 Strainers should be used for all systems connected to water supplies prone to sediment or debris.

A.2.4.1.3 Sprinkler piping should be a minimum of Schedule 40 steel for pipes 6 inches or less in diameter and Schedule 30 steel for pipe greater than 6 inches in diameter.

A.2.4.1.4 Areas should be designed to no less than Ordinary Group 1 requirements (per NFPA 13) and should not exceed 130 square feet per sprinkler. For Ordinary Group 2 and Extra Hazard occupancies, sprinkler coverage should not exceed 100 square feet per sprinkler.

A.2.4.1.5 The system shall be designed to the greater hydraulic demand of either the NFPA 13 design area, or the worst case scenario as identified in the DSA, such as combination of multiple fires caused by a common mode event (e.g. earthquake).

A.2.4.1.6 For Seismic Design Category (SDC) 3 and higher, a qualified structural engineer should utilize the loads provided by the site seismic design authority in conjunction with NFPA 13 criteria to evaluate locations where hangers and earthquake sway bracing.

A.2.4.1.7 Environmental conditions should be defined and documented for sprinkler systems and the system should be designed to remain operable for those events they are relied on, as specified in the DSA. Examples include:

a) Seismic;

b) Other natural phenomena hazards such as high wind potential, tornadoes, flooding, lightning, low temperature and humidity;

c) Facility hazards, such as internal flooding, explosions, fire outside the system boundary, missile and vehicle impacts, corrosive environments;

d) Wildland fire;

e) Physical damage from adjacent equipment and systems (for example – during a seismic event); and,

f) Water quality.

A.2.4.1.8 The system shall be designed by a professional engineer or a National Institute for Certification in Engineering Technologies (NICET) Level III or IV technician.

A.2.4.1.9 Identify critical components and maintain spare parts.

A.2.4.1.10 To support appropriate implementation of the site or project QA program relative to fire protection systems, the following topics should be addressed (beyond what is specifically identified in DOE O 420.1C and referenced NFPA codes and standards):

a) Document control (documents are stored properly to avoid damage, responsibility for completeness, maintenance and distribution are identified, etc.);

b) Records of qualification of fire protection staff and control of qualification records;

c) Procurement documentation and control of purchased items or services; receipt inspections and verification of quality.

d) Identification and control of components (e.g., sprinkler heads) per Requirement 8 of ASME NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications*;

e) Handling, shipping and storage requirements for components;

f) Control of nonconforming items to prevent inadvertent installation or use;

g) Commercial grade dedication of components based upon third party testing and production monitoring;

h) Records of qualification for installation personnel and control of qualification records;

i) Records of qualification for tools and equipment used in preparation of installation hardware (e.g. appropriate gauges & cutters for grooved pipe, welding) and control of qualification records;

j) Records of proper use of manufacturer installation instructions (e.g. use of proper sprinkler installation wrenches, proper bolt torque for grooved fittings, valve trim, acceptance testing) and control of qualification records;

k) Configuration and design control; and,

l) Results of commissioning testing.

The Quality Assurance (QA) Program for wet pipe automatic sprinklers should be audited in different phases (design, construction, and operations) using DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.

A.2.4.2 Safety Class Design Criteria for Wet Pipe Sprinkler Systems

In addition to the criteria for general use and SS applications, the following additional design requirements/guidance is applicable for wet pipe sprinkler systems used in SC applications:

A.2.4.2.1 Active features of a sprinkler system shall be designed to preclude a single point failure for SC sprinkler systems, if the component failure results in the system's inability to perform its safety function. Active features of a sprinkler system include the sprinklers themselves, as well as any other installed component that would exhibit

a change in state. The impact of the loss of a single sprinkler head should be evaluated to ensure that it will not prevent the sprinkler system from performing its safety class function.

A.2.4.2.2 There should be a minimum of two sprinklers in each area being protected.

A.2.4.2.3 Consideration should be given to providing additional redundancy in the system, thus providing operational flexibility for inspection, test and maintenance activities. This is especially important for facilities that cannot be readily transitioned to a shutdown mode and compensatory measurers cannot effectively control a design basis fire.

A.2.5 Codes and Standards

The following codes and standards are applicable to the design, installation, operation, and testing of wet pipe sprinkler systems.

- NFPA 13, *Standard for the Installation for Sprinkler Systems*
- NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*

A.2.6 Operability Criteria for Safety Significant and Safety Class Wet Pipe Sprinkler Systems

TSRs and LCOs should be defined (including appropriate action statements which outline compensatory actions to address situations when the system is inoperable). TSR' surveillance requirements should be defined using NFPA 25 Inspection Testing and Maintenance requirements as a minimum. Attachment A-2 provides example TSRs for wet pipe sprinkler systems.

A.3 Water Supply

A.3.1 System Function and Critical Characteristics

A.3.1.1 System Function

The SC and SS function of the water supply system is defined in the DSA of the facility (typically in Chapter 4 of the DSA)[1]. This may include information regarding the water supply needs (flows and pressures) for the system being supported.

Additionally, conditions under which the water supply system is to remain operable to prevent or mitigate analyzed events (e.g., seismic and loss of power events) should also be documented in the DSA or a design document.

Safety-related water supply systems meeting the criteria of this standard may be used to supply a new safety-related sprinkler system, provided the supply system still complies with this standard considering the additional demands.

For water supply systems required to support a safety-related suppression system for an enduring mission, the designer shall assess long term availability and reliability. It is expected that an appropriately-designed safety-related water supply system (new or existing) will be provided.

[1] Note that the water supply system may be discussed as a support system to a SC or SS system (such as a wet pipe sprinkler system).

For water supply systems needed of a temporary nature (not to exceed five years), more flexibility may be available in the use of existing water supplies.

A.3.1.2 Critical Characteristics

The critical characteristics of the system should be included in a configuration-controlled document (e.g. design document) including, as appropriate:

- Hydraulic performance requirements (supply volume, pressure, flow rate);
- System Construction Materials;
- Standby and fire pump startup criteria;
- Availability and reliability requirements;
- Component design lifetimes and any environmental condition limitations;
- Seismic requirements;
- Level of DOE control of the supply system;
- Design for future planned expansion; and,
- Design to accommodate the potential for multiple fires.

This information may also be included in the System Design Description.

A.3.2 System Boundary for the Water Supply System

A.3.2.1 The boundary of the SC and SS water supply system should be defined such that it is clear which components are SC, SS, and general industry use. The boundary of the SC and SS water supply may start at the water source and include all components necessary to deliver water up to either the boundary of the facility safety-related system.

A.3.2.2 Boundaries between safety and non-safety systems water supply components should be identified, including identification of the means of isolation between the two. System boundaries should be described in a configuration controlled design document. Piping and instrumentation drawings (P&ID) should be developed for each system that clearly delineates system interfaces and points of isolation.

A.3.2.3 All piping should either be designed for the maximum pressure and DBA conditions, or the design shall show that failure of the piping or component not credited to be SC or SS, will not negatively impact the credited portions of the system.

A.3.2.4 Support Systems for the Water Supply Systems shall be identified. Examples of support systems may be public/municipal water supplies, water storage systems, water treatment systems, and electric power systems that supply power to water pumps. Details supporting implementation of DOE O 420.1C (consistent with guidance in DOE G 420.1-1) for a public water supply, water storage system, water treatment system, and electric power system are provided below.

A.3.2.5 Water supply for a limited life facility

Given the short term nature of some DOE missions (5 years or less), some flexibility may be allowed in relying on a safety-related water supply system and in establishing system boundaries. The reliability of the existing supply must be evaluated to ensure it will remain viable over the life of that project. The following topics shall be addressed in any evaluation and the results incorporated into safety basis documentation:

A.3.2.5.1 Reliability. Existing supplies shall be evaluated to determine if the piping and water source has sufficient reliability to meet the project needs. Topics to be considered are the failure history, problems identified in operating the system, long term availability of the water source (e.g. pumps, tanks, wells), motive power for pressure maintenance of the system (e.g. electric pumps, diesel pumps, gravity tanks), volume capacity of the storage, delivery capacity of the piping, availability of the supply at the point of use, redundancy of supplies and redundancy of supply piping. The system shall also be capable of fulfilling all of the critical characteristics defined for the system including the continued operation after a seismic event if required by the DSA .

A.3.2.5.2 Operations. While it may not be reasonable to expect the existing system to be fully upgraded to a safety related system, portions of the system shall be operated to ensure the availability of water to the safety-related system on-demand. This would include the portion of the existing supply near the safety related system, and the water source(s) for the supply. Since this equipment may not be under the control of the facility with the safety related suppression system, procedures and engineered controls shall be in place such that management of the facility with the safety related system will be immediately notified of any planned or accidental off-normal event (e.g. a working fire using water, pipe break, loss of a well or source) or operation of components within the identified area, so appropriate TSRs or LCOs can be implemented as required by the facility safety basis documents.

A.3.2.5.2.1 To determine the extent of the controlled boundary, the water supply shall be analyzed to identify the portion of the existing system where any single normal or off normal event (e.g. closed valve, hydrant flow, periodic high flow process demand, water source not available, pump not available) can reduce the available pressure and flow to the safety system below minimum requirements. Those portions and components of the existing system shall be identified as part of the required boundary for the facility safety related system. In general, the water supply piping, valves, hydrants and large process demands located near the facility will need to be controlled. In a gridded supply network, this would typically be the components on the piping adjacent to the facility, as well as many of those on the neighboring loops. The need to control water supply sources will depend on the number and location of the source relative to the facility.

A.3.2.5.2.2 Those portions of the water supply system within the identified control boundary shall be managed with a combination of procedures and engineered controls to achieve the safety function. Controlled components shall be clearly identified by some readily recognizable method (such as locks, tags, seals, color, etc) so operators will know that the facility with the safety system needs to be notified prior to operating the component, so appropriate actions can be implemented. Those portions of the system shall also be brought under a configuration management system.

A.3.2.5.2.3 Those portions of the water supply system within the identified control boundary, shall be included in enhanced maintenance and testing activities, consistent with requirements for any other safety related system and clearly documented.

A.3.2.5.2.4 Any required agreements between the facility management and the organization operating the water supply system to implement the water supply for a limited life facility shall be incorporated into contract documents or memorialized in a memorandum of understanding.

A.3.2.5.2.5 All activities associated with the water supply system shall be addressed by the facility safety basis, LCOs and TSRs, as if the portion of the water supply system within the boundary were part of the facility system.

A.3.2.5.3 Redundancy. An existing water supply meeting all of the requirements of this section may be used as one of the redundant supplies for a safety class system, provided the second supply system is completely independent and not subject to any common mode failure.

A.3.3.1 Public Water Supplies

Refer to Attachment A-1 for further discussion on use of various water supply arrangements.

A.3.3.1.1 In some cases, the nuclear safety function can be accomplished by providing a suppression system designed for a specific hazard, such as an interior glovebox protection. Such a system can be designed to meet only the SS or SC nuclear safety needs for its capacity and will not necessarily have to be designed to meet the capacity requirements of other requirements such as NFPA 1, *Fire Prevention Code*, NFPA 801, or NFPA 13, provided this system is independent of any other system in the facility. For example, if the nuclear safety objective can be met with a 500-gallon pressure tank within the facility, the NFPA criteria that may dictate larger water supply tanks for facility fire safety do not need to apply to the design of the independent portion of the system that is only serving the SS or SC function.

A.3.3.1.2 If a municipal system is the only source of water supply, an analysis should be made to ensure the water system will perform reliably in accordance with the DSA functional and reliability requirements and DOE O 420.1C in a manner that is equivalent to or exceeds that provided by stand alone systems controlled by DOE.

A.3.3.2 Water Treatment Systems

Water treatment systems are seldom within the SS or SC boundary since the treated water in storage normally meets SS or SC water capacity needs. However, treatment systems may be required to meet SS or SC criteria if water storage capacity is inadequate and the raw water source is not suitable for fire protection purposes.

