U.S. NUCLEAR REGULATORY COMMISSION May 2001

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 1.191

(Draft was DG-1069)

FIRE PROTECTION PROGRAM FOR NUCLEAR POWER PLANTS DURING DECOMMISSIONING AND PERMANENT SHUTDOWN

A. INTRODUCTION

This guide has been developed to describe methods acceptable to the NRC staff for complying with the NRC's regulations regarding fire protection programs for licensees who have certified that their plants have permanently ceased operations and that the fuel has been permanently removed from the reactor vessels.

The regulations that apply to fire protection programs for nuclear power plants during decommissioning and permanent shutdown are in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The certification connected with decommissioning is described in 10 CFR 50.82, "Termination of License."

The licensee of a permanently shutdown nuclear power plant is required by 10 CFR 50.48(f) to maintain a fire protection program to address the potential for fires that could result in the release or spread of radioactive materials. The objectives of the fire protection program are to (1) reasonably prevent fires from occurring, (2) rapidly detect, control, and extinguish fires that do occur, and (3) minimize the risk of fire-induced radiological hazards to the public, the environment, and plant personnel.

This guide does not apply to independent spent fuel storage installations (ISFSIs) that are licensed in accordance with the requirements of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," except for the fire exposure risk to an ISFSI from a reactor during decommissioning. This guide does apply to spent fuel storage facilities licensed under 10 CFR Part 50.

The regulations provide for a performance-based fire protection program that can readily be modified during the decommissioning process to address residual hazards. The performance goals and measures established by the licensee should be founded on established industry standards and practices and should provide reasonable assurance that the fire protection objectives of 10 CFR 50.48 will be met. If a licensee chooses to use fire protection methods different from the guidelines recommended in this guide, the licensee should provide an equivalent level of fire protection. The licensee is responsible for demonstrating the equivalency of proposed alternative methods.[1]

Appendix A to this guide is a glossary of terms that have been used in this guide. These definitions have been taken from existing regulatory documents and industry fire protection standards when possible. If published definitions were not available, the staff defined the terms. Appendix B to this guide provides examples of the level of fire protection that is acceptable to the NRC staff for spent fuel areas.

The information collections contained in this regulatory guide are covered by the requirements of 10 CFR Part 50, which were approved by the Office of Management and Budget, approval no. 3150-0011. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

B. DISCUSSION

GENERAL

The fire protection requirements for operating reactors are provided by General Design Criterion (GDC) 3 of Appendix A to 10 CFR Part 50, 10 CFR 50.48, and Appendix R to 10 CFR Part 50. Before the decommissioning rule was published on July 29, 1996, the NRC's fire protection regulations did not address nuclear power plants that have permanently ceased operations and are in the process of decommissioning.

The primary objectives of the fire protection program for operating reactors are to minimize fire damage to structures, systems, and components (SSCs) important to safety; to ensure the capability to safely shut down the reactor; and to maintain it in a safe shutdown condition. For

[1] As of the date of this regulatory guide, the NRC has not received any submittals of performance-based fire protection programs nor has it reviewed any methods or approaches for developing or implementing performance-based programs. Moreover, the NRC staff is not aware of the existence of specific methods or approaches for developing and implementing an acceptable performance-based program. Nevertheless, as such methods and approaches are developed in the future, they could provide a basis for meeting the requirements of 10 CFR 50.48(f).

an initial period following shutdown, accidents that can challenge the 10 CFR Part 100 limits remain credible. The fire protection program should continue to provide protection against these events. The primary fire protection concern for permanently shutdown plants is protecting the integrity of the spent fuel and preventing or minimizing the release of radioactive materials resulting from fires involving contaminated plant SSCs or radioactive wastes. The radiation dose limits specified in 10 CFR Part 20, "Standards for Protection Against Radiation," apply to plant personnel and members of the public for fire incidents at permanently shutdown nuclear power plants. Licensees should make every effort to maintain exposures to radiation resulting from a fire as low as reasonably achievable.

The fire protection program for an operating reactor provides the basis for developing the fire protection program for the decommissioning phase. The goal of the fire protection program during decommissioning of nuclear power plants is to provide an appropriate level of defense-in-depth protection against the threat of fires. Defense in depth, relative to fire protection, involves a comprehensive program of administrative controls, physical fire protection features, emergency response capabilities, and protection of SSCs necessary to prevent or mitigate the potential of an unacceptable release of radioactive materials. This combination of fire protection elements acts to reduce both the probability and consequences of fire events, and it provides assurance that the failure of any one element within the fire protection program is adequately compensated for by the others, thereby minimizing the risks to the public, environment, and plant personnel.

Licensees that have permanently shut down their nuclear power plants, and have made the submittals to the NRC required by 10 CFR 50.82, may either immediately begin decommissioning and dismantling the facility or may choose to place the facility in a monitored storage condition for some period of time before beginning final decommissioning and dismantlement activities. The fire protection requirements may differ considerably, depending on the licensee's approach to decommissioning.

In general, the processes and activities associated with nuclear plant decommissioning can be dynamic, with plant conditions and configurations continuously changing. Decommissioning activities may increase fire hazards in the plant through mechanisms that include, but are not limited to, increased hot work (e.g., welding, cutting, grinding), increased combustible loading, erection of temporary structures to support decommissioning or dismantlement of the plant, and deactivation or abandonment of plant systems. In addition to the physical changes to the plant, the licensee's organizational structure and responsibilities are expected to be different during decommissioning, with staffing levels significantly lower than during plant operations.

C. REGULATORY POSITION

1. FIRE PROTECTION PROGRAM

1.1 Objectives

This regulatory guide describes a fire protection program for permanently shutdown nuclear power plants that is acceptable to the NRC staff for meeting the requirements of 10 CFR 50.48(f) regarding fire protection for permanently shutdown nuclear power plants. Because of the dynamics of the decommissioning process, the licensee's fire protection program should be reevaluated at least annually and revised as necessary to reflect the facility condition through the various stages of decommissioning in accordance with this regulatory guide. The fire protection program should address the following performance objectives.

