

NFPA 801

Standard for Fire Protection for Facilities Handling Radioactive Materials

2003 Edition



NFPA, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 801
Standard for
Fire Protection for Facilities Handling Radioactive Materials
2003 Edition

This edition of NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, was prepared by the Technical Committee on Fire Protection for Nuclear Facilities and acted on by NFPA at its November Association Technical Meeting held November 16–20, 2002, in Atlanta, GA. It was issued by the Standards Council on January 17, 2003, with an effective date of February 6, 2003, and supersedes all previous editions.

This edition of NFPA 801 was approved as an American National Standard on January 17, 2003.

Origin and Development of NFPA 801

The Committee on Atomic Energy was organized in 1953 for the purpose of providing the fire protection specialist with certain fundamental information about radioactive materials and their handling and to provide designers and operators of such laboratories with some guidance on practices necessary for fire safety. The first edition of NFPA 801, whose coverage was limited to laboratories handling radioactive materials, was adopted at the 1955 Annual Meeting.

In 1970 the format was revised, and the document was updated to reflect current thinking and practices. It was also expanded to apply to all locations, exclusive of nuclear reactors, where radioactive materials are stored, handled, or used.

The 1975 edition was a reconfirmation of the 1970 edition with editorial changes.

The 1980 edition included a clarified statement regarding the presence of and levels of radiation; cautionary statements about the assumption of risks by the fire officer and the importance of training in the handling of radioactive materials by fire department personnel; a clarification concerning the variations of the intensity of a radiation field; and a restyling of the document to conform with the NFPA *Manual of Style*.

The 1985 edition revised and updated previous material for clarification in recognition of technology and terminology changes.

The 1991 edition was a total revision of the document and included a complete reorganization of the chapters. This was done to provide an update of the latest technology and to improve the document's user-friendliness.

The 1995 edition included a variety of updates necessary to convert the document from a recommended practice to a standard. One of the more noteworthy changes was a revised scope statement to recognize a threshold value with respect to the amount of radioactive materials that are stored, handled, or used.

The 1998 edition incorporated the recommendations of NFPA 802, *Recommended Practice for Fire Protection for Nuclear Research and Production Reactors*.

The 2003 edition includes a new chapter on permanent facility shutdown and decommissioning and has been reformatted to conform to the NFPA *Manual of Style*.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, Annex D lists the complete title and edition of the source documents for both mandatory and nonmandatory extracts. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex D.

Chapter 1 Administration

1.1 Scope.

1.1.1* This standard addresses fire protection requirements intended to reduce the risk of fires and explosions at facilities handling radioactive materials. These requirements are applicable to all locations where radioactive materials are stored, handled, or used in quantities and conditions requiring government oversight and/or license (e.g., U.S. Nuclear Regulatory Commission or U.S. Department of Energy) to possess or use these materials and to all other locations with equal quantities or conditions.

1.1.2 This standard shall not apply to commercial power reactors that are covered by NFPA 804, *Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants*, and NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants*.

1.2 Purpose.

1.2.1* Responsibilities. This standard shall provide requirements and guidance for personnel responsible for the design, construction, operation, and regulation of facilities that involve the storage, handling, or use of radioactive materials.

1.2.2 Defense-in-Depth.

1.2.2.1 This standard shall be based on the concept of defense-in-depth.

1.2.2.2 Defense-in-depth shall be achieved when a balance of each of the following elements is provided:

- (1) Preventing fires from starting
- (2) Detecting fires rapidly and controlling and extinguishing promptly those fires that do occur, thereby limiting damage and consequences
- (3) Providing a level of fire protection for structures, systems, and components so that a fire that is not promptly extin-

guished will not prevent essential facility functions from being performed

1.3* Application. These requirements shall be applicable to all locations where radioactive materials that meet the thresholds established in 10 CFR 30 are stored, handled, or used, in quantities and conditions requiring government oversight and/or license (e.g., U.S. Nuclear Regulatory Commission or U.S. Department of Energy) to possess or use these materials, and to all other locations with equal quantities or conditions.

1.4 Retroactivity.

1.4.1 The provisions of this standard shall be considered necessary to provide a reasonable level of protection from loss of life and property from fire. They reflect situations and the state of the art at the time the standard was issued.