A.3.3.3 Electric Power to Pumps

A.3.3.3.1 The electric power to fire pumps that are necessary to support the safety function shall be classified at the same functional classification level (general duty, SS, or SC) as the system they are supporting. For general duty and SS fire pumps, where there is not a diesel back-up, the electric power to the fire pumps should be fed from two separate utility connections or from a generator and a utility connection. The more

usual arrangement is to install a diesel driver and pump that serves to back up an electric pump with a single source of power.

A.3.3.3.2 For SC applications, in addition to the above, per DOE O 420.1C, the electrical power supplies shall be designed to preclude single point failure.

A.3.4 Design Criteria for the Water Supply System

The following provides a summary of the requirements, criteria and guidance for SS, and SC water supply systems supporting wet pipe automatic sprinkler installations. Attachment A-1 provides examples of arrangements of fire protection systems that are acceptable.

A.3.4.1 Safety Significant Design Criteria for Water Supply Systems

A.3.4.1.1 Underground piping should be limited to cement lined ductile iron (Class 52 minimum), polyvinyl chloride (PVC) piping with a dimension ratio (DR) of DR14, and high density polyethylene piping (DR9). Additional limitations of material type may be imposed for seismic design.

A.3.4.1.2 Where restraints are required, two separate means of joint restraint should be used (e.g., thrust blocks, mechanical, and rodding).

A.3.4.1.3 Ferrous piping should be provided with corrosion protection such as polyethylene wrap or cathodic protection per American Water Works Association standards.

A.3.4.1.4 A stable pipe bed such as backfilling around piping to a height of eighteen inches of sand bedding (from outside of piping) should be provided.

A.3.4.1.5 Sectional and sprinkler/standpipe control valves should be limited to factory assembled PIV assemblies.

A.3.4.1.6 In-ground pipe identification systems should be provided (ribbon, trace wire, red mud, etc.).

A.3.4.1.7 Acceptance testing should include full suppression system demand flow at the base of the riser, using a temporary header if necessary.

A.3.4.1.8 If the water supply system feeds multiple suppression systems considered in the DSA to be vulnerable to a common mode failure event, the water supply shall be capable of supplying the system with adequate flow and pressure during such an event.

A.3.4.1.9 Environmental conditions should be specified for water supply-systems and, if necessary, support systems should be provided to mitigate the condition. Examples include:

a) Natural hazards such as seismic events, tornado, high winds, flooding, lightning, temperature (e.g., below freezing), and humidity;

b) Facility hazards, such as internal flooding, explosions, fire, missile impacts, vehicle impacts, and corrosive environments;

c) Wildland fire;

d) Physical damage from adjacent equipment and systems (for example – during a seismic event); and,

e) Water quality.

A.3.4.1.10 To support appropriate implementation of the site or project QA program relative to fire protection systems, the following topics should be addressed (beyond what is specifically identified in DOE O 420.1C and referenced NFPA codes and standards):

a) Document control, including the assurance that documents are stored properly to avoid damage and that responsibilities for completeness, maintenance and distribution are identified;

b) Records of qualification of fire protection staff and control of qualification records;

c) Procurement documentation and control of purchased items or services, receipt inspections, and verification of quality;

d) Identification and control of components (e.g., sprinklers, water supply pumps) per requirement 8 of ASME NQA-1-2008;

e) Requirements for handling, shipping and storage of components;

f) Control of nonconforming items to prevent inadvertent installation or use;

g) Commercial grade dedication of components, based upon third party testing and production monitoring;

h) Records of qualification for installation personnel and control of qualification records;

i) Records of qualification for tools and equipment used in preparation of installation hardware (e.g. appropriate welders and cutters for HDPE pipe, cathodic protection) and control of qualification records;

j) Records of proper use of component manufacturer installation instructions (e.g. proper bolt torque for fittings, proper bedding of pipe, proper mounting of fire pumps) and control of qualification records;

k) Configuration and design control; and,

l) Results of commissioning testing.

A.3.4.1.11 The QA program should be audited in different phases (design, construction and operations) using DOE O 413.3B.

A.3.4.2 Safety Class Design Criteria for Water Supply Systems

In addition to the criteria for general use and SS applications, the following additional design requirements/guidance is applicable for water supply systems used in SC applications:

A.3.4.2.1 Active features of a water supply system shall be designed to preclude a single point failure if the component failure results in the system's inability to perform its safety function.

A.3.5 Codes and Standards

The following codes and standards are applicable to the design, installation, operation, and testing of water supply systems.

- NFPA 13, *Standard for the Installation for Sprinkler Systems*
- NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*
- NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*
- NFPA 70, *National Electric Code®*

A.3.6 Operability Criteria for Safety Significant and Safety Class Water Supply Systems

TSR's LCOs should be defined (including appropriate action statements to address situations when the system is inoperable). TSR surveillance requirements should be defined using NFPA 25 Inspection Testing and Maintenance requirements as a minimum, or other established requirements by equipment manufacturers and water purveyors. Attachment A-2 provides example TSRs.

A.4 Fire Barriers

The following provides a summary of the functions, critical characteristics, requirements, criteria and guidance for new SS, and SC fire barrier installations:

A.4.1 System Function and Critical Characteristics

A.4.1.1 System Function

The SC and SS function of the fire barrier system is defined in the DSA of the facility (typically in Chapter 4). This may include information regarding the size and type of fires that the system is designed for, along with any specific considerations that may be required for the system to perform its intended function. For example, the function of the fire barrier is generally to limit the transfer of thermal energy from one side of the barrier to the other, thereby preventing a fire on one side of the barrier from starting a fire on the other side of the barrier for a specified period of time.

A.4.1.2 Critical Characteristics

The critical characteristics of the system should be included in a configuration controlled document (e.g. design document) including, as appropriate:

- The fire barrier's hourly fire-resistance rating;
- Performance characteristics of components (e.g. pressure rating, dynamic/static flow rating, leakage rate, temperature transmission);
- Materials used in the barrier that form the basic composite of the barrier (e.g. gypsum wall board on steel stud with specific screw size and pattern plus joint protection, or reinforced concrete masonry units of sufficient size and thickness);
- Protection of openings (including dimensions and materials of doors, door frames, dampers, as well as the sealing of penetrations); and,

- Mechanisms for and timing of any components that are required to reposition to perform their SS or SC safety function (e.g., fire damper closure).

A.4.2 System Boundary for the Fire Barrier System

The boundary of the SC or SS fire barrier system should be defined such that it is clear which components are to be classified within the system. A boundary for fire barriers may include all walls and devices designed to protect openings in the wall between different fire zones.

A.4.3 Support Systems for the Fire Barrier System

Fire barriers are primarily passive or self-actuating devices that do not require motive force outside of the barrier component (e.g., self-actuating dampers). The only support systems are typically structural components, such as: structural bearing or non-bearing fire barriers; floor/ceiling, column/beam assemblies; and, trusses/roof framing. The latter are the most important support elements and shall be classified as having a fire-resistance rating at least equal or greater than that of the SC or SS barrier and classified as equal or superior to SC or SS fire barrier system where (1) these elements provide structural support to credited SC or SS fire barriers, or (2) failure of the support system component could fail and damage an adjacent SC or SS fire barrier.

A.4.4 Design Criteria for Fire Barriers

The following provides a summary of the requirements, criteria and guidance for new SS, and SC fire barriers.

A.4.4.1 Safety Significant Design Criteria for Fire Barriers

In addition to the criteria identified in DOE-STD-1066, the following additional design requirements/guidance are applicable for fire barrier installations used in SS applications:

A.4.4.1.1 Fire barrier installations should be designed to remain operable for those environmental events for which they are relied on, as specified in the DSA. Examples include:

a) Seismic events;

b) Other NPH, such as high wind potential, tornadoes, flooding, lightning, low temperature and humidity;

c) Facility hazards, such as internal flooding, explosions, fire outside the system boundary, missile and vehicle impacts, corrosive environments;

d) Wildland fire; and

e) Physical damage from adjacent equipment and systems; e.g., during a seismic event.

A.4.4.1.2 Fire-rated doors, windows, dampers and penetration seals used to protect openings. Penetration seals shall maintain the fire resistance rating of the overall fire barrier assembly.

A.4.4.1.3 Fire barriers components (e.g., doors, dampers) should be readily accessible for inspection and testing, as well as marked and identifiable in the field, as required by National Recognized Testing Laboratory. Fire barriers should be readily labeled and identifiable in the field.

A.4.4.1.4 To support appropriate implementation of the site or project QA program relative to fire protection systems, the following topics should be addressed (beyond what is specifically identified in DOE O 420.1C and referenced NFPA codes and standards):

a) Document control, including the assurance that documents are stored properly to avoid damage and that responsibilities for the completeness, maintenance and distribution are identified;

b) Records of qualification of fire protection staff and control of qualification records;

c) Procurement documentation and control of purchased items or services, receipt inspections, and verification of quality;

d) Identification and control of components (e.g., fire dampers) per requirement 8 of ASME NQA-1-2008;

e) Reqirements for handling, shipping and storage of components;

f) Control of nonconforming items to prevent inadvertent installation or use;

g) Commercial grade dedication of components, based upon third-party testing and production monitoring on the contractor's quality assurance program;

h) Records of qualification for installation personnel and control of qualification records.

i) Records of qualification for tools and equipment used in preparation of installation hardware (e.g. appropriate welders and cutters for HDPE pipe, cathodic protection) and control of qualification records.

j) Records of proper use of component manufacturer installation instructions (e.g. bolt torque for components, attachment to structure / wall, mounting of frames) and control of qualification records.

k) Configuration and design control; and,

l) Results of commissioning testing.

A.4.4.1.5 The QA Program should be audited in different phases (design, construction, and operations) using DOE O 413.3B.

A.4.4.2 Safety Class Design Criteria for Fire Barriers

In addition to the criteria for SS applications, the following additional design requirements/guidance is applicable for fire barrier installations used in SS applications:

A.4.4.2.1 The following components should not be used:[2]

a) Fire-rated glazing assemblies.

b) Curtain-style fire dampers in non-confinement ventilation ducts for SC fire barriers (since their reliability to sufficiently close and latch under dynamic flow has been documented as a concern by the Nuclear Regulatory Commission).

A.4.4.2.2 For SC fire doors, fire-resistive glazing materials shall not be used over an area of more than 100 square inches in one door leaf for the entire fire barrier.

A.4.4.2.3 Fire doors in SC fire barriers shall be equipped with automatic closures and positive latching devices in accordance with NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, which can be held open only with magnetic devices designed to close on either activation of any one of four detectors (two detectors on each side of the fire barrier). The detectors shall be arranged to be independent of the fire alarm system and designed to release the magnetic hold open device upon primary electrical failure.

A.4.4.2.4 Fusible link devices that are integral to the door closers are not permitted.

A.4.4.2.5 Where non-confinement ventilation ducts pass through SC fire barriers, only multiple blade style dynamic fire dampers which will operate and close under anticipated air flow velocities and anticipated pressures are permitted, or air flow shall be shut down by redundant detection so as not to comprise their effectiveness.

A.4.4.2.6 All opening protection devices that must change position (e.g. doors, dampers) shall be designed to preclude a single active failure.

A.4.5 Codes and Standards

NFPA 80 Standard for Fire Doors and Other Opening Protectives

NFPA 221 Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls

NFPA 251 Standard Methods of Tests of Fire Resistance of Building Construction and Materials

ASTM E 119 Fire Tests of Building Construction and Materials Protection of Electrical Raceways

A.4.6 Operability Criteria for Safety Significant and Safety Class Fire Barriers

TSR's LCOs should be defined (including appropriate action statements to address situations when the system is inoperable). Attachment A-2 provides example TSRs.