- **Prevent fires.** Administrative controls and, where possible, physical features (e.g., barriers or other physical separation of combustibles from ignition sources) should be implemented to provide reasonable assurance that fires will not occur.

- **Rapidly detect, control, and extinguish fires that do occur and could result in a radiological hazard.** Appropriate levels of fire protection, including detection systems, automatic or manual fire suppression systems, water supplies, and emergency response capability, should be provided based on the fire hazards present.

- **Minimize the risk to the public, environment, and plant personnel resulting from fires that could result in a release of radioactive materials.** Plant SSCs important to the prevention or mitigation of fire-induced releases of radioactive materials should have an appropriate level of fire protection. Plant personnel should be adequately trained in emergency response procedures for fire events.

1.2 Fire Protection Program Standards

The fire protection program for decommissioning should be based on sound engineering practices and established industry standards such as those provided by the National Fire Protection Association (NFPA). This regulatory guide endorses several standards as guidance for implementing various elements of the fire protection program. These standards are cited in this guide as guidance, not NRC requirements. Deviations from industry codes and standards should be justified on a case-by-case basis. The cited standards should be applied in a manner consistent with the NRC's regulations. An individual plant's standards of record are generally established in the operating plant's fire protection program and will also be considered to apply to the decommissioning fire protection program as appropriate. Licensees may consider adoption of standards more recent than the plant's standards of record when they are consistent with NRC's regulations and with appropriate evaluations for reductions in protection.

1.3 Transition from Operating Plant Program

Operating plants are required to have a fire protection program in accordance with the requirements of 10 CFR 50.48 and General Design Criterion 3, "Fire Protection," of Appendix A to 10 CFR Part 50. The primary objective of the operating plant fire protection program is to provide defense-in-depth protection of the capability to shut down the reactor and maintain it in a safe shutdown condition. The safe shutdown objective is not applicable during decommissioning, with the reactor permanently shut down and the fuel removed from the reactor vessel. However, many of the elements of the operating plant fire protection program continue to be applicable under plant decommissioning. The operating plant fire protection program provides the baseline analysis and description of plant fire hazards, administrative controls, physical protection features, and emergency response capabilities. Many of these elements will be carried over to the fire protection program for decommissioning.

1.4 Fire Protection Program for Decommissioning

The fire protection program is expected to change throughout the various phases of decommissioning. Initially, with spent fuel removed from the reactor and stored in the spent fuel pool, it is appropriate to develop and maintain a comprehensive decommissioning fire protection program to provide assurance that the probability of fires affecting the spent fuel or other radiological hazards is minimized and that the consequences of fires, should they occur, are adequately mitigated. As decommissioning progresses and the spent fuel is moved to an independent storage facility or permanent repository, the fire protection requirements for the plant may be scaled down in accordance with the diminishing radiological hazard. However, even in the absence of spent fuel in the spent fuel pool, a fire protection program that ensures adequate protection from the fire-induced release of radioactive material from contaminated plant areas and combustible wastes should be maintained.

The decommissioning fire protection program described in this regulatory guide is limited to decommissioning activities associated with the radiological hazards present in the plant or in the ancillary facilities (e.g., onsite waste storage) that directly support the decommissioning process. This guide does not provide guidance on fire protection for ISFSIs. The licensee alone will determine fire protection requirements for plant areas that the licensee's fire hazards analysis has shown to have property loss concerns.

The licensee should maintain a fire protection program as long as there are radiological hazards on the site or until the Part 50 license is terminated and the site is released for restricted or unrestricted use.

Subject to the requirements of 10 CFR 50.48(f)(3), a licensee may make changes to the fire protection program without prior NRC approval provided the changes do not reduce the effectiveness of fire protection for facilities, systems, and equipment that could result in a radiological hazard, taking into account the plant conditions and activities during decommissioning.

2. FIRE HAZARDS ANALYSIS

The fire hazards analysis provides a comprehensive evaluation of the facility's fire hazards, the fire protection capability relative to the identified hazards, and the ability to protect spent fuel and other radioactive materials from potential fire-induced releases. The fire hazards analysis in place for plant operation may be used as the baseline, but it should be reevaluated and revised as necessary to reflect the unique or different fire protection issues and strategies associated with decommissioning. At a minimum, the fire hazards analysis should address the following items.

2.1 Fire Hazards

The fire hazards should be identified specifically, typically by fire area. The fire hazards for a plant undergoing decommissioning may be significantly different from those for an operating plant, and they may change as decommissioning progresses. The fire hazards analysis should consider the potential for increased combustible loading from sources such as equipment lay down areas, waste accumulation and storage areas, and materials necessary to support decontamination and dismantlement activities. Hot work involving open flames or sparks is also likely to increase during decommissioning. Other fire hazards may include temporary structures and support systems (e.g., electrical, heating, and ventilation) that may impact the fire hazards in the plant.

2.2 Physical Plant Configuration and Condition

The fire hazards analysis should describe the layout, configuration, and condition of the plant fire areas and should be updated to reflect any significant changes that occur through the various decommissioning phases. Dismantlement of or modifications to facility structures and the deactivation, modification, or removal of plant systems may impact fire protection program elements.

2.3 Fire Protection Elements

The fire hazards analysis should describe the administrative controls, fire detection and suppression systems, smoke exhaust systems, fire barriers, and any other pertinent elements of the administrative and physical fire protection program that protect against the identified fire hazards.