1.4.2 Unless otherwise noted, the provisions of this standard shall not be applied retroactively, except in those cases where it is determined by the authority having jurisdiction (AHJ) that the existing situation involves a distinct hazard to life, property, or the environment.

1.4.3 Any alteration, installation of new equipment, or change in occupancy shall meet the requirements for new construction, except where approved by the AHJ.

1.4.4 Only the altered, renovated, or modernized portion of an existing building, system, or individual component shall be required to meet the provisions of this standard that are applicable to new construction.

1.5 Equivalency.

1.5.1 Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety as alternatives to those prescribed by this standard, provided technical documentation is submitted to the AHJ to demonstrate equivalency, and the system, method, or device is approved for the intended purpose.

1.5.2 The specific requirements of this standard shall be permitted to be modified by the AHJ to allow alternative arrangements that will secure as nearly as practical the level of fire protection intended by this document.

1.5.3 In no case shall a modification afford less fire protection than that which, in the judgment of the AHJ, would be provided by compliance with the corresponding provisions contained in this standard.

1.5.4 Alternative fire protection methods accepted by the AHJ shall be considered as conforming with this standard.

1.6* Units and Formulas.

1.6.1 SI Units. Metric units of measurement in this standard shall be in accordance with the modernized metric system known as the International System of Units (SI).

1.6.2* Primary and Equivalent Values. If a value for a measurement as given in this standard is followed by an equivalent value in other units, the first stated value shall be regarded as the requirement.

1.6.3 Conversion Procedure. SI units have been converted by multiplying the quantity by the conversion factor and then rounding the result to the appropriate number of significant digits.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1998 edition.

NFPA 11, *Standard for Low-Expansion Foam*, 1998 edition.

NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*, 1999 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2000 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 1997 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1999 edition.

NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems*, 2000 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2001 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 1999 edition.

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 1998 edition.

NFPA 17A, *Standard for Wet Chemical Extinguishing Systems*, 1998 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 1999 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 1998 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 1995 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2002 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2000 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2000 edition.

NFPA 50, *Standard for Bulk Oxygen Systems at Consumer Sites*, 2001 edition.

NFPA 50A, *Standard for Gaseous Hydrogen Systems at Consumer Sites*, 1999 edition.

NFPA 54, *National Fuel Gas Code*, 1999 edition.

NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders*, 1998 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2001 edition.

NFPA 70, *National Electrical Code*[®], 2002 edition.

NFPA 72[®], *National Fire Alarm Code*[®], 1999 edition.

NFPA 75, *Standard for the Protection of Electronic Computer/Data Processing Equipment*, 1999 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1999 edition.

NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment*, 1999 edition.

NFPA 86, *Standard for Ovens and Furnaces*, 1999 edition.

NFPA 86C, *Standard for Industrial Furnaces Using a Special Processing Atmosphere*, 1999 edition.

NFPA 86D, *Standard for Industrial Furnaces Using Vacuum as an Atmosphere*, 1999 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 1999 edition.

NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, 1999 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 1999 edition.

NFPA 101[®], *Life Safety Code*[®], 2000 edition.

NFPA 220, *Standard on Types of Building Construction*, 1999 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 2000 edition.

NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*, 2000 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, 2000 edition.

NFPA 430, *Code for the Storage of Liquid and Solid Oxidizers*, 2000 edition.

NFPA 480, *Standard for the Storage, Handling, and Processing of Magnesium Solids and Powders*, 1998 edition.

NFPA 481, *Standard for the Production, Processing, Handling, and Storage of Titanium*, 2000 edition.

NFPA 482, *Standard for the Production, Processing, Handling, and Storage of Zirconium*, 1996 edition.

NFPA 600, *Standard on Industrial Fire Brigades*, 2000 edition.

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, 1999 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2000 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 1997 edition.

NFPA 804, *Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants*, 2001 edition.

NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants*, 2001 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 2002 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2000 edition.

2.3 Other Publications.

2.3.1 ASTM Publication. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 814, *Fire Tests of Through-Penetration Fire Stops*, 1994 edition.

2.3.2 UL Publication. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 1479, *Fire Tests of Through-Penetration Fire Stops*, 1994 edition.