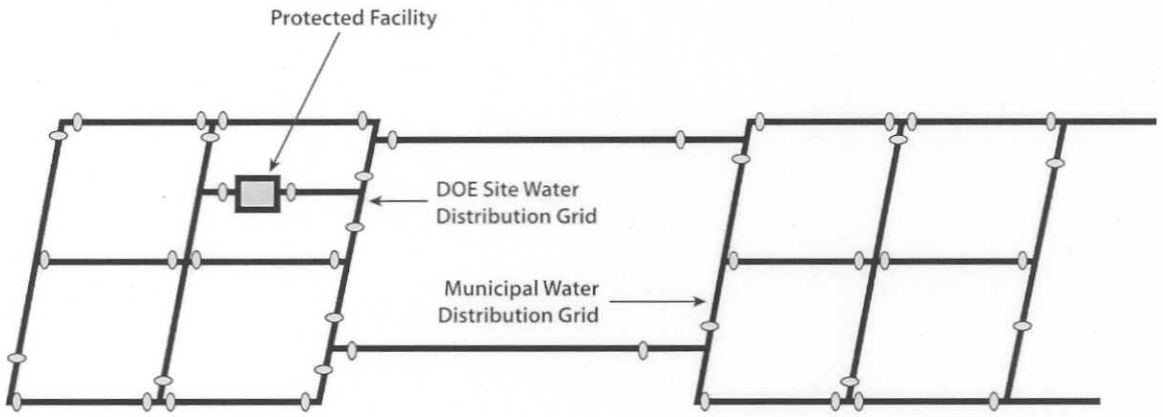
[2] If the user chooses to utilize these devices, their potential impact should be evaluated separately.

Attachment A-1

Typical Water Supply Arrangements

Water Supply Arrangement No. 1: Multipurpose (domestic/industrial/fire) water supply system tied to a municipal water provider outside of DOE control.

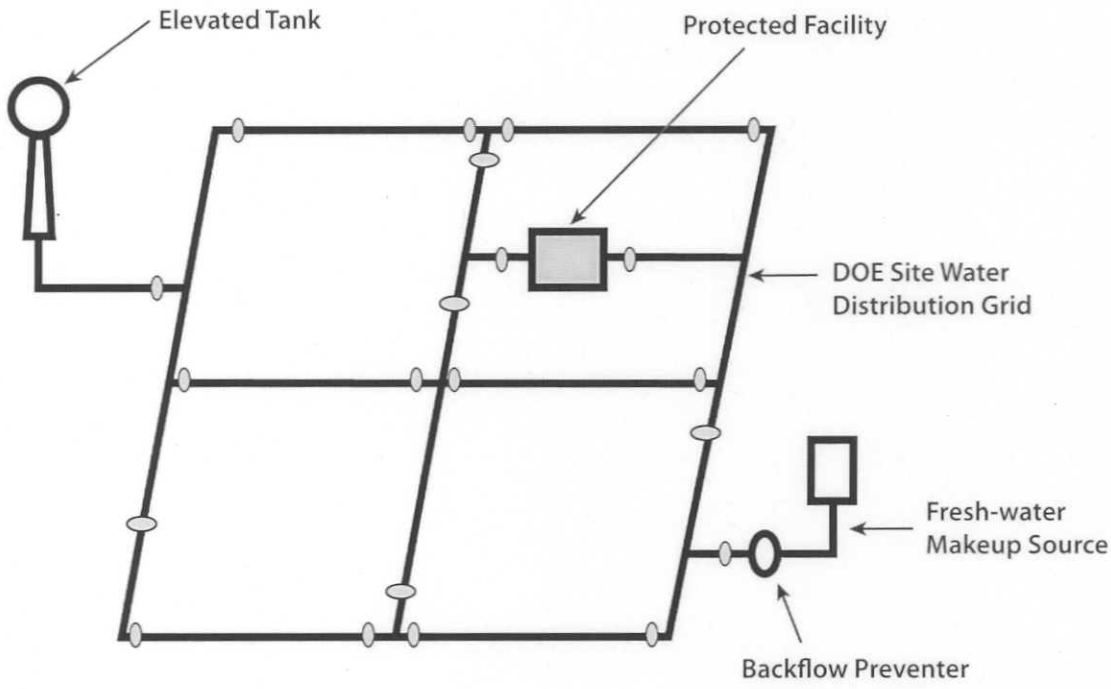
In this arrangement, water is obtained from a qualified municipal water purveyor.



This arrangement should not be utilized for SC applications, but is used for general purpose fire protection. In addition, this arrangement may be used for SS applications if requirements for reliability, quality assurance, and safe operation are met. The reason the system should not be used in SC applications is that, even though the system is essentially passive, the lack of DOE control over the supply, makes it prudent to have an additional (e.g., backup) system, under DOE control, to supply the facility. The use of this system for either SS or SC applications raises concerns related to whether the municipality would be subject to DOE enforcement requirements that will need to be addressed. Finally, this arrangement also raises issues regarding where the SC or SS boundary would be drawn. Notwithstanding all these potential drawbacks, arguments have been made that municipal water supplies are extremely reliable, even more so than dedicated systems, and should be allowed. If this is the case for a given site and facility, it may be possible to provide a justification to utilize a municipal system, if all of the nuclear safety criteria can be met and the issues discussed above are addressed.

Water Supply Arrangement No. 2: Multipurpose (domestic/industrial/fire) water supply system under DOE control.

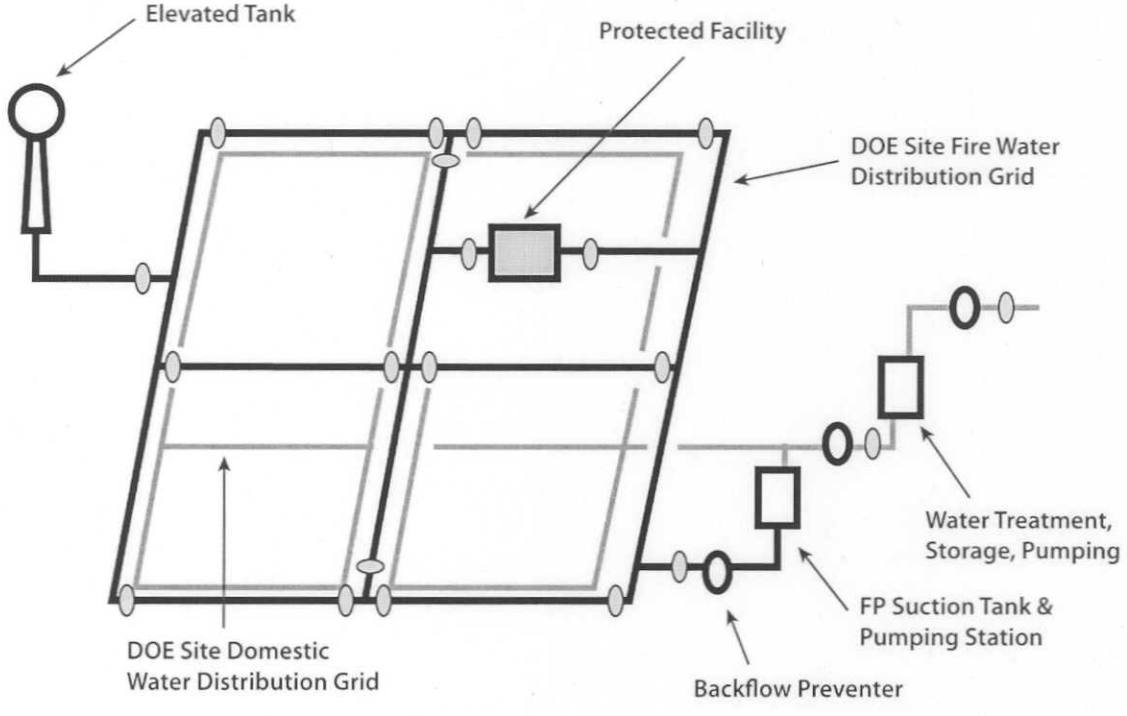
In this arrangement, water is obtained from a fresh-water source, such as a well or river, treated and then stored on site by both suction and elevated water storage tanks.



Similar to Arrangement 1, this arrangement should not be utilized for SC applications, but is used for general purpose fire protection. In addition, this arrangement may be used in SS applications, if requirements for reliability, quality assurance, and safe operation are met. The reason the system should not be used in SC applications is that, even though the system is essentially passive and under DOE control, it is not under the facility's control. Because it is not under the facility's control, it is prudent to have an additional backup system that is under the facility's control. Furthermore, this arrangement raises issues regarding where the SC or SS boundary would be drawn.

Water Supply Arrangement No. 3: DOE Site supplied by a separate site-maintained fire water distribution network.

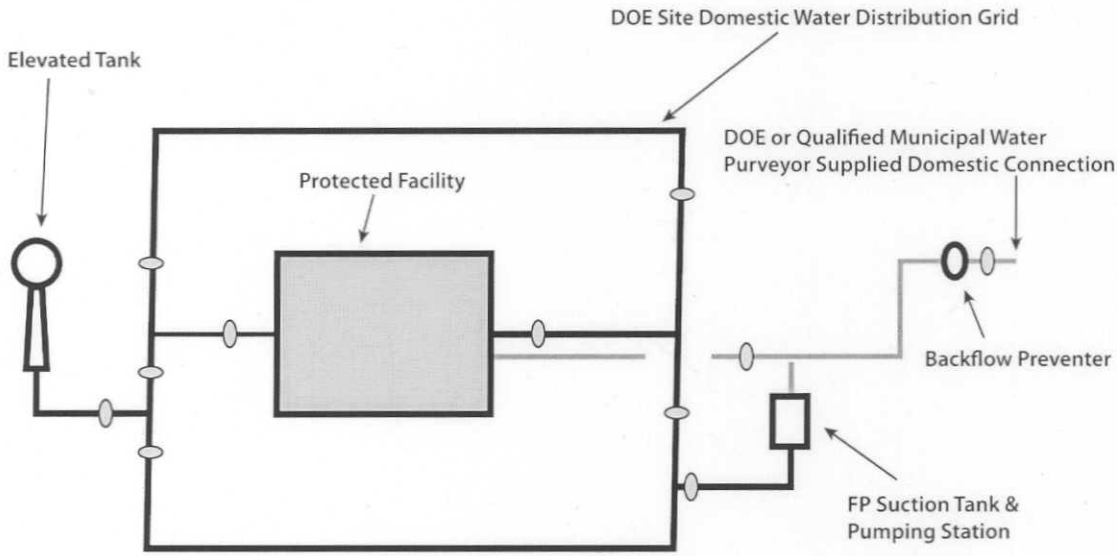
In this arrangement, water is obtained from a fresh-water source, such as a well or river, treated and then stored on site by both suction and elevated water storage tanks. The fire water and domestic water systems are separate. The only interface is the feeding of the fire water suction tank from the domestic water system.



Similar to Arrangement 2, this arrangement should not be utilized for SC applications, but is used for general purpose fire protection and may be used for SS applications, if requirements for reliability, quality assurance, and safe operation are met. The reason the system should not be used in SC applications is that, even though the system is essentially passive and under DOE control, it is not under the facility's control. Because it is not under the facility's control, it is prudent to have an additional backup system that is under the facility's control.

Water Supply Arrangement No. 4: DOE Protected Facility supplied by a dedicated fire water distribution network.

In this arrangement, water is obtained from a fresh-water source, such as a well or river, treated and then stored on site by both suction and elevated water storage tanks. The fire protection suction tank is sized to provide adequate water supply without reliance of the fill for the design basis fire.