2.4 Radiological Hazards and Systems Important to Safety

The fire hazards analysis should identify the radiological hazards by fire area and, as appropriate, identify the SSCs such as the plant ventilation systems necessary to prevent or mitigate the release of radioactive materials in the event of a fire. Consideration should be given to the control of runoff from fire suppression activities in areas containing radioactive materials. The onsite and offsite radioactive releases expected from a fire should be quantified or referenced in the fire hazards analysis and compared to the dose acceptance criteria in 10 CFR Part 20.

As decommissioning progresses, the radiological hazards may change as areas and structures are decontaminated, contaminated components are removed, the spent fuel storage configuration is changed (e.g., from pool to dry cask or the fuel removed to an ISFSI), and

contaminated waste accumulates (before being transported to an offsite storage facility). System configurations and requirements may also change with changing hazards and the general progression of decommissioning activities; significant changes should be reflected in the analysis.

2.4.1 Spent Fuel

The SSCs necessary to protect the spent fuel should be identified and may include the spent fuel storage enclosure and pool, spent fuel pool cooling and makeup systems, and any necessary support systems such as instrumentation and control, ventilation, and electrical power systems. The fire hazards analysis should describe the fire threats, the associated measures to protect the spent fuel, and any associated SSCs that are important to maintaining spent fuel integrity. Appendix B to this guide provides examples of the level of fire protection acceptable to the NRC staff for spent fuel areas.

2.4.2 Contaminated Plant Areas and Waste Storage

The fire hazards analysis should identify areas of the plant that contain significant radioactive contamination that might be released or spread by the effects of a fire. As the plant is decontaminated and dismantled, contaminated waste (including combustible and potentially contaminated plant equipment such as electrical cables) may accumulate. The fire hazards analysis should include an assessment of the potential for this material to be involved in a fire and of the protective measures provided to minimize the potential for fire-induced releases or spread of radioactive material. Appendix B to this guide contains an example of the level of fire protection acceptable to the staff for radioactive waste storage areas.

2.5 Exposure Risks from Co-Located Facilities

The fire hazards analysis should evaluate the risks of exposure associated with fires at the same site or at nearby facilities. Consideration should be given to the effects of a fire on shared systems for multi-unit sites and to the potential for fires to propagate from one facility to the other.

Decommissioning may require erecting temporary onsite structures for the storage of radioactive and other wastes generated by the decommissioning and dismantlement activities. The fire hazards associated with fires in these facilities should be analyzed in conjunction with the potential for such fires to propagate to other plant areas and result in radiological releases.

3. ADMINISTRATIVE CONTROLS

Administrative controls involve the policies, procedures, and practices that govern the performance or execution of fire protection program activities necessary to ensure that the fire protection objectives are met. These controls establish the necessary fire prevention measures and contain the requirements for maintenance, testing, inspection, and availability of physical fire protection features (e.g., barriers, detection, and suppression); organizational responsibilities; and the training or qualification requirements for general employees, emergency responders, and licensee contractors.

3.1 Organization

Licensees' decommissioning organizations are likely to be significantly smaller than those necessary for an operating plant. The fire protection program should identify and clearly establish the organizational responsibilities for management and implementation of the fire protection program. The fire protection responsibilities of licensee contractors should also be established.

Organizations or positions responsible for the following fire protection activities should be identified:

- Management of the overall fire protection program,
- Development, maintenance, updating, and verification of compliance of the fire protection program,
- Implementation of fire protection program requirements (including policies and procedures, training, fire protection system controls, system inspection, testing, maintenance and design, control of combustibles, and hot work),
- The leadership, staffing, and training of the emergency response team (e.g., fire brigade) and agreements with offsite responders.

The organizations responsible for implementing the fire protection program should include an individual (or individuals), adequately qualified in nuclear safety and fire protection engineering, who will ensure that the fire protection program is implemented in accordance with applicable industry standards and NRC regulations.

3.2 Fire Protection Procedures

Procedures should be provided to formally establish the organizational responsibilities and administrative practices of the fire protection program.

Emergency procedures should be provided to describe emergency response actions, including the operational actions (e.g., ventilation system lineups and operational requirements), necessary to mitigate the consequences of fires. Fire pre-plans should identify the fire fighting strategy to be employed according to the fire location and the hazards involved. Coordination with offsite responders and the fire response leadership and command structure for both the onsite fire brigade and offsite responders should be explained.

The activities associated with decommissioning and dismantling a plant result in constantly changing hazards. Maintaining adequate fire protection and safety in this changing environment requires constant vigilance on the part of the fire protection staff, plant personnel, and decommissioning contractors. For this reason, the fire protection program should be integrated with the work control processes and should provide for proper review and authorization of work activities involving fire hazards or fire system maintenance, testing, impairments, or deactivation.

3.3 Training

Training is necessary to ensure that the licensee's employees, contractors, and emergency responders have the necessary knowledge and skills to properly execute their responsibilities regarding the fire protection program.

3.3.1 General

Plant personnel and contractor employees should be informed of the proper procedures for reporting a fire, responding to plant fire alarms, preventing fires at the plant, locating and using fire extinguishers, and of the hazards of incipient-stage fire fighting. Personnel who are designated to use a fire extinguisher as part of an emergency action plan should receive training in the appropriate use of the available equipment. Additional guidance and information is provided in NFPA 1, "Fire Prevention Code."

3.3.2 Fire Watch

Fire watch personnel for buildings and hot work operations should be informed of their specific duties and responsibilities. Fire watch personnel should be trained in the use of fire extinguishers and should practice on training fires. Additional information and guidance is given in Chapter 34, "Welding, Cutting, and Use of Torches," and Chapter 41, "Safeguarding Building Construction and Demolition Operations," of NFPA 1 and in Chapter 3, "Fire Prevention Precautions," of NFPA 51B, "Standard for Fire Prevention in Use of Cutting and Welding Processes."