2.3.3 U.S. Government Publication. U.S. Government Printing Office, Washington, DC 20402.

Title 10, Code of Federal Regulations, Part 30.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction 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.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Canyon. An enclosure beside or above a series of hot cells for the purpose of servicing the hot cells.

3.3.2 Cave. See 3.3.20.1.

3.3.3 Criticality. The state of sustaining a chain reaction, as in a nuclear reactor.

3.3.4 Criticality Incident. An accidental, self-sustained nuclear fission chain reaction.

3.3.5 Decontamination. The removal of unwanted radioactive substances from personnel, rooms, building surfaces, equipment, and so forth, to render the affected area safe.

3.3.6 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.

3.3.7 Fire Barrier. A continuous vertical or horizontal construction assembly designed and constructed to limit the spread of heat and fire and to restrict the movement of smoke.

3.3.8* Fire Door. The door component of a fire door assembly.

3.3.9* Fire Emergency Organization. Personnel trained to respond to facility fire emergencies, which can include in-plant fire-fighting operations.

3.3.10 Fire Hazards Analysis. A comprehensive assessment of the potential for a fire at any location to ensure that the possibility of injury to people or damage to buildings, equipment, or the environment is within acceptable limits.

3.3.11 Fire Prevention. Measures directed toward avoiding the inception of fire.

3.3.12 Fire Protection. Methods of providing for fire control or fire extinguishment.

3.3.13* Fire Resistance Rating. The time, in minutes or hours, that materials or assemblies have withstood a fire exposure.

3.3.14 Fire-Resistant Fluid. A listed hydraulic fluid or lubricant that is difficult to ignite due to its high fire point and autoignition temperature and that does not sustain combustion due to its low heat of combustion. [850:1.4]

3.3.15* Fissionable Materials. Materials that are capable of being induced to undergo nuclear fission by slow neutrons.

3.3.16* Flame Spread Rating. A relative measurement of the surface burning characteristics of building materials.

3.3.17* Gamma Rays. High-energy short-wavelength electromagnetic radiation.

3.3.18* Glove Box. A sealed enclosure in which items inside the box are handled exclusively using long rubber or neoprene gloves sealed to ports in the walls of the enclosure.

3.3.19* Hood. An enclosure, with or without gloveports or doors, characterized by the flow of air from the room to the enclosure.

3.3.20 Hot Cell. A heavily shielded enclosure in which radioactive material can be handled safely by persons working from outside the shield using remote tools and manipulators while viewing the work through special leaded-glass or liquid-filled windows or through optical devices.

3.3.20.1 Cave. A small hot cell intended for a specific purpose and limited equipment.

3.3.21 Isotope. Any of two or more forms of an element having the same atomic number and similar chemical properties but differing in mass number and radioactive behavior.

3.3.22 Liquid.

3.3.22.1* Combustible Liquid. A liquid that has a closed-cup flash point at or above 37.8°C (100°F).

3.3.22.2 Flammable Liquid. A liquid that has a closed-cup flash point that is below 37.8°C (100°F) and a maximum vapor pressure of 2068 mm Hg (40 psia) at 37.8°C (100°F).

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

3.3.24 Occupancy. The purpose for which a building or portion thereof is used or intended to be used. [101:3.3]

3.3.25 Particle.

3.3.25.1* Alpha Particle. A positively charged particle emitted by certain radioactive materials, identical to the nucleus of a helium atom.

3.3.25.2* Beta Particle. An elementary particle, emitted from a nucleus during radioactive decay, with a single electrical charge and a mass equal to $\frac{1}{1837}$ that of a proton.

3.3.26* Radiation. The emission and propagation of energy through matter or space by means of electromagnetic disturbances that display both wave-like and particle-like behavior.

3.3.26.1 Nuclear Radiation. The emission from atomic nuclei in various nuclear reactions including alpha, beta, and gamma radiation and neutrons.

3.3.27 Radiation Area. An area, accessible to personnel, in which radiation exists, originating in whole or in part within radioactive material, at such levels that a major portion of the body could receive a dose in excess of 5 millirems (5×10^{-5} sievert) during any single hour or a dose in excess of 100 millirems (100×10^{-5} sievert) during any five consecutive days.