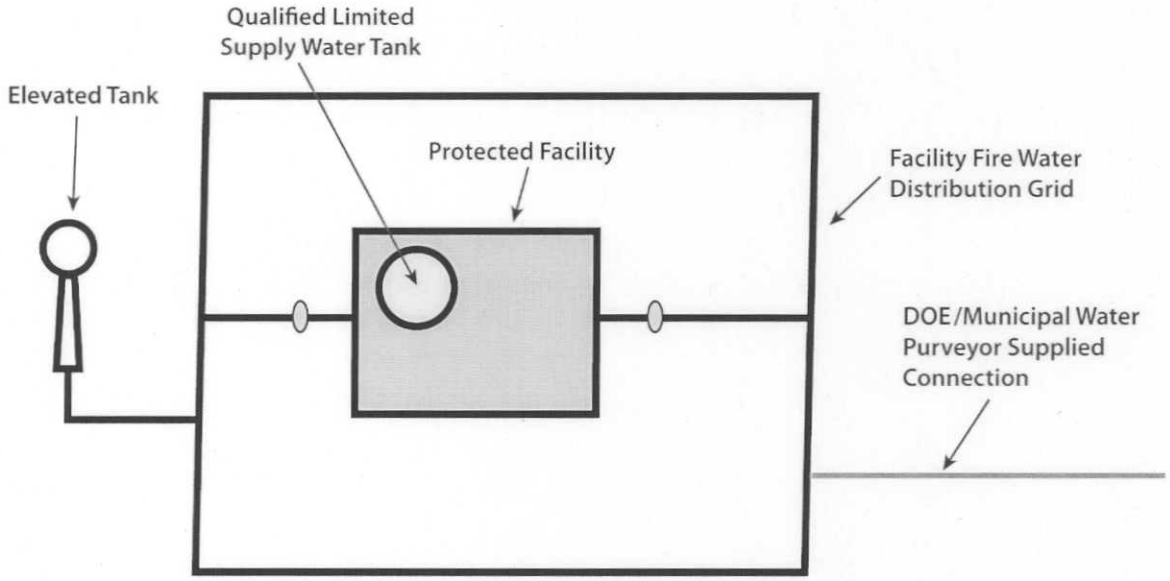


This arrangement could be utilized for SS applications, if conditions specified in A.3.2 and A.3.3. of this standard are met. If the supplied system (e.g., wet pipe sprinkler) needs to operate in a seismic event (e.g., to mitigate a seismically induced fire), the supply system shall be qualified to the same level as the supplied system.

This arrangement may be appropriate for use in SC applications with assurance that no active single failure could disable the system.

Water Supply Arrangement No. 5 – Hazard-specific limited supply water system.

Water system flow and capacity for property protection, program preservation, and life safety, etc. are specified by NFPA 1, NFPA 801, the IBC, NFPA 13 or other general industrial standards. These standards typically require from several hundred thousand to several million gallons of water. None of these specify the amount of water needed to adequately protect an SC or SS special hazard. This shall be determined on a case-by-case basis and justified in the FHA or DSA, taking into account issues, such as criticality and spread of contamination. Nuclear safety objectives can often be achieved with much lower quantities of water provided the system is independent of the general building system. For example, 500 gallons may be sufficient to meet the SC objective to protect a special hazard (e.g. a glove box) in a given facility. Such a limited supply could be provided by a single, passive, self-contained pressure tank within the facility, qualified to seismic and other SC criteria (such as redundancy of active components), thus significantly limiting the SC boundary. An additional water supply per the above codes and standards would be required to meet other fire protection objectives, but that additional supply is not required to meet SC or SS criteria.



Attachment A-2

Example Technical Safety Requirements (TSR) for Fire Protection Systems Used in Safety Class or Safety Significant Applications

1. Wet Pipe Automatic Sprinklers

Below is an example format of a limiting condition of operation (LCO) for wet pipe automatic sprinklers.

LCO X.Y.Z The wet pipe fire suppression sprinkler systems listed in the table below shall be OPERABLE with the following components:

a) An unobstructed and intact Water Delivery System from the FACILITY post indicator valve (PIV) to the sprinklers; and,

b) Water Supply System supplying adequate water supply through the FACILITY PIV.

MODE APPLICABILITY:

a) OPERATION: When CATEGORY 3 or greater quantities of nuclear material (NM) or DESIGNATED nuclear explosive-like assemblies (NELA) are present.

b) MAINTENANCE: When CATEGORY 3 or greater quantities of NM or a DESIGNATED NELA are present.

PROCESS AREA APPLICABILITY: Building XXXX-XX

LCO X.Y.Z ACTIONS

CONDITION	REQUIRED ACTION	COMPLETETION TIME
A. The Wet Pipe Fire Suppression System is inoperable	A.1 Place all DESIGNATED NELA(s), NM, and EXPLOSIVES, if collocated with NM, in a SAFE AND STABLE CONFIGURATION	IMMEDIATELY
	AND	
	A.2 Implement any other actions deemed necessary to protect the material at risk from the event of concern in the affected area	IMMEDIATELY
	AND	
	A.3 Implement a FIRE WATCH or reduce/remove/containerize COMBUSTIBLES for the affected areas as determined by Fire Protection	IMMEDIATELY

CONDITION	REQUIRED ACTION	COMPLETETION TIME
	Engineering **AND** A.4 Place FACILITY in MAINTENANCE MODE	4 Hours
B. While in Condition A, activities are required to transfer a FACILITY to a MODE or condition for which the LCO does not apply	B.1 Submit a RECOVERY PLAN	7 Days

LCO X.Y.Z SURVEILLANCE REQUIREMENTS

SURVEILANCE REQUIREMENT	FREQUENCY
SR 4.X.Y.1 Flow Test Main Drain	QUARTERLY
SR 4.X.Y.2 Inspect Control Valves are in the Open Position and Locked	QUARTERLY
SR 4.X.Y.3 Inspect Exterior (Alarm Valve) Riser/Trim	QUARTERLY

Appropriate compensatory measures should be identified when the LCO are not met.

2. Water Supply

Below are example formats of LCOs, LCO actions, and surveillance requirements for water supply systems.

LCO X.Y.Z: The Water Supply System shall be OPERABLE with the following:

a) Two OPERABLE diesel fire pump/tank configurations with automatic start, capable of supply xxx,xxx gallons of usable water.

b) Ability to deliver sufficient water for two hours.

MODE APPLICABILITY: At all times

LCO X.Y.Z ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One diesel fire pump/tank configuration is INOPERABLE, except during maintenance testing	A.1 Restore the diesel fire pump/tank configuration to OPERABLE status	14 Days, or in accordance with an approved RECOVERY PLAN
B. Both diesel fire pump/tank configurations are INOPERABLE	B.1 Enter LCO for wet pipe and/or LCO for Deluge for all applicable FACILITIES **AND**	IMMEDIATELY
	B.2 Restore at least one diesel fire pump/tank configuration to OPERABLE status	7 Days, or in accordance with an approved RECOVERY PLAN
C. Inability to deliver sufficient water	C.1 If the cause is a fire sprinkler system operation, enter LCO for wet pipe and/or LCO for deluge for all applicable FACILITIES or	IMMEDIATELY
	C.2.1 If the cause is a leak, isolate the leak **AND**	IMMEDIATELY
	C.2.2 Determine which FACILITY(s) Fire Suppression Systems are affected by the leak and notify the respective FACILITY Representatives via Operations Center **AND**	IMMEDIATELY after leak isolation
	C.2.3 Enter LCO for wet pipe and/or LCO for Deluge for the affected FACILITIES **OR**	IMMEDIATELY after notification

LCO X.Y.Z ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Inability to deliver sufficient water (continued)	C.3.1 If the cause is something other than a fire sprinkler system activation or a leak that affects the critical safety function of the water supply system, then determine which FACILITY(s) fire sprinkler systems are affected and notify the respective FACILITY Representative via the Operations Center **AND**	IMMEDIATELY
	C.3.2 Enter LCO for set pipe and/or LCO for deluge for all applicable FACILITIES	IMMEDIATELY after notification
D. Low water level alarm system indicator is found to be INOPERABLE on a tank with an OPERABLE diesel fire pump/tank configuration	D.1 Manually verify tank level	IMMEDIATELY, unless personnel safety conditions or severe weather warnings are in effect and, in that case, IMMEDIATELY after the personnel safety conditions or severe weather warnings are lifted **AND** SHIFTLY thereafter, except when personnel safety conditions or severe weather warnings are in effect
	AND	
	D.2.1 Repair Water Level Alarm System Indicator	30 Days, or in accordance with an approved RECOVERY PLAN

LCO X.Y.Z SURVEILLANCE REQUIREMENTS

	SURVEILLANCE REQUIREMENT	FREQUENCY
SR 4.4.4.1	Test Diesel Fire Pump to ensure it will automatically start on a pressure drop (___ psig ± 10 psig) and churns with static pressure of ___ psig or greater, Check that the Pump House Temperature is above 40° Verify fuel capacity of __ usable gallons Perform a voltage and amperage reading of the batteries used to start the diesel engine which drives the fire pumps Check Diesel Fuel Tank for Water	WEEKLY WEEKLY WEEKLY WEEKLY QUARTERLY
SR 4.4.4.2	Inspect the water level using a dip stick to ensure it is above ___,___ gallons	WEEKLY
SR 4.4.4.3	Inspect the Water Supply System Pump House Control and Sectional Valves (position Open and Locked)	QUARTERLY
SR 4.4.4.4	Test Water Level Alarm to ensure it sends a signal to the emergency dispatcher when the reservoir level reaches __ ft. _ in.	QUARTERLY
SR 4.4.4.5	Perform a Fire Pump Flow Test to ensure that the diesel fire pumps will produce a flow for the following pump curve (churn at ___ psig, _,___ gpm at __ psig, and _,___ at __ psig)	ANNUALLY
SR 4.4.4.6	Flow Test Underground Piping Pipe Condition Test	5 YEARS

DF.X Water Supply System

There is an LCO for the water supply system to be operable. In addition to the LCO, the water supply system has a design feature for those elements that are part of the inherent system design. The following functional requirements apply to the water supply system design feature:

a) The water supply system shall provide 2 hours of water considering water flow to the highest flow facility.

IN-SERVICE INSPECTION Requirement(s)

IN-SERVICE INSPECTION	FREQUENCY
Visually inspect the mechanical condition of the Water Supply System above the ground piping.	QUARTERLY
Visually inspect the external portions of the Water Supply Water Level Alarm System stainless steel tubing, compression valves, and fittings for signs of damage, leaks, or degradation.	QUARTERLY

3. Fire Barriers

3.1 Example Limiting Condition of Operation

The fire barrier shall be unaltered, not breached, penetrated by unstopped or unapproved fire penetration systems, damaged or removed from its original design or approved configuration, consistent with this standard and all fire barrier TSR surveillance requirements shall be current.

3.2 Example Surveillances

3.2.1 Fire barriers shall be maintained and shall be properly repaired, restored, or replaced where damaged, altered, breached, penetrated, removed, or improperly modified. A program for the inspection and/or testing and maintenance of fire barriers and protected openings (e.g., fire doors and hardware, fire dampers, glazing, and penetration seals) shall be established, based on the requirements of NFPA 1 and NFPA 80.

3.2.2 NFPA 1 and 80 should be used to establish the TSR surveillance requirements and LOCs and should clearly include requirements for damaged or compromised barriers identified during surveillances or facility operations.

3.2.3 All fire barriers and their components should be visually inspected at least on an annual basis, in accordance with the applicable NFPA code (e.g., NFPA 80), to ensure the critical characteristics of the barrier are preserved so its performance will restrict the spread of fire, as expected by the safety basis.

3.2.4 Testing shall also be conducted on all active barrier components (e.g., doors closures and dampers) to ensure they will function. For example, the fire damper manufacturer may require that actuators be tested at a certain frequency; thus, this testing frequency shall be incorporated into the Inspection, Testing and Maintenance (ITM) program for fire barriers. If a fire barrier or fire barrier component is damaged, it shall be replaced or returned to the required level of fire resistance using a listed/approved repair system or using materials and methods equivalent to the original construction.

APPENDIX B
FIRE HAZARD ANALYSIS

This appendix provides guidance on the development and content of a fire hazards analysis (FHA) for DOE facilities as required by DOE O 420.1C.

B.1 General

B.1.1 The FHA should include an assessment of the risk from fire and related hazards (wildland fire exposure, direct flame impingement, hot gases, smoke migration, fire-fighting water damage, etc.) in relation to existing or proposed fire safety features to ensure that the facility can be safely controlled and stabilized during and after a fire.

B.1.2 The FHA shall address/define the specific DOE order, standard or mandatory code and standard requirements that are applicable to the facility. If, during the analysis, it is determined that a departure from requirements is necessary, the technical basis for relief in the form of variances, exemptions or equivalencies shall be documented in the FHA.