3.3.3 Fire Brigade and Offsite Support

Plant personnel who are assigned manual fire fighting responsibilities should receive training commensurate with their responsibilities. Fire brigade members and responding offsite emergency services personnel should receive training on facility layout, fire hazards, fire pre-plans, fire fighting equipment, radiation hazards, and health physics relevant to fire fighting operations. Periodic drills should be conducted to determine the readiness and capability of fire brigade personnel and offsite responders. The plant training program should be described in writing, and written records of all plant fire brigade training should be maintained. Fire protection standards NFPA 600, "Standard on Industrial Fire Brigades," NFPA 801, "Standard for Facilities Handling Radioactive Materials," and NFPA 1500, "Fire Department Occupational Safety and Health Program," provide information and guidance on training for fire suppression personnel.

3.4 Control of Combustible Materials

Combustible materials, including flammable and combustible liquids, compressed gases, construction materials, and refuse, should be used, stored, and disposed of in a manner that minimizes the occurrence of fire. Chapter 3-11, "Combustible Waste and Refuse," and Part V, "Special Processes and Material Handling," of NFPA 1 and Chapter 3, "Processes and Hazards," of NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations," provide information and guidance on the control of combustible materials. NFPA 30, "Flammable and Combustible Liquids Code," and NFPA 55, "Use and Handling of Compressed and Liquefied Gases in Portable Cylinders," provide information and guidance on the handling, storage, and use of flammable and combustible liquids and gases.

3.4.1 Transient Combustibles

Transient fire hazards associated with decommissioning activities should be minimized to the extent possible, and they should be removed promptly upon completion of the activities. In particular:

- The quantity of transient combustible materials should not exceed actual needs and should be separated from ignition sources. Accumulation and storage of combustible wastes should be minimized.

- Wood should not be used for permanent applications in plant areas with a potential for a radiological release. The use of wood for temporary purposes should be minimized and, if used, the wood should be listed as pressure impregnated fire retardant lumber.

- The use of plastic sheeting should be minimized and, if used, the plastic sheeting should be fire retardant. NFPA 701, "Standard Methods of Fire Tests for Flame-Resistant Textiles and Films," provides additional guidance.

- Combustible waste materials that are radioactively contaminated or that present a fire risk to radioactive material should be handled, packaged, and stored in a manner that minimizes the threat of fire. Such waste materials should be protected by an active fire suppression system or fire barriers or by limiting quantities.

- Oily rags and materials susceptible to spontaneous ignition should be stored in a listed disposal container and should be removed daily from areas containing radioactive materials or contamination.

- Good housekeeping practices should be maintained, with particular attention to areas containing radioactive materials or contaminated waste and equipment. Accumulations of combustible material, including waste and debris, should be removed from the work location at the end of each shift. Spills of combustible or flammable liquids should be contained and cleaned up immediately, with appropriate consideration for the safety of personnel. The cleaning materials and waste should be removed from the area daily and disposed of appropriately. General housekeeping practices should be implemented to remove trash and clutter and to maintain clear access and egress routes throughout the plant.

3.4.2 Storage of Flammable and Combustible Liquids and Gases

Flammable and combustible liquids and flammable compressed gases should be stored where they do not present a fire risk to areas containing radioactive materials, contamination, or SSCs important to the prevention or mitigation of radioactive material releases. Refer to NFPA 30 and NFPA 55 for additional information and guidance.

Smoking and working with open flame should not be permitted in areas used for the storage of flammable and combustible liquids or compressed gases.

3.5 Control of Ignition Sources

3.5.1 Control of Hot Work

Cutting, welding, grinding, and work involving open flame should be controlled so that it does not present an undue risk of fire. Chapter 34, "Welding, Cutting, and Use of Torches," of NFPA 1, NFPA 51B, and NFPA 241 provide information and guidance for minimizing the risk of fires from hot work. A qualified fire watch should be provided during the hot work activity and for at least one-half hour after completion of the hot work.

3.5.2 Control of Temporary or Portable Heat-Producing Equipment

The fire protection program should identify the measures necessary to prevent portable heat-producing equipment from causing a fire. Listed heat-producing equipment should be used. Temporary heating devices should be secured to prevent tip-over and separated from combustible materials, equipment, and construction in accordance with their listing. For fuel-fired heating, the fuel storage, transfer and refueling systems, and operations should be in accordance with applicable NFPA standards. The use of portable heat-producing equipment should be controlled in areas with radiological hazards or significant quantities of combustible material that presents an exposure hazard to radioactive materials or systems important to safety. Additional guidance and information is contained in Chapter 41 of NFPA 1 and in Chapter 3 of NFPA 241.

3.5.3 Control of Smoking

Smoking should be permitted only in designated areas. Where smoking is permitted, safe receptacles for smoking materials should be provided. Smoking should be prohibited in other areas of the plant, specifically in the vicinity of hazardous operations or combustible or flammable materials. No Smoking signs should be posted in these areas.

3.6 Control of Fire Protection Systems and Equipment

3.6.1 Control of Fire Protection Equipment

Personnel protective equipment for fire brigades, including turnout gear and self-contained breathing apparatus, should regularly be inventoried, inspected, tested, and maintained to ensure proper performance.

Manual fire fighting equipment, including extinguishers, hoses, nozzles, tools, fittings, portable lighting, and communication and ventilation devices, should be regularly inventoried, inspected, tested, and maintained to ensure proper operation in the event of a fire.

3.6.2 Fire Protection System and Features Operability, Inspection, Testing, and Maintenance

A program for inspection, testing, and maintenance should be provided to verify the operability of installed fire protection systems and features. Fire protection features include passive fire protection systems such as fire barrier components and fire barrier seals. Fire protection systems include fire alarm systems, fire suppression systems, and fire water supply systems. The program for inspection, testing, and maintenance should be based on vendor recommendations, insurance standards, or fire protection engineering judgment, as well as on criteria specified in industry codes and standards such as those published by the NFPA.