3.3.28 Radioactivity. The spontaneous decay or disintegration of an unstable atomic nucleus accompanied by the emission of radiation.

Chapter 4 Fire Protection Program

4.1* Management Policy and Direction. Management shall establish policies and institute a program to promote life safety, the conservation of property and essential equipment, the protection of the environment, and the continuity of operations through provisions of fire prevention and fire protection measures at each facility.

4.1.1 Administrative controls for changes in processes, equipment, or facilities shall be developed to include fire protection concerns.

4.1.2 For the life of the facility, the administrative controls for facilities shall be reviewed and maintained to reflect current conditions and updated periodically.

4.2 Fire Hazards Analysis. See Annex B, Fire Hazards Analysis.

4.2.1 A documented fire hazards analysis shall be initiated at the beginning of the design process or when configuration changes are made to ensure that the fire prevention and fire protection requirements of this standard have been evaluated.

4.2.2 This evaluation shall consider the facility's specific design, layout, and anticipated operating needs.

4.2.3 The evaluation shall consider acceptable means for separation or control of hazards, the control or elimination of ignition sources, and the suppression of fires.

4.2.4* For existing facilities, a documented fire hazards analysis shall be performed for all areas of the facility.

4.2.5 The evaluation shall consider the storage and use of radioactive materials, as their release under fire or explosion conditions can result in a severe hazard.

4.3 Fire Prevention Program. A written fire prevention program shall be established and shall include the following:

- (1) Fire safety information for all employees and contractors, including familiarization with procedures for fire prevention, emergency alarm response, and reporting of fires
- (2)*Documented facility inspections conducted at least monthly, including provisions for remedial action to correct conditions that increase fire hazards
- (3)*A description of the general housekeeping practices and the control of transient combustibles
- (4) Control of flammable and combustible liquids and gases and oxidizers in accordance with the applicable documents referenced in Section 7.1
- (5)*Control of ignition sources including, but not limited to, grinding, welding, and cutting

(6)*Fire reports, including an investigation and a statement on the corrective action to be taken

(7)*Fire prevention surveillance

(8) The restriction of smoking to designated and supervised areas of the facility

(9)*Construction, demolition, and renovating activities that conform to the requirements of NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, such as the following:

- (a) Scaffolding, formworks, decking, and partitions used inside buildings shall be noncombustible or fire-retardant treated.
- (b) If wood is used, it shall be one of the following:
 - i. Listed, pressure-impregnated, fire-retardant lumber
 - ii. Treated with a listed fire-retardant coating
 - iii. Timbers 15.2 cm $\times$ 15.2 cm (6 in. $\times$ 6 in.) or larger
- (c) Tarpaulins (fabrics) and plastic films shall be certified to conform to the weather-resistant and flame-resistant materials described in NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*.

4.4 Testing, Inspection, and Maintenance.

4.4.1 Upon installation, fire protection systems and features shall be inspected and tested in accordance with the applicable documents referenced in Section 6.7.

4.4.2 Testing, inspection, and maintenance shall be documented by means of written procedures, with the results and follow-up actions recorded, and specific acceptance criteria shall be provided for each test.

4.5 Impairments.

4.5.1 A written procedure shall be established to address impairments to fire protection systems and shall include the following:

- (1) Identification, tagging, and tracking of impaired equipment
- (2) Identification of personnel to be notified
- (3) Determination of needed compensatory fire protection and fire prevention measures

4.5.2 Impairments to fire protection systems shall be managed to minimize the duration of the equipment outage.

4.5.2.1 If the impairment is planned, all necessary parts and personnel shall be assembled prior to removal of the protection system(s) from service.

4.5.2.2 When an unplanned impairment occurs, or when a system has discharged, the repair work or fire protection system restoration shall be expedited.

4.5.3 Once repairs are completed, tests shall be conducted to ensure that full fire protection equipment capabilities are restored and operational.