B.1.3 In accordance with the "graded approach" concept, the level of detail necessary for an acceptable FHA is directly related to the complexity of the facility and the potential risk to the public and facility operators. An FHA for a fully compliant facility can be relatively brief, but deviations from codes, standards or directives require documentation that may substantially increase the level of detail.

B.1.4 The FHAs and facility assessment reports may be combined, provided that they address all essential elements. To facilitate the development of graded fire hazards analyses, the DOE Fire Protection Web Site contains copies of "models" of separate and combined FHAs and assessment reports. These models are located at the following URL:
http://www.hss.doe.gov/nuclearsafety/ns/fire/models/models.html

B.2 FHA Development

B.2.1 An analysis of planned facilities requiring an FHA should begin early in the development phase to ensure that an acceptable level of protection is being incorporated in the evolving design, including: building placement; height; area per floor; emergency access; construction materials; fire areas; and, other fire related details.

B.2.1.1 The project or preliminary FHA (typically called a PFHA) should be updated whenever significant changes occur and should form the basis for post-construction FHA. A post-design FHA is often useful to document the changes during the design. The analysis shall also support the conclusions of a preliminary Documented Safety Analysis (DSA) where required.

B.2.1.2 For significant new facilities (e.g., valued in excess of $150 million), that are not considered hazardous, the PFHA serves to guide the construction process and provide historic documentation, but post construction FHA reviews and revisions are not required.

B.2.3 The FHA shall be performed under the direction of a qualified fire protection engineer (FPE). This should include directing all of the technical aspects of an FHA's development, including support from emergency services, systems, electrical, and mechanical engineers, as well as authorization basis and operations staff, as needed.

B.2.4 An FHA should contain, but not be limited to, a conservative assessment of the following as the related to fire safety:

a) DOE Order, and Industry codes and standards drivers;

b) Mission and associated hazards;

c) Occupancy classification and building code construction requirements;

d) Critical process equipment;

e) High-value property;

f) Fire hazards;

g) Operations;

h) Potential for a toxic, biological and/or radiological incident due to a fire;

i) Natural hazards (earthquake, flood, wind, lightning, and wildland fire) impact on fire safety;

j) Damage potential: include both the Maximum Possible Fire Loss (MPFL) and Maximum Credible Fire Loss (MCFL), including the basis for the conclusions;

k) DSA design basis fire scenario;

l) Fire protection features, including special fire protection features, and fire protection features classified as Safety Class (SC) or Safety Significant (SS);

m) Protection of essential SC systems;

n) Life safety analysis;

o) Emergency planning;

p) Fire Department/Brigade response (may be discussed and evaluated in a stand-alone site wide document);

q) Recovery potential;

r) Security and Safeguards considerations related to fire protection;

s) Exposure fire potential and the potential for fire spread between two fire areas;

t) Effect of significant fire safety deficiencies on fire risk; and,

u) Environmental impacts from a fire including suppression system run-off considerations.

A graded approach may omit some of these topics but it should be clear that the omission was intentional.

B.2.5 The FHA should evaluate the consequences of a single, worst-case automatic fire protection system malfunction, such as, the failure of a detection system used to activate a pre-action type sprinkler system, and transmit an alarm to the site emergency response force; or, the failure of a valve in the underground main that could impair multiple systems, either in the same building or in adjacent buildings evaluated as an exposure.

B.2.6 The FHA shall address findings, and where appropriate provide a path forward for resolving the finding. It is recommended that the FHA, in addition to discussions of findings and recommendations found within the body of the report, provide a listing of findings and associated recommendations in table format. This is to avoid the potential for findings and

associated recommendations to become lost. A distinction should be made between mandatory recommendations, including those listed as general industry practice and those proposed as a matter of preference.

B.2.7 The focus of the FHA should be the individual fire areas that comprise the facility. A fire area is an area that is physically separated from other areas by space, barriers, walls, or other means, in order to contain fire within that area. Traditionally, fire-resistance ratings of a minimum of 2 hours have been used to define fire areas. It cannot be assumed that a 2 hour rated boundary is sufficient to contain a worst-case fire. Compliance with the building code may require 3- or 4-hour rated free-standing boundaries, without openings, designed to prevent failure in the event the structure on either side collapses. Additional focus should include fire-rated compartmentation provided for the separation and management of hazardous materials (chemical) inventories, such as the "control area" concept in the International Building Code and the "lab unit" concept in NFPA 45.

B.2.8 The boundaries of exterior fire areas (yard areas) should be as determined by the authority having jurisdiction (AHJ) or delegated authority. In a situation where a facility is not subdivided by fire-rated construction, the fire area should be defined by the exterior walls and roof of the facility. In production facilities, conveyor and trolley systems may pass through credited fire walls or barriers. In some instances, the design and operation of the equipment may preclude the use of fire dampers and similar devices. Such installations in new construction may require fire testing and taking credit for all features (non-rated fire dampers, metal construction, the use of fire-rated glass, in addition to confinement control glass, etc.) of the conveyor/trolley design that will impede fire spread from one fire area to an adjacent fire area.

B.2.9 In determining the adequacy of fire-rated construction, especially when the facility structure or confinement system is being credited with preventing or limiting a radiological release, it is important to fully estimate fire load within the facility, including transient, process equipment and facility construction materials that are combustible. For example, a large process piping system constructed of plastic piping could result in a large fire load, one which might challenge 1- or 2- hour fire-rated construction.

B.2.10 An important element of an acceptable FHA for nuclear facilities is an inventory of all SC and SS systems within the fire area that are susceptible to fire damage.

B.2.10.1 All credible fire-related failure modes of safety systems should be considered. It should be noted that such systems may be active or passive. In the case of certain passive SC or SS systems, the need for fire protection may not be required. This can arise in the case of concrete vehicle barrier systems or drainage systems. Such systems would generally be immune from fire damage by the nature of their construction, and thus would not require protection by an active fire-suppression system.

B.2.10.2 The analysis shall determine whether a fire can have a credible impact on the SC or SS system such that the system's credited safety function is compromised.

B.2.11 Fire propagation and the potential for fire-induced radiological dispersal through the facility should be considered. These effects should be considered for the normal operating mode of the air distribution system, as well as alternate modes, such as shutdown, that may result from the fire. In nuclear and radiological facilities, ventilation (air flow) is from the least contaminated to the most contaminated areas. In large facilities, this could represent a challenge for emergency responders should the fire originate in a lower contaminated area. Consideration should be given as to whether such an event could compromise fire fighter

response, or if the facility's layout would permit alternate avenues to gain access to the fire area.

B.3 Fire Modeling

B.3.1 While not usually needed, a tool that may be used in the development of an FHA is a fire model, such as those developed by the National Institute of Standards and Technology, as applied by qualified FPEs, and approved for DOE use as a Central Registry Toolbox code. This includes the CFAST Fire Model and other models in the following web site: http://www.nist.gov/building-and-fire-research-portal.cfm

B.3.2 All assumptions used in a model should be listed in the FHA and limiting conditions of operation or specific administrative controls established to assure that these assumptions produce reasonably conservative results. In addition, small variations in an assumption can have a major impact on the outcome. For example, assuming a door is closed might reduce fire intensity by half, but there is no assurance that the door will remain closed throughout the life of the facility. Because of their limitations and potential for errors, the use of fire models to estimate the potential effects of fire in nuclear, radiological, high-hazard and other facilities with potential resulting offsite and worker consequences, should be limited to persons highly-qualified in the model's use. Results or outputs from the model should be approved by a qualified FPE who is knowledgeable on the use of the model. In all cases, the output of the model should be compared with expected fire dynamics. Where the model's output does not match normally expected fire dynamics, the models output should be suspect.

B.4 Special Considerations

B.4.1 As a general rule, nuclear, radiological, high-hazard, explosive, and certain other facilities may require a higher standard of fire protection than that normally accepted for general industry, and, in some cases, above that considered acceptable for Highly Protected Risk (HPR) facilities, including the use of SC and SS fire protection systems.

B.4.2 The analysis may rely on actual fire testing or historical data on fire events both inside and outside the DOE complex, provided that adequate documentation of such information is available for the AHJ's review.

B.4.3 The quantity and associated hazards of flammable liquids and gases, as well as combustible liquids and other materials may be found within the fire area should be factored into the analyses. Consideration should also be given to the presence of transient combustibles associated with storage and maintenance activities.

B.4.3.1 When conditions prevent employment of normal fire protection features, such as automatic sprinklers, noncombustible construction, and fire-resistant boundaries, the FHA should quantify fixed-combustibles and their locations and determine limits and locations of transient combustibles. These limits are usually enforced through formal combustible loading programs with permits for each combustible material brought into the area.

B4.3.2 Averaging combustible loading throughout a space as a means to characterize the fire severity is not considered an acceptable technique since localized severity, vulnerability, and combustible loading may vary significantly from the average.

B.4.4 FHAs for high-bay locations should consider the effects of smoke/hot gas stratification that may occur at some intermediate point below the roof or ceiling, as well as the potential for

delayed sprinkler response. Similarly, the effect of smoke movement through doors and dampers held open by fusible links should be addressed.

B.4.5 When both an FHA and a safety basis document (DSA, Safety Analysis Document, or Basis for Interim Operation) are developed for a facility, the developmental effort should be coordinated to the maximum extent possible to avoid duplication of effort. It is recognized, however, that because an FHA is based on the premise that a fire will occur and considers a variety of fire issues (property loss and program interruption potential) that are not normally considered in the DSA, the conclusions of the FHA may be more conservative for the facility as a whole, while the DSA may be more conservative for a specific process. For example, the FHA may assume that building sprinklers are sufficient for fixed and transient combustibles, but the DSA may rely on combustible controls to limit fire exposure in a specific area. Nevertheless, the FHA and its conclusions should be addressed in the facility DSA in such a manner as to reflect all relevant fire safety objectives, as defined in DOE O 420.1C. As a general rule, the FHA shall be developed so as to provide input into the DSA. Thus, some portions of the FHA may be developed early in the safety basis development process, and in some cases concurrently with the safety basis development process. In no case should the FHA be back-fitted so that results of the FHA correspond to results of the safety basis documentation. However, the FHA is required, as described in Section B.2.4, to address DSA design basis fire scenarios and the protection of SC and SS features.

B.4.6 Information related to emergency response (number of emergency responders, number and types of apparatus, response time, etc.) should be incorporated into the safety basis documentation as a means of clearly establishing a "floor", below which this level of capability should not be reduced. This information may be discussed in a separate stand-alone evaluation of the site's fire department services.

APPENDIX C
RELOCATABLE STRUCTURES

C.1 Application

The provisions of this Appendix apply to the purchase and lease, as well as the design and construction, of all relocatable structures that:

- will remain in place for more than 180 days onsite;
- contain significant fire hazards; or,
- have programmatic importance or significant value as determined by the cognizant fire protection engineer (FPE).

Modifications made to existing relocatable structures should be performed in accordance with this appendix. Site-specific interpretations of the provisions of this appendix should be the responsibility of the DOE authority having jurisdication (AHJ).

C.2 Structural Requirements

C.2.1 Construction: Relocatable structures should be constructed to conform to applicable National Fire Protection Association (NFPA) standards and the International Building Code.

Exception 1: Tents or other membrane-type structures should be constructed of material that has been tested and approved by a nationally-recognized, independent fire test authority for the anticipated end use using NFPA 701 *Standard Methods of Fire Tests for Flame Propagation for Textiles and Film* (Test Method 2). Approval should be based on the performance of large scale tests.

Exception 2: This criterion does not apply to semi-trailers and cargo containers.

C.1.2 Compartmentation: Relocatable structures should be separated such that the largest fire area does not exceed the limits imposed by the building code. No fire area in a relocatable structure should have a Maximum Possible Fire Loss (MPFL) exceeding limits imposed by DOE O 420.1C.

C.1.3 Anchors and Supports: Each relocatable structure should have support and anchoring systems that have been properly designed and installed to resist overturning and lateral movement of the structure.