Inspection, testing, and maintenance should be documented by means of written procedures, with results and follow up actions recorded.

Personnel performing inspection, testing, and maintenance of installed fire protection systems and features should be trained and qualified for the type of system to which they are assigned.

3.6.3 Control of Fire Protection System Outages and Impairments

The fire protection program should provide the necessary controls to minimize the duration and impact of impairments to the fire protection systems. Additional guidance and information is provided in Chapter 11, "Impairments," of NFPA 25, "Standard for the Inspections, Testing, and Maintenance of Water-Based Fire Protection Systems." The controls should provide for identifying, prioritizing, and promptly correcting fire protection impairments, informing fire protection staff of the impairment, and establishing compensatory measures for the duration of the impairment. Compensatory measures may include, but are not limited to, conducting fire watch tours of affected areas, limiting work activities involving fire hazards, providing alternative fire protection features, and requesting special fire department support.

Work control practices during decommissioning should avoid scheduling activities that involve hot work, the use of flammable or combustible materials, or other fire hazards in areas with impaired fire protection systems.

3.6.4 Control of Fire Area Boundaries or Barriers

The fire protection program should address the control of fire area boundaries or barriers and the maintenance of these structures as the facility is modified or dismantled during decommissioning. Breaches in the fire barriers, caused by the removal of penetration seals or other modifications, should be protected in accordance with the modified barrier's fire resistance capability and the associated fire hazards. A program for inspecting, testing, and maintaining fire doors, fire dampers, and fire walls or separations should be developed and implemented to ensure these devices will perform as intended. The barrier control program should allow for redesignation, modification, or removal of barriers, based on changes to the facility and hazards (i.e., fire and radiological) as the facility is decommissioned. NFPA 221, "Standard for Fire Walls and Fire Barrier Walls," contains additional information and guidance.

3.7 Control of Structures, Enclosures, and External Areas

3.7.1 Control of Temporary Enclosures and Structures

The fire protection program should address fire hazards created by the construction and location of temporary enclosures and structures. The fire protection program should evaluate the need for automatic or manual fire suppression capability inside and outside each temporary structure. The use of combustible construction materials should be minimized and controlled in accordance with Regulatory Position 3.4, "Control of Combustible Materials," of this guide. Chapter 2, "Temporary Construction, Equipment and Storage," of NFPA 241 provides additional information and guidance for controlling the fire hazards associated with temporary structures.

Temporary structures should not present a fire exposure hazard to plant structures containing radioactive materials or radioactive contamination, or to contaminated waste material accumulation or storage areas. NFPA 80A, "Recommended Practice for Protection of Buildings From Exterior Fire Exposures," provides guidance for the appropriate separation of structures to minimize the fire exposure.

Tents or other membrane-type structures should be constructed of noncombustible, fire-retardant material. Membrane-type materials should be certified as conforming to the requirements of the large-scale test described in NFPA 701.

3.7.2 Preventing Fire From Exposing Structures and Materials

The fire protection program should identify controls to protect structures containing radioactive materials from an exposure fire. The fire hazard presented by transient combustibles, including stored materials, debris, vegetation, and nearby or contiguous structures, should be considered. Additional information can be found in NFPA 80A.

4. PHYSICAL FIRE PROTECTION FEATURES

The ability to rapidly detect, control, and suppress fires is one of the primary defense-in-depth objectives of the fire protection program. The need for physical protection features is governed by the plant's fire hazards and by the potential of these hazards to result in the release or spread of radioactive materials.

4.1 Fire Detection and Alarms Systems

Detection systems in operating reactor facilities are generally placed in locations where fire hazards present an exposure threat to safety-related equipment. Alarm systems are provided to alert plant staff in the event of a detected fire or operation of an automatic suppression system. During decommissioning, the fire hazards and the associated detection and alarm requirements may change significantly. The change in priorities from protecting safety-related equipment required for safe shutdown to protecting against the release or spread of radioactive material may require reevaluation of the detection and alarm system design to ensure that decommissioning fire hazards are adequately protected.

Fire alarm and supervisory signals should be annunciated in a constantly attended location. The fire alarm system should provide a signaling system for notifying plant personnel. Refer to NFPA 72, "National Fire Alarm Code." The fire alarm system should meet the following criteria.

- The operation of an automatic fire suppression system initiates a fire alarm.
- Automatic fire detection systems using smoke, heat, or flame detectors, as appropriate, are maintained for early detection of fires.
- Supervision of automatic fire suppression system control functions maintained, as appropriate, by the alarm system.

4.2 Fire Barriers

4.2.1 Designating Fire Areas

Fire areas are established to prevent or restrict the propagation of fires from one area of a facility to another, to protect personnel, and to limit the consequences of a fire. For operating reactors, fire area boundaries are generally based on the need to separate and protect safe shutdown systems. Based on a fire hazards analysis, fire areas may be redesignated to address the unique hazards and protection requirements of the decommissioning process. The designation of fire areas should be based on consideration of the hazards present; the potential for a fire in a given area to result in an unacceptable release of radioactive materials; the ability to effectively contain, fight, and control the fire using manual suppression; and the ability of personnel to safely evacuate the plant.

4.2.2 Fire Barrier Requirements

Fire areas should be separated by fire-rated barriers. The fire resistance rating of a fire barrier should be commensurate with the potential fire severity in each fire area. The components of fire barriers are walls, ceilings, and floors, along with structural supports such as beams, joists, and columns. Openings in a fire barrier should be sealed by the installation of fire dampers, fire door assemblies, fire window assemblies, fire-rated penetration seals, and special floor drains. Fire barrier components and seals should be qualified by testing. The design and installation of fire barriers should be based on the applicable guidance in NFPA 80, "Standard for Fire Doors and Fire Windows," NFPA 221, and NFPA 801. Any unprotected openings in a fire barrier should be identified and justified in the Fire Hazards Analysis.