4.5.4 Following restoration to service, those parties previously notified of the impairment shall be advised.

4.6* Emergency Response. A written emergency response plan shall be developed and shall include the following:

- (1) Response to fire alarms and fire systems supervisory signals
- (2) Notification of personnel identified in the plan

- (3) Evacuation from the fire area of personnel not directly involved in fire-fighting activities
- (4)*Coordination with security forces, radiation protection personnel, and other designated personnel for the admission of public fire department and other emergency response agencies
- (5)*Fire extinguishment activities, particularly those that are unique to the facility handling radioactive materials
- (6) The effects of fire-fighting water on such areas, assuming disruption of the contents by accident or by fire hoses
- (7) Requirements for training, drills, and exercises to verify the adequacy of the emergency response plan, including practice sessions coordinated around previously developed valid emergency scenarios particular to the facility

4.7 Facility Fire Emergency Organization.

4.7.1 A facility fire emergency organization in accordance with the requirements of NFPA 600, *Standard on Industrial Fire Brigades*, or NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, shall be provided.

4.7.2 The size of the facility and its staff, the complexity of fire-fighting problems, and the availability and response time of an off-site fire department shall determine the composition of the facility fire emergency organization.

4.7.3 Facility fire emergency organization training requirements and drill frequencies necessary to demonstrate proficiency shall be implemented in accordance with the emergency response plan in Section 4.6.

4.7.4 Drills shall be critiqued and documented.

4.7.5 Two-way communications for the facility fire emergency organization shall be provided if required by the Federal Housing Administration (FHA).

4.8 Pre-Fire Plans.

4.8.1* Detailed pre-fire plans for all site fire areas shall be developed for assisting the facility fire emergency organization.

4.8.2 Pre-fire plans shall be reviewed and updated to reflect the current facility conditions.

4.8.3* Pre-fire plans shall be made available to the facility fire emergency organization.

Chapter 5 General Facility Design

5.1* Special Considerations. The design of facilities handling radioactive materials shall incorporate the following:

- (1) Limits on areas and equipment subject to contamination
- (2) Design of facilities, equipment, and utilities to facilitate decontamination

5.2 Location with Respect to Other Buildings and Within Buildings.

5.2.1 Facilities having quantities of radioactive materials that can become airborne in the event of fire or explosion shall be segregated from other important buildings or operations.

5.2.2 Attention shall be given to the location of intakes and outlets of air-cleaning systems to reduce contamination potential.

5.3* Contamination Control.

5.3.1 Temporary containment structures shall be of noncombustible materials or flame-resistant materials described in NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*.

5.3.2 The facility shall be designed to provide construction that confines a potential radiation contamination incident and shall include surface finishes that are easy to clean.

5.4* Fire Area Determination. The facility shall be subdivided into separate fire areas, as determined by the fire hazards analysis, for the purposes of limiting the spread of fire, protecting personnel, and limiting the consequential damage to the facility.

5.5 Construction. Buildings in which radioactive materials are to be used, handled, or stored shall be fire resistant or noncombustible (Type I or Type II in accordance with NFPA 220, *Standard on Types of Building Construction*).

5.6 Openings in Fire Barriers.

5.6.1* Openings in fire barriers shall be protected consistent with the designated fire resistance rating of the barrier including, but not limited to, mechanical and electrical penetrations, building construction joints, and HVAC penetrations.

5.6.2 Fire doors and fire windows used in fire barriers shall be installed and maintained in accordance with NFPA 80, *Standard for Fire Doors and Fire Windows*.

5.6.3 Penetration seals provided for electrical and mechanical openings shall be listed to meet the requirements of ASTM E 814, *Fire Tests of Through-Penetration Fire Stops*, or UL 1479, *Fire Tests of Through-Penetration Fire Stops*.

5.7 Shielding.

5.7.1 Any permanent or temporary shielding materials shall be noncombustible.

5.7.2 Where noncombustible materials cannot be used, fire protection measures shall be provided as determined by the fire hazards analysis.

5.8* Interior Finish.

5.8.1 Interior wall and ceiling finish in areas processing or storing radioactive materials shall be Class A, in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

5.8.2 Interior floor finish in areas processing or storing radioactive materials shall be Class I, in accordance with NFPA 253, *Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*.

5.9* Heating, Ventilating, and Air Conditioning.

5.9.1* General.

5.9.1.1 The design of the ventilation shall be in accordance with NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*; NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*; and NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*.

5.9.1.2 Where shutdown of the ventilation system is not permitted, fire dampers shall not be required for ventilation duct penetrations, and an alternative means of protecting against fire propagation shall be provided.