C.1.4 Interior Finish: The interior finish of all relocatable structures should comply with NFPA 101, as amended below.

Relocatable structures used for any of the following occupancies should have an interior finish with a flame spread rating <25 and a smoke development rating <50 per ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*:

a. Dedicated to housing electronic data processing equipment or other computer equipment;

b. Structures used for sleeping quarters;

c. Structures used for storing, processing, or involving radiological materials; and,

d. Structures used for storing or operating lasers and related equipment.

If fire retardant pressure impregnated wood is used as interior finish it should be the non-leachable type that meets Underwriter's Laboratories (UL) "Standard Rain Test" and should be installed with corrosion resistant fasteners that will withstand the chemicals impregnated in the wood. It should be rated as FR-S material as currently listed in the UL Building Materials Directory or equivalent. Fire retardant paint is not acceptable for flame spread reduction for interior finish.

Interior finish requirements should also apply to the shell covering material of tension-supported structures.

C.1.5 Skirting: Relocatable structures with open under-floor areas should be provided with skirting to prevent the accumulation of combustibles and debris beneath the structures.

C.1.6 Identification: All relocatable structures should be marked with the number, symbol, or name for identification purposes. The marking system used should be permanent and consistent with the system currently used at the site.

C.1.7 Heating Ventilating and Air Conditioning (HVAC): HVAC equipment should be listed or approved by a nationally-recognized, independent fire testing authority and installed in accordance with its approved design and applicable industry standards. Portable heating appliances should not be permitted.

C.1.8 Surveillance: Exterior structural features of relocatable structures should be inspected in conjunction with the site fire protection assessment program to monitor potential physical deterioration due to atmospheric conditions. If such deterioration has resulted in a significant increase in fire risk, structural repairs or other appropriate mitigating measures should be implemented.

C.2 Placement Requirements

C.2.1 Separation Distances: Relocatable structures should comply with the separation distances as shown in Table C.1.

Table C.1 Minimum Separation Distances

Exposing Wall Length ft (m)	Minimum Separation Distance ft (m)
10 (3)	20 (6)
20 (6)	30 (9)
30 (9)	35 (11)
40 (12)	40 (12)
50 (15)	45 (12)
60 (18)	50 (15)
More than 60 (18)	60 (18)

The following adjustments of the separation distances specified in Table C.1 are cumulative, but the minimum distance should not be less than 10 feet (3 meters):

- 50 percent reduction for light fire loading, e.g., 8,000 BTU/sq. ft. or less;
- 50 percent increase for heavy fire loading, e.g., 160,000 BTU/sq. ft. or higher;
- 50 percent reduction for limited supply suppression system in the exposing relocatable structure which completely protects the structure;
- 75 percent reduction for an automatic sprinkler system in the exposing relocatable structure; and,
- 75 percent reduction for exposure deluge system.

Exception 1: The separation distances requirement does not apply if the MPFL of the relocatable structure combined with all exposed structures is less than $5 million.

Exception 2: Tents and other fabric-type structures should comply with the separation distances and exposure protection requirements of NFPA Standard 80A.

In all cases, the required separation distance should be based on the "worst-case" between the structures, such as when structures are positioned on an angle. Required distances to separate permanent buildings or facilities from relocatable structures should be determined in a similar manner. Due to the many factors that should be considered for permanent buildings, NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, should be used to establish their separation distance.

C.2.2 Exposures: Exposures presented by exterior canopies, connecting walkways, and intervening combustibles should also be considered when determining separation distances and protection features.

There should be no storage of combustible or hazardous materials between the relocatable structure and the exposed building(s).

C.2.3 Location Restrictions

Relocatable structures should be placed so emergency vehicles can operate within 100 feet (30 meters) of the structure. The space between the structure and the road should be free of natural obstructions that would prevent or severely restrict access by emergency responders. Security barriers should be designed in a manner that permits emergency access. Landscaping and similar non-essential obstructions should not restrict emergency access.

Relocatable structures should not be located where they impede, or otherwise hinder personnel egress or ingress to, or within, other facilities or structures.

Relocatable structures should not be located where they impede, or otherwise hinder, the access of emergency response vehicles to other facilities or structures.

Relocatable structures should not be placed inside permanent facilities that do not have sprinklers, unless a fire hazards analysis (FHA) demonstrates that there is no significant increase in fire risk to the facility. Structures that are placed inside permanent facilities should be protected with the same level of fire protection as provided for the permanent facility.

Relocatable structures should not be placed over control valves, access ways to underground utilities, utility corridors, gas mains, or water mains. Relocatable structures may be placed above utility lines that service the structure itself.

Relocatable structures should not be placed beneath vital power lines or lines over 600 volts such that a fire in the structure could damage the lines. Such structures should also not be placed under other vital utilities, such as communication cables and inerting gas lines, unless the relocatable structure is protected by an automatic fire suppression system. Service conductor clearances and disconnects should be in accordance with NFPA 70.

Site location(s) for relocatable structures should be evaluated for wildland fire exposures. Where a significant fire risk exists, appropriate fire-resistive building materials and/or other methods of protection should be utilized as determined by the cognizant FPE.

Relocatable structures should not be placed closer than 50 feet (15 meters) to a fire hydrant unless there are other hydrants within the distance specified in C.4.3.

C.2.4 Cargo Containers: Cargo containers should be limited to stacks 2-high unless otherwise approved by the cognizant FPE. The arrangement of cargo containers, should reflect the fire hazard of contents, the risk to personnel, value, and access for emergency responders.

C.3 Occupancy Considerations

Unless a graded FHA demonstrates that a particular occupancy represents an unacceptable fire risk to the health and safety of the public, site personnel, or to program continuity, there are no restrictions on the occupancy of portable structures except as delineated below and in the building code.

Relocatable structures should be governed by site or facility-specific procedures for the use and storage of combustible, flammable, radioactive, and hazardous materials so as to minimize the risk from fire. Such procedures should also exist for activities, such as smoking limitations, isolation of hot work, and other fire prevention measures that contribute to a reduction in fire risk.

C.3.2 Computer Automated Information Systems Equipment: Relocatable structures used to house automated information systems or other computer equipment should comply with NFPA 75.

C.3.3 Laboratories: Structures may be used to house laboratories provided they were designed for this purpose and comply with this standard and the applicable NFPA standards.

C.3.4 Hazardous Material Storage: Relocatable structures may be used for the storage of hazardous materials if the structures comply with this standard, the applicable NFPA standards, and all applicable hazardous waste storage requirements.

C.3.5 Sleeping Facilities: Sleeping areas should not be permitted in relocatable structures unless they are specifically designed for this purpose. Such facilities should conform with the provisions of NFPA 101, including the requirements for two remote means of egress, an automatic sprinkler system and a smoke detection system that alarms in the facility and is interconnected with the site fire alarm/signaling system.

C.3.6 Remote Facilities: Where fire protection criteria of this appendix cannot be feasibly met because the relocatable structure is in a remote location, alternate fire protection features may be provided as determined by the AHJ.

C.3.7 Portable Heat Producing Devices: Coffee pots, hot plates, ovens, and similar items producing heat or capable of overheating should be listed by a nationally-recognized, independent testing agency. All such devices or the receptacles into which they are plugged should feature a light or other equivalent means to indicate when the appliance is energized. Circuits should be de-energized at the end of each workday.

C.4 Fire Protection Requirements

C.4.1 Automatic Sprinklers: Complete automatic sprinkler protection designed per the applicable NFPA standards should be provided for relocatable structures as follows:

a. In all structures over 5,000 square feet (465 square meters);
b. In all structures having an MPFL in excess of $5 million;
c. In all structures where the MPFL will affect a vital program for a period longer than that specified as acceptable by the AHJ;
d. In all structures where quantities of hazardous materials are used or stored in excess of the limits delineated in the Uniform Fire Code, or alternate model fire code as determined by the AHJ; and,
e. In all structures used for sleeping quarters, including day care centers. (For such structures, "quick-response" sprinklers shall be utilized.)

Exception 1: Limited supply suppression systems may be used where a reliable water supply is not available, or where the application of water would increase the overall hazard in the event of a fire.

Exception 2: Automatic sprinkler systems are not required in fabric or membrane-type structures where alternate means of fire protection will provide an acceptable level of protection. Such means include, but are not limited to, fire detection systems combined with foam fire extinguishing systems and other special total flooding fire suppression systems.

C.4.2 Portable Fire Extinguishers: Portable fire extinguishers, listed by a nationally recognized independent testing agency, should be provided for relocatable structures in accordance with NFPA 10.

C.4.3 Fire Hydrants: Unless the structure is under 5,000 square feet (465 square meters) in floor area or has an MPFL less than $5 million, at least one fire hydrant supplied by an adequate and reliable water distribution system should be located so that it does not require more than 300 feet (91 meters) of fire hose to reach any exterior portion of a relocatable structure or a group of structures to be protected.

C.4.4 Emergency Notification and Egress: All relocatable structures that are occupied by people should have access to a means to summon emergency assistance. In situations where a fire alarm or signaling system is not otherwise provided or required, this may take the form of a telephone, radio, or equivalent means.

a. Relocatable structures should be provided with fire alarm and notification systems as required by NFPA 101 for the specific occupancy.
b. Relocatable structures equipped with an automatic fire suppression or detection system shall also be equipped with local alarm(s) that transmit separate and distinct signals for fire, trouble, and supervisory to either: the site fire department/emergency response center; or, to a continuously occupied station for the purpose of initiating emergency response.
c. Provisions for emergency egress, including exits, emergency lighting, and exit signage should be in accordance with NFPA 101.

APPENDIX D
D&D FACILITIES

D.1 Deactivation and Decommissioning (D&D) planning should consider the impact that this transition has upon fire protection features and activities. Such factors are additionally important if the facility possesses a definable value and/or mission as determined by the DOE program office, or if a fire would significantly increase the cost of the D&D process. Examples of the latter include the destruction of vital equipment required for D&D activities, a delay in transition commitments, the undermining of public confidence, and an increase in the cost of clean-up.

It should be noted that considerable cost savings (e.g., electric, heating, Inspection, Testing and Maintenance) may be realized when combustibles within D&D facilities are reduced to near zero which, in turn, permits deactivation of the building's fire suppression and alarm system, provided that fixed combustibles such as construction materials, interior finish, electrical cables, and combustible roofing are not a fire threat.

D.2 Fire safety and emergency response for transitional facilities are governed by the requirements contained in 10 CFR 851 (including 29 CFR Part 1926) and the provisions of the National Fire Protection Association (NFPA) Standard 241, *Safeguarding Construction, Alteration and Demolition Operations*. (See also FM Datasheet 1-0 *Safeguards During Construction*, and Chapter 8 of NFPA 801.)

D.3 Decisions relating to fire safety of such facilities should be made on the basis of the following principles, with key aspects being captured in the D&D fire hazard analysis (FHA).

D.3.1 Fire risks imposed by the work in relation to the need for traditional fire safety features should be evaluated. The facility's FHA may be utilized, where applicable, to complete this evaluation. This can be accomplished through a graded FHA that has been reviewed and concurred with by the authority having jurisdication (AHJ). All requests for relief should be processed in accordance with DOE procedures. Approved relief from normal DOE requirements should be listed on the signature page.

D.3.2 Fire hazards within these facilities may change over time, such as an increase in combustible loading during abatement activities. Fire protection should be adequate to deal with these changes. The FHA, together with updated pre-incident plans, should account for this through a phasing schedule, or it should be revised, as appropriate, when significant changes in occupancy or hazard occur that affect fire safety.

D.3.3 Fire safety features that have originally been required by DOE may be rendered inoperable or considered no longer needed if justified by the FHA, provided that the safety of D&D workers and emergency responders will not be compromised. Such features may be abandoned in place (and properly identified as being out of service), until they are dismantled as part of planned demolition activities.