4.3 Fire Suppression Systems

4.3.1 Fire Water Supply

During decommissioning, the plant fire water supply system should be maintained, and the system should be capable of providing the maximum water flow needed to supply automatic fire suppression systems and manual fire fighting. The system should be capable of delivering the maximum water flow demand for a minimum of 2 hours. The following factors should be considered in determining the adequacy of the water supply:

- Reliability of the water supply source
- Availability of tanks or other water sources, pumps, fire hydrants, and distribution system
- Adequate flow and pressure to meet water flow demands of automatic or manual fire suppression, or both, at the point of delivery
- Capacity of the water supply source and distribution system. If the water system is a combined domestic, process, and fire system, the system should be capable of supplying the maximum daily consumption or the peak hourly flow rate, whichever is higher, plus the maximum required fire flow.

Decommissioning activities may result in the isolation, removal, or abandonment of portions of the distribution system. Any system changes should be reviewed to ensure that adequate flow and coverage is provided for the remaining plant areas that contain radioactive

materials, present a fire exposure threat to areas containing radioactive materials, or include systems necessary to mitigate the release of radioactive materials.

Where temperatures cannot reliably be maintained at or above 4°C (40°F), water-based fire suppression system components should be protected against freezing in accordance with the applicable NFPA code. Freeze protection for sprinkler system components should be reviewed regularly during decommissioning activities.

Decommissioning activities should not be allowed to affect the water supply to the operating units or the fire water supplies and distribution systems that are shared at multi-unit sites, and the capability to isolate the units should be maintained.

The design and installation of the water supply systems should be based on the applicable guidance in NFPA 20, "Standard for the Installation of Centrifugal Fire Pumps"; NFPA 22, "Standard for Water Tanks for Private Fire Protection"; NFPA 24, "Standard for the Installation of Private Fire Service Mains and their Appurtenances"; and NFPA 801.

4.3.2 Automatic Fire Suppression Systems

Automatic fire suppression systems that exist when a plant enters the decommissioning phase should be maintained operable based on the fire hazards analysis; these systems should be able to protect plant egress routes for evacuation of plant personnel in the event of a fire.

Automatic fire suppression systems should be provided where flammable or combustible materials are used or stored. Construction of new or temporary structures to support decommissioning may require the installation of automatic systems based on the fire and radiological hazards of the structures. Some factors to consider in selecting the type of suppression system to be installed are the types of fire hazards and health hazards, cleanup of the suppression agent, and the effect of the suppression agent on vital systems, structures, and components in the area. NFPA 11, "Standard for Low-Expansion Foam"; NFPA 11A, "Standard for Medium- and High-Expansion Foam Systems"; NFPA 12, "Standard on Carbon Dioxide Extinguishing Systems"; NFPA 12A, "Halon 1301 Fire Extinguishing Systems"; NFPA 13, "Installation of Sprinkler Systems"; NFPA 15, "Standard for Water Spray Fixed Systems for Fire Protection"; NFPA 16, "Standard for the Installation of Deluge Foam-Water Sprinkler, and Foam-Water Spray Systems"; NFPA 16A, "Standard for the Installation of Closed-Head Foam-Water Sprinkler Systems"; NFPA 17, "Standard for Dry Chemical Extinguishing Systems"; NFPA 17A, "Standard for Wet Chemical Extinguishing Systems"; and NFPA 75, "Standard for the Protection of Electronic Computer/Data Processing Equipment," should be used as the bases for the design, installation, and operation of automatic fire protection systems.

The need for automatic fire protection systems in plant areas during decommissioning activities may change, depending on the type of operations being performed in an area, the addition or removal of combustible materials, or the removal of radioactive materials and contamination. Plant areas should be reviewed for changing conditions that could affect the need for automatic fire suppression systems.

4.3.3 Manual Fire Suppression Systems

Manual fire suppression systems should be provided in the plant to supplement automatic fire protection systems and to provide suppression coverage to areas not protected by automatic systems. Decommissioning activities may change the plant configuration and fire hazards, may require the construction of temporary enclosures or structures, and may necessitate the abandonment or removal of automatic systems as facilities are dismantled or modified and radiological hazards are removed. Adequate manual fire suppression capability must be provided or maintained based on the decommissioning fire hazards analysis to ensure protection against fire-induced radioactive material releases.

The following considerations are important in evaluating the manual fire protection systems:

- Standpipe and hose systems should be maintained to provide manual fire suppression capabilities. Standpipe and hose systems should be maintained in areas of the plant that are above or below grade, that require long hose lays from the nearest hydrant, or that are required to maintain the confinement of airborne radioactive materials. Refer to NFPA 14, "Standard for the Installation of Standpipe and Hose Systems."

- Manually operated fire suppression systems may be provided to supplement automatic fire suppression systems or in areas where automatic fire suppression systems are not installed and are not needed to rapidly control a fire. The need for manually operated fire suppression systems should be based on consideration of the hazards present; the potential that a fire in a given area could result in release of radioactive materials; the ability to effectively contain, fight, and control the fire using manual suppression; and the ability of personnel to safely evacuate the area.

- Outside hydrants and hose houses should be maintained to support manual fire suppression of internal fires and to provide protection from the threat of external exposure fires to those plant areas that contain radioactive materials or SSCs necessary for the prevention or mitigation of radioactive material releases. Refer to NFPA 24 for additional information and guidance.

4.3.4 Onsite Fire Brigade and Offsite Fire Emergency Response

Manual fire fighting capability should be provided by an onsite fire brigade or by offsite emergency services, or by both. A fire emergency plan should be developed describing the response to fire alarms and the responsibilities assigned to emergency response personnel (see Regulatory Positions 3.1, 3.2, 3.3, and 5.2). Refer to NFPA 600, NFPA 801, and NFPA 1500 for information and guidance on fire fighting activities, training, equipment, and fire emergency plans. The following factors should be considered in determining the manual fire fighting capability:

- The magnitude and complexity of potential fires in and around plant areas where radioactive materials or contamination are present
- The availability of onsite staffing for a fire brigade at any time
- The availability of offsite emergency services, the capability of their staff and equipment, the response time, the staff’s training, and access to the plant site

- The compatibility of the plant's fire system connections and fittings with the fire apparatus and equipment of offsite responders.