D.3.4 The decision to deactivate automatic fire suppression systems in large facilities should consider the possibility that fire department personnel may not be able to safely enter the facility to effect manual fire suppression. If DOE concurs that such an approach can be done safely without undermining public confidence, a defensive tactical approach, (i.e. exterior fire attack and protection of exposures), should be a part of the baseline needs assessment (BNA) described in Section 6 of this standard and written into the fire department's updated pre-incident plan. Such an approach necessitates additional emphasis on maintaining

communication and cooperation between facility personnel and the fire department so that emergency responders are aware of changes in occupancy and fire protection system status.

D.3.5 Retained fire protection features in these facilities are not required to comply with all of the design and installation criteria of the governing NFPA standard, if the AHJ concurs that the system will function adequately during a fire in its altered design mode. The AHJ concurrence should be documented in accordance with site procedures.

D.3.6 Retained fire protection features should be inspected, tested and maintained to ensure that the features will function adequately during fire incidents.

D.3.7 D&D facilities should be routinely inspected and reviewed by representatives of the fire department and fire protection engineering staffs consistent with established standard operating procedures and fire protection program criteria. Tours of facilities should also be conducted by the fire department to familiarize them with existing conditions and to revalidate pre-incident plans. Drills and training exercises should also be conducted at these locations at an appropriate frequency commensurate with the fire risks and complexity of the facility.

D.3.8 Prior to commencement of work activities in a facility, the D&D FHA should be updated, and appropriate procedures should be approved and implemented (including worker training) to govern the control of potentially hazardous operations including, but not limited to, cutting and welding, storage and handling of flammable or combustible liquids, transient combustibles, and sources of ignition, such as temporary wiring and heating equipment. Smoking areas, if allowed on the premises, should also be established.

D.3.9 The fire risks associated with materials and processes used as part of the transition process should be evaluated by a fire protection engineer. Fire protection features should be adequate to limit these risks to an acceptable level., Combustible supplies required for D&D should be limited to a one-day supply within the D&D facility unless automatic sprinkler protection is being maintained. Facilities for the storage of combustible D&D supplies should be located outside and away from the structure.

D.3.10 The deactivation of process lines containing hazardous materials, as well as flammable or combustible liquids should be preceded by an analysis, or performed under a work plan that addresses the methods used to control related hazards during the deactivation process. Appropriate safeguards need to be in place to control and minimize the release of residual materials that may remain in piping and tanks.

D.3.11 Safeguards to assure D&D worker and emergency responder safety and health shall conform to the requirements in 10 CFR 851, and the requirements for buildings under construction or demolition, as provided in NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, unless relief has been granted by the AHJ. In buildings where regular tours and inspections are conducted, adequate exits and lighting shall be provided as a minimum as required by NFPA 101. Compensatory measures should be established whenever routine surveillance is being performed in these facilities. These measures should be approved by the site fire authority. Locked and abandoned facilities where there is no human occupancy do not need to maintain emergency egress features.

D.3.12 Where no automatic system exists, an effective means for manually summoning the fire department and for communicating with personnel inside of a building is required. This can take the form of exterior fire alarm pull stations or call boxes, telephones (fixed or mobile), radios, or some combination of the above, based on the accessibility of the devices to all personnel and their reliability. However, in accordance with NFPA 101, all egress features shall be reviewed

once the facility is reopened for actual demolition activities. Stairwells should be inspected on a routine basis and maintained accessible, clear and dry in the event firefighting activities are required.

D.3.13 All retained interior fire protection systems should be maintained operational to the extent possible while interior work activities are taking place. The sequence of removal of these systems should be clearly spelled out in contractor requirement documents and the FHA. Verification of operable status should include appropriate inspection and testing in accordance with established procedures. Sprinkler systems should be retained until all fixed and transient combustible materials have been removed. Where it is economically feasible, wet sprinkler systems may be converted to dry systems to minimize heating needs. Any temporary deactivation of fire protection features during transition operations should be treated as an impairment, with appropriate interim compensatory measures implemented until the feature is returned to full operational mode pending final demolition. It should be noted that, during winter months where limited heating is provided within facilities undergoing D&D, it may be impossible to prevent sprinkler and standpipe system freezing due to the potential for hidden piping and piping low points that may not drain, or that cannot be economically be drained. Deactivated systems deteriorate rapidly. Fire suppression systems should not be removed from service for a prolonged period with the intent to restore protection for safety of workers when final disposition is funded.

D.3.14 The site and facility fire water distribution system, including hydrants, fire department connections, and interior standpipe systems, should be maintained in an operable state. Access for mobile apparatus for emergency response should be maintained and verified on a frequent basis. (Refer to fire department pre-incident fire plans.)

D.3.15 To the extent that the FHA validates the need to maintain fire protection features during transition activities, such features should be inspected, tested and maintained, consistent with established procedures, sufficient to ensure that they will function effectively during a fire, based on their intent during transition. Defects or design deficiencies that are not essential to ensure liability and effective performance, as determined by the AHJ, may remain as is.

APPENDIX E
EXPLANATORY MATERIAL

This appendix provides additional explanatory material supporting the requirements in the body of this Standard. These "endnotes" are identified by their corresponding section number.

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[1] 2 DOE and contractor fire safety programs include all activities pertaining to fire hazards and related perils including: emergency services, operations and maintenance activities, such as hot work or combustible material handling or storage; activities related to fire safety; installation and testing of fire protection systems; water supply and distribution systems; fire safety training; assessments; facility and site walk downs; and other fire protection activities that are not explicitly identified here.

[2] 2.1 For example: "DOE expects that the site fire department will maintain a capability to provide Advanced Life Support, as defined in the State of..." or "...will provide an emergency services capability that fully conforms with the requirements of the State of..., DOE directives, and NFPA codes and standards, unless explicit relief has been granted by DOE." Note that state requirements do not apply on DOE sites but may apply to responses off-site as part of mutual assistance agreements.

[3] 2.2 Public Law 100-678 Compliance With Nationally Recognized Codes and Standards requires Federal agencies to use national consensus standards. DOE regulations and directives require use of "applicable" fire standards. The National Fire Codes (NFPA) comprise over 200 codes and standards. In addition, ASTM and other organizations promulgate national standards for fire protection. The applicable standards are generally a small subset of the total which may vary significantly from facility to facility, depending on how the facility is used and the hazards it contains. Applicability can usually be determined by an "applicability" statement at the beginning of each standard and as determined by the AHJ.

[4] 2.3 Beginning with the Manhattan Project, facilities were also required to meet "Highly Protected Risk" (HPR) criteria. This requirement continues with latest revision of DOE O 420.1C. HPR is an insurance term used by the DOE to define a facility where both the frequency and the severity of a fire related loss (risk) has been addressed by fire protection features such as, but not limited to, noncombustible construction, the installation of fire suppression and detection systems, redundant water supplies, fire alarm systems, and specific measures and procedures to address special hazards. Compliance with national codes and standards, and building codes relative to property protection is required to be judged a HPR property. Where national codes and standards are lacking relative to a hazard at a DOE site, FM Global Datesheets and recognized experts are used to address the potential risk. Most importantly management interest and commitment to loss prevention is essential to a HPR property and is demonstrated by timely completion of legacy non-compliances with these codes and standards. Additionally, impairments to fire protection systems are minimized and compensatory measures for impairments are invoked. Manual fire fighting is provided to reduce the severity of fire loss. Additionally, mission impact from fire is appropriately addressed. HPR relates primarily to property protection and mission impact rather than Life Safety or protection of the public from nuclear accident. However, HPR protection features can be effective in meeting Life Safety objectives.

[5] 3.2.2 The elements of the fire protection self-assessment also provide guidance for the conduct of independent program assessments.

[6] 4.1.1 For large projects it may be beneficial to establish a fire protection working group composed of DOE and contractor fire protection engineers, safety basis representatives, responsible design engineers, operations personnel and others as may be appropriate. Such working groups can be successful in resolving fire protection challenges, ensuring that issues do not become side-tracked, identifying early the possible need for exemptions or equivalencies, and most important avoiding costly delays in design or construction.

[7] 4.2.5.3 Special facilities should be designed and constructed using building components of fire-resistant and noncombustible material, particularly in locations vital to the functioning of confinement systems. Combustible materials should not be used in the construction of process system confinement barriers.

[8] 4.2.8.1 Water supply demand consists of the following: 1) sprinkler or water spray demand, 2) the simultaneous demand of other water-based fire suppression systems, such as plenum cool down and water spray sprinklers or exposure protection sprinklers, 3) hose stream demand based upon fire department operations criteria and safety basis assumptions, i.e., calculation for interior hose streams required in order to avoid opening confinement barrier doors, and 4) other demands which cannot be curtailed such as domestic or industrial demands.

[9] 4.2.8.5 The resulting protection should be designed to ensure that a fire would be successfully controlled until such time that emergency response forces arrive to extinguish it. The FHA and the safety basis documentation should specify any additional requirements beyond those for a standard wet pipe sprinkler system.

[10] 4.2.8.8 When the use of water sprinkler coverage is precluded because of nuclear criticality or other incompatibility reasons, nonaqueous extinguishing systems (e.g., inert gas, carbon dioxide, Halon alternatives, etc.) that will be successful in extinguishing the anticipated fire and which is not reactive to materials present should be used. Additional precautions may be needed since these alternative systems are much less reliable than sprinklers and their limited supply of extinguishing agent may permit re-ignition.

[11] 4.2.9 The requirement for providing a fire alarm system appear in the IBC, NFPA 101, and OSHA 1910.165. Additional requirements may be developed from the FHA.

[12] 4.3.1 Standards that provide design guidance include: *Compresses Gases and Cryogenic Fluids Code*; NFPA 58, *Liquefied Petroleum Gas Code*; ASME B31.3 *Process Piping*; ASME *Boiler and Pressure Vessel Code, Section VIII, Rules for the Construction of Unfired Pressure Vessels.*

[13] 4.4.1.1 NFPA 801 provides guidance for radioactive materials. Other hazardous materials are addressed by the International Fire Code, Chapter 27.

[14] 4.4.1.2 Process confinement systems generally include one or more of the following: 1) ventilation systems, 2) gloveboxes, 3) material transfer systems that are enclosed, and 4) piping systems with or without tanks.

To protect the integrity of the physical barriers associated with process confinement systems, fire protection features should include the following:

1. A fire extinguishing system to rapidly remove heat produced by fire to prevent or minimize damage to the process system or to prevent over pressurization the pressurization of a process confinement system and to rapidly extinguish a fire to minimize the loading of ventilation system filters with combustion products
2. The introduction of the extinguishing agent in a way that does not result in over pressurization of the confinement barriers.
3. Where appropriate providing vulnerable portions of the confinement system with a fire resistive enclosure, or fire wrap of suitable fire rating.
4. Administrative controls for the storage of combustible materials within or close to such systems.
5.

[15] 4.4.2.4 For deflagration prevention, the flammable/combustible concentrations should be maintained at or below 25 percent of their lower flammable limit. For combustible and pyrophoric metals, the oxygen concentration should not exceed 25 percent of the level required for combustion.

[16] 4.4.3 DOE-HDBK-1169-2003, *Nuclear Air Cleaning Handbook*, Chapter 10, expands on these objectives. These objectives are in addition to the Life Safety and property damage protection objectives discussed elsewhere in this Standard. Although the guidelines in this section are specifically applicable when only high efficiency particulate air (HEPA) type filters serve as the final means of effluent cleaning in

a nuclear air cleaning ventilation system, the guidelines can be applied with engineering discretion to other types of filtration and cleaning systems and their configurations.

Design of confinement ventilation systems usually incorporates redundant trains of HEPA assemblies and fans to improve reliability and allow maintenance activities. The provision of these redundant trains is valuable from a fire protection standpoint since they allow isolation or even loss of one filter assembly without interrupting confinement ventilation filter function.

This section does not include specific definitive fire protection design requirements for High Efficiency Metal Fiber filter systems, Radioiodine Adsorber air cleaning systems, Deep Bed Fiberglass filter systems, or Deep Bed Sand Filter systems.). This section does not include the protection of HEPA type filters utilized in a clean room application. (Refer to NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities*.)