Fire fighting equipment should be provided for manual fire fighting, including hoses, nozzles, protective clothing, breathing apparatus, communications equipment, salvage equipment, ladders, smoke removal equipment, portable lighting, portable radiation monitoring equipment, extinguishers, and miscellaneous tools. (See Regulatory Position 3.6.1.)

Periodic drills and exercises should be performed by the onsite fire brigade and offsite emergency services. See Regulatory Position 3.3.3 regarding the training of the fire brigade and offsite personnel.

5. RISK MANAGEMENT

5.1 Personnel Safety

The fire protection program should provide for personnel safety in the event of a fire. Egress and evacuation routes should be clearly established and maintained as the plant configuration changes. The effect of smoke on exiting personnel should be considered. Emergency lighting and alarms should be provided, and personnel should be appropriately trained in fire response. Policies and procedures should establish radiological control and security practices to be implemented under emergency fire evacuation scenarios. NFPA 101, "Code for Safety to Life from Fire in Buildings and Structures," provides additional information and guidance on ensuring personnel safety.

5.2 Emergency Response

For operating reactors, early detection and application of manual suppression can be critical in minimizing the fire damage to safe shutdown systems that are necessary to prevent damage to the reactor core and subsequent releases of radioactive material. When a reactor is permanently shutdown and the spent fuel is stored in the spent fuel pool or dry cask storage, fire suppression response times may not be as critical. The necessary fire emergency response capability should be determined by the fire hazards and the potential for those hazards to involve radioactive material.

The fire protection program should identify the responsibilities of the licensee's organization and of offsite responders in the event of a fire emergency. Although an adequately prepared, trained, and equipped plant fire brigade may suppress small fires and provide the initial assault on and control of larger fires, a fully equipped fire service should be the primary force in the manual suppression of large structure or site-area fires. This fire service may be provided by offsite agencies provided the offsite responders have the necessary qualifications and capabilities, as described in Regulatory Positions 3.1, 3.2, 3.3, and 4.3.4. If the licensee maintains an onsite fire brigade, the assignment of personnel to the brigade should not impair the ability of the remaining plant staff to respond to the event and maintain plant functions such as security, radiation control, and operations.

The event management and command structure should be clearly established, including the fire attack roles and responsibilities of the onsite brigade and offsite responders. Security control and radiation dosimetry requirements for offsite emergency responders should be clearly established and should not delay the response.

D. IMPLEMENTATION

The purpose of this section is to inform licensees and applicants of the NRC staff's plans for using this regulatory guide.

Except when the applicant or licensee proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods described in this guide will be used in evaluating submittals for licensing-basis documents and periodic revisions or updates to the decommissioning fire protection program that is submitted in accordance with the required updates to the final safety analysis report.

REFERENCES

The following is a list of the National Fire Protection Association (NFPA) standards referenced in this regulatory guide. The existing fire protection program for a given plant may include additional NFPA and industry standards. Continued compliance with existing program standards should be reviewed with due consideration of existing license commitments and conditions, and the fire protection design basis of the specific plant. NFPA standards may be purchased from the National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9146, Quincy, MA 02269-9959 (telephone 1-800-344-3555).

NFPA 1, "Fire Prevention Code."

NFPA 11, "Standard for Low-Expansion Foam."

NFPA 11A, "Standard for Medium- and High-Expansion Foam Systems."

NFPA 12, "Standard on Carbon Dioxide Extinguishing Systems."

NFPA 12A, "Halon 1301 Fire Extinguishing Systems."

NFPA 13, "Installation of 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 Deluge Foam-Water Sprinkler, and Foam-Water Spray Systems."

NFPA 16A, "Standard for the Installation of Closed-Head Foam-Water Sprinkler Systems."

NFPA 17, "Standard for Dry Chemical Extinguishing Systems."

NFPA 17A, "Standard for Wet Chemical Extinguishing Systems."

NFPA 20, "Standard for the Installation of Centrifugal Fire Pumps."

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 51B, "Standard for Fire Prevention in Use of Cutting and Welding Processes."

NFPA 55, "Use and Handling of Compressed and Liquefied Gases in Portable Cylinders."

NFPA 72, "National Fire Alarm Code."

NFPA 75, "Standard for the Protection of Electronic Computer/Data Processing Equipment."

NFPA 80, "Standard for Fire Doors and Fire Windows."

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

NFPA 101, "Code for Safety to Life from Fire in Buildings and Structures."

NFPA 221, "Standard for Fire Walls and Fire Barrier Walls."

NFPA 241, "Standard for Safeguarding Construction, Alteration, and Demolition Operations."

NFPA 600, "Standard on Industrial Fire Brigades."

NFPA 701, "Standard Methods of Fire Tests for Flame-Resistant Textiles and Films."

NFPA 801, "Standard for Facilities Handling Radioactive Materials."

NFPA 1500, "Fire Department Occupational Safety and Health Program."

APPENDIX A

GLOSSARY

The following definitions have been taken from existing regulatory documents and industry fire protection standards when possible. When published definitions were not available, the staff defined the terms.

Abandonment. Permanently ceasing the use, operation, and maintenance of a structure, system, or component through deactivation and isolation without intent to return the structure, system, or component to service.

Co-located facilities. Facilities that share a common site with the nuclear power plant, including any temporary structures.

Combustible material. Any material that will burn or sustain the combustion process when ignited or exposed to fire conditions.