[17] 4.4.3.6 Tests by Lee of Atlantic Richfield in 1974 established the following design features for fire screens to prevent the passage of fire. Fire screens should be located upstream from the prefilters and final filter plenums. Fire screens with metal meshes from 8 to 16 openings per inch should be provided and located so that they are at least 4 to 5 feet (1.2 to 1.5 meters) upstream from all prefilters and at least 20 feet (6.1 meters) upstream from all final filter plenum enclosures.

[18] 4.4.3.7 If spot type heat detectors or pilot heads are used for fire detection in the HEPA filter enclosure, they should be installed in the airstream prior to the first stage and in the airstream after the first stage. If linear thermostatic cable is used for fire detection in the HEPA filter enclosure, it should be installed across the face of the first stage filters. It may also be desirable to install linear thermostatic cable either on the downstream side of the first stage filters or across the face of the second stage filters. If the heat detectors are modified for ease of maintenance or testing (e.g. in a thermal well), the affect of this modification should be analyzed and approved by the AHJ.

[19] 4.4.3.8 If the cooling of the hot gases is to be accomplished with dilution air, engineering calculations should demonstrate that the inlet temperature to the HEPA assembly is at least 100^0F below the damage threshold of the filters. If the cooling of the hot gases is to be accomplished with water spray or sprinklers in the duct work, the flow rate of 1gpm for every 500cfm should be used unless another flow rate can be justified. These in-duct systems should be automatic.

[20] 4.4.3.9 Tests and calculation show that the pressures drop across prefilters is higher than the HEPA for the same mass loading because the HEPA filters have larger filter surface areas. Replacing the prefilters with either extended surface area media or HEPA type filters will greatly improve the performance of the ventilation system during a fire emergency. If it becomes necessary to maintain confinement ventilation, the redundant filter assembly can be engaged and the plugged filter train can be isolated.

[21] 4.4.3.11 Sprinkler or water spray should be designed to reach the face of the first stage of filters. This may require multiple nozzles if the filter assembly is subdivided. Previous DOE design guidance established a water density of 0.25 gpm/ft^2 of filter face area and that the system is manually operated. Designs applying less water or automatic operation should be justified in the FHA.

[22] 5.1.4.3 Combustible control programs should address the quantity, type and location limits on combustibles allowed in critical areas. These limits should be based on the minimum fire size capable of threatening structures, systems or components that are necessary to maintain an acceptable level of health and safety risk.

[23] 5.2.1.1 Staffing levels for the contractor's fire protection program should be based on a "work load analysis" or similar analysis that provides a technical basis for the fire safety staff. Staffing for the fire department should be based upon conclusions reached in the Baseline Needs Assessment (BNA) required by DOE O 420.1C.

[24] 5.2.1.2. Although state and local requirements do not apply on Federal reservations, it may be desirable to apply them selectively to facilitate mutual assistance agreements with nearby jurisdictions.

[25] 5.2.3 The level of documentation necessary to support a request for relief will vary depending on the issue. As a minimum, each request should:

- identify the specific site, facility location or condition at issue and the paragraph/section of the rule, directive, code or standard which addresses the issue;
- discuss why the requirements cannot or should not be met , including benefits that are to be gained by approval;
- identification and justification of the acceptance of the threat or threats that will be incurred if the request is granted,
- justify the conclusion that the alternate configuration is acceptable from a safety, environmental, property damage, or program continuity perspective to what is stipulated in the code or standard; and
- discuss other pertinent data or information that supports the request for relief.

All functions should also be addressed. For example, an automatic sprinkler system provides detection, local alarms, fire department notification, and fire suppression. The description of alternatives in an equivalency should address each of these functions. In addition, relief from a requirement in one directive or standard does not constitute relief from a similar requirement in another directive or standard. Every source requirement for the system or feature must be identified and addressed since the purpose of the system or feature may differ. For example, exemption from the DOE O 420.1C requirement for sprinklers in a radiological facility over 5000 square feet does not constitute relief from the requirement for sprinklers from NFPA 801. Both documents must be identified and addressed in the exemption request.

A change in use or occupancy usually requires bringing a facility up to current codes and standards, voiding all exemptions, equivalencies and variances. Re-evaluation and resubmittal of requests for relief for the same deviations must clearly explain why the facility deviations could not be corrected during the conversion. A failure to follow request for relief commitments to which the operating contractor committed or a failure to comply with conditions of approval may result in the relief being voided.

The temporary exemption process should be employed when corrective action is planned but may take several years to implement, the issue is of a short-term duration, the facility in question has a very short continued operational life of three years or less, and similar circumstances.

[26] 5.2.4.2 Routine activities include issuing of permits; reviewing and approving construction documents and shop drawings (new construction, modification, or renovation); accepting fire protection equipment, materials, installation, and operational procedures (fire system inspection and testing), interpretation of building codes or standards; and other activities that require AHJ approval.

[27] 6.1.1 In addition, the document should describe the organization's various programs that support its personnel. This should include training, physical fitness, and medical programs relating to emergency responders. In developing the BNA, the intent is that this be a coordinated effort involving the AHJ and the representatives of the site emergency services organization. Additional expertise in unique emergency response or fire prevention issues, legal matters, labor-related issues, emergency medical protocols, etc., may be required to assist in the development of the BNA.

[28] 6.1.2 This does not mean that the BNA has to be written to confirm code conformance on the basis of line-by-line comparisons. A reasonable degree of documentation is expected. It should also address applicable contract provisions and aid agreements with other contractors on site as well as offsite organizations. The goal is to capture in one document information that will identify needs and confirm that the emergency response requirements can be met. Note that there is a "model" BNA that can be downloaded and edited, available on the DOE fire protection website at http://www.hss.doe.gov/nuclearsafety/ns/fire/models/models.html

[29] 6.1.4 This can be done via a BNA or comparable document, commensurate with the offsite organization's responsibilities. This document should delineate what is required (capability), why is it required (hazards, accident potential, code requirements, etc.), and how this capability is assured by the

offsite emergency services organization. Where the offsite emergency responders exclude fire fighting involving nuclear or other site hazards, the BNA should clearly describe integration of site and offsite efforts.

[30] 6.1.5 In developing the BNA, the basic assumption should be that there is only one emergency incident occurring onsite, with a casualty requiring emergency medical assistance. However, the document should also describe how the fire department would respond if a second incident occurred while the first was underway. The second response capability could be based on documented mutual aid agreements and utilization of some percentage of off-duty personnel overtime. To the extent that an insufficient response capability is determined to exist for this second emergency, the BNA should address the required supplemental emergency response resources that would be needed to respond to this event. Where the fire department provides service to others, unless dedicated fire department services are reserved for protection of the site, the BNA should address the potential for offsite fire response concurrent with a required onsite response, including the potential for delayed response or a resource limited response.

[31] 6.1.6 A critical factor in any such analysis is the minimum response time necessary to begin active intervention (fire suppression, emergency medical, technical rescue, etc.) activities. The determination of a minimally acceptable response time should be based on risk and should reflect categories, such as alarm, call processing, dispatch, response, and turnout times that have been established in NFPA 1710. DOE expects that the response time requirements of NFPA 1710 be the starting point in the determination. Site specific conditions, such as the widespread installation of automatic fire suppression systems, could be used to extend response time to structural fires through the NFPA 1710 accepted equivalency process. Similarly, the provision of localized Automated External Defibrillators (AEDs) and first-aid supplies, along with appropriate employee training, could be used, in part, as a basis for extending Emergency Medical Service response times.

[32] 6.1.7 The level below which onsite fire department resources should not drop should consider whether mutual aid response would be timely given the sites location, as well as whether offsite fire fighters are prepared and willing to respond to fire events at the site, especially if fires might involve radioactive materials or other hazardous materials. This information can be inserted in summary fashion or the BNA can be incorporated directly into the above-referenced documents.

[33] 6.2.1.1 Living quarters should provide a comfortable, private and safe environment for personnel, consistent with state or local requirements. This includes adequate sleeping quarters where necessary (when personnel are working more than a 12-hour shift), kitchen facilities, training rooms, physical fitness areas, and other ancillary needs. To the extent that related occupancies such as alarm rooms, maintenance rooms, and personnel areas are co-located within the same facility, appropriate fire-rated physical separation, ventilation and exhaust, and other fire protection features should be provided to prevent interference and to ensure the viability of individual areas in the event of a fire.

[34] 6.2.1.4 Station location should also reflect prevailing traffic patterns, climatic conditions, railroad tracks and other sources of delay. Where multiple stations are provided they should be located near the site's high risk facilities or areas while providing an acceptable level of fire protection for other facilities located throughout the site. Station location and resource allocation should also consider the hazard classification of the facilities, the actual fire threat to personnel, the facility, and its mission, the level of automatic fire suppression provided (the extent to which manual firefighting efforts may be required, traffic patterns, potential road bottle necks, and other factors as may be appropriate.

[35] 6.2.2.1 Examples include hazardous material response, heavy rescue, rough terrain rescue, chemical or large flammable liquid spills, and wildland fire response. The selection of apparatus must consider potential need and frequency, and whether special apparatus having limited need would be available through mutual aid or other means.

[36] 6.2.2.3 Periodic replacement programs for apparatus should be structured to avoid excessive "down time" and repair costs and should reflect the industry norm of useful life cycles (e.g., 20 years). The apparatus replacement program should be scheduled over time so as to avoid peaks in apparatus

replacement cost. Fire departments should be required to maintain apparatus response and mileage logs to assist in identifying inappropriate use of apparatus and in developing replacement schedules.

[37] 6.2.3.1 It is recognized that, where lives may be at risk, the Incident Commander has the authority and responsibility to initiate rescue with less than this minimum if, in his judgment, it is safe to do so, for instance, in properties fully protected by automatic sprinkler systems. Additional emergency response personnel will be necessary where multiple hose lines are required to suppress a fire and to support other fire ground activities such as search and rescue.

[38] 6.2.3.3 Historical DOE guidance maintains that a minimum of 5 SCBA equipped emergency responders shouldl be available at the fire ground prior to any interior firefighting or other operations are attempted.

[39] 6.2.3.4 Where reliance is placed on offsite fire brigades or fire departments for fire suppression, efforts should be made to obtain suitable clearances for fire response personnel in order to avoid delays in fire department response, and associated consequences (e.g., loss of life, injury, increased fire damage) that may result as a result of delayed response.

[40] 6.2.5.1 As part of this effort, regular facility tours should be conducted utilizing current pre-incident fire plans as well as to verify that plans are accurate. Contractors subject to 10 CFR Part 851 must adhere to 29 CFR Parts 1910 and 1926 if these regulations are applicable to the hazards at their covered workplace. See 10 CFR § 851.23 (a)(3) and (7).

[41] 6.2.5.3 This includes "live fire" training, confined space entry, vehicle extrication, hazardous material response, and other site-specific conditions. Where onsite training facilities are unavailable, arrangements should be made for appropriate training for fire department personnel offsite at nearby city or county training facilities, or at regional or state training facilities.

[42] 6.2.5.4 The term 'fire fighters' is intended to mean those whose sole responsibilitie is fire department activities, as opposed to fire brigades or emergency response team members, whose primary responsibilities are other than the fire department.

[43] 6.3.2 For additional information and to access "model" documents that can be downloaded and edited, refer to the DOE fire protection web site at:
http://www.hss.doe.gov/nuclearsafety/ns/fire/models/models.html

[44] 7.1.1 Examples of facilities not generally requiring an FHA include small utility buildings, trailers, and small office buildings.

CONCLUDING MATERIAL

Review Activity:

HSS
NNSA
EM
NE
SC
CTA/CNS
CTA/CDNS

Field and Operations Offices

CBFO
CH
ID
OH
OR
ORP
RL
SR

Preparing Activity:

HS-21

Project Number:

FIRP-0002

Site Offices:

Argonne Site Office
Brookhaven Site Office
Fermi Site Office
Kansas City Site Office
Livermore Site Office
Los Alamos Site Office
Nevada Site Office
Pantex Site Office
Princeton Site Office
Savannah River Site Office
Sandia Site Office
Y-12 Site Office