Contamination. Fixed or loose residual radioactive material deposited inside or outside structures, systems, and components where it presents a potential radiological hazard.

Deactivation. Shutting down or otherwise idling plant systems and components to prevent their operation, particularly in preparation for abandonment or removal.

Decommissioning. Safely removing a facility or site from service and reducing residual radioactivity to a level that permits releasing the property for unrestricted use and terminating the license or releasing the property under restricted conditions and terminating the license.

Dismantlement. Physically disassembling and removing plant structures, systems, and components.

Emergency responders. Organizations and individuals who respond to plant emergency events (including licensee emergency management and response staff, security personnel, and fire brigades) and offsite responders (including law enforcement officials, medical personnel, and fire departments).

Fire apparatus. A vehicle specifically designed to respond to fire events and provided with fire fighting tools, equipment, and fire suppression capability.

Fire area. A part of a structure that is separated from other areas by fire barriers.

Fire barrier. Construction components (e.g., walls, floors, and ceilings, and their supports, such as beams, joists, and columns; penetration seals; fire doors; and fire dampers) that are used to prevent the spread of fire and that are rated by approving laboratories in hours of fire resistance.

Fire brigade. A team of onsite plant personnel who have been specifically assigned the responsibility for fire fighting and who are adequately equipped for and trained in fighting fires.

Fire exposure hazard. A fire hazard that is external to a structure, system, or component in or adjacent to the same area. The exposure to fire effects (e.g., smoke, heat, ignition) may impact the capabilities of adjacent structures, systems, and components to prevent or mitigate the release of radioactive material.

Fire hazard. Conditions necessary to initiate and support combustion, including in situ or transient combustible materials, ignition sources (e.g., heat, sparks, open flames), and an oxygen environment.

Fire-retardant material. Material that has been coated or treated with chemicals, paints, or other materials designed to reduce the combustibility of the material.

Fire risk. The combination of the probability of a fire event and the estimated consequences of the event.

Fire watch. One or more persons responsible for providing additional coverage (e.g., during hot work) or compensatory coverage (e.g., for system impairments) of plant activities or areas for the purpose of detecting fires or identifying activities and conditions that present a potential fire hazard. The person or persons should be trained in identifying conditions or activities that present potential fire hazards and in the use of fire extinguishers and the proper fire notification procedures.

Hot work. Activities (such as cutting, welding, and grinding) that involve the use of heat, sparks, or open flame and that are typically controlled by a formalized work permit system controlled or reviewed by a fire protection engineer.

Impairment. Degradation of a fire protection system that decreases the ability of the system to perform its intended functions.

Independent spent fuel storage installation (ISFSI). A facility designed and constructed for the interim storage of spent nuclear fuel and other radioactive materials associated with spent fuel storage.

Lay down areas. Areas used for the temporary staging of materials before their use or disposal.

Listed. Equipment or materials on a list published by a nationally recognized testing laboratory, inspection agency, or some other product evaluation organization that periodically inspects production of the listed equipment or materials. The listing states that the equipment or materials meet nationally recognized standards and have been tested and found suitable for use in a specified manner.

Monitored storage. The operations and conditions associated with a permanently shutdown plant that has no fuel in the reactor and for which decommissioning has been deferred to the future.

Noncombustible material. A material which, in the form it is used and under anticipated conditions, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Also a material with a structural base of noncombustible material, as defined above, with a surfacing not over 1/8 inch thick, that has a flame-spread rating not higher than 50 when measured using ASTM E-84 (1997), "Standard Test Method for Surface Burning Characteristics of Building Materials."[1]

Performance-based approach. A method of implementation based on measurable performance goals and objectives.

Permanently ceased operations. Operations have permanently ceased when a licensee certifies to the NRC that it has permanently ceased or will permanently cease reactor operations, or a final legally effective order to permanently cease operations has come into effect.

Permanent fuel removal. Fuel has been permanently removed when all fuel assemblies have been removed from the reactor vessel and the licensee has certified to the NRC that it has permanently removed all fuel assemblies from the reactor vessel.

Pre-plan. A document that describes the facility layout, access, contents, construction, hazards, hazardous materials, types and locations of fire protection systems, and other information important to the planning of emergency fire response.

Radiological hazard. The presence of radioactive material, including sources, contamination, wastes, and spent fuel, that presents a radiological exposure hazard that may be released in the event of a fire and that is in excess of the dose limits to plant personnel specified in 10 CFR Part 20.

Safe shutdown. For fire events, the sequence of plant conditions specified in the plant technical specifications as hot standby, hot shutdown, or cold shutdown.

Spent fuel. Reactor fuel assemblies that have been irradiated in the reactor core.

Standards of record. The standards, including specific editions, that constitute the licensing or design basis for the plant.

Structures, systems, and components (SSCs). Structural elements, plant systems, and components whose function is to prevent or mitigate the release of radioactive materials in the event of a fire, including physical confinement barriers (building walls, floors, ceilings), ventilation systems, spent fuel cooling systems and support systems, and waste storage containers.

Temporary structures. Buildings, tents, shelters, platforms, and other structures that are erected during decommissioning activities. They are not permanent site facilities.

[1] ASTM E-84 is available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

Turnout gear. Protective clothing for fire fighting such as coats, pants, boots, helmets, gloves, and self-contained breathing apparatus (SCBAs).

Transient combustibles. Combustible materials that are not fixed in place or an integral part of an operating system or component.

Unrestricted use. Areas in which the licensee neither limits nor controls access by the general public and to which the public exposure requirements of 10 CFR Part 20 apply.

APPENDIX B

EXAMPLES OF FIRE PROTECTION FOR SELECTED FIRE AREAS, STRUCTURES, SYSTEMS, AND COMPONENTS

The following examples describe acceptable fire protection for selected plant areas that may contain radiological hazards. These examples are generic and do not encompass all possible radiological and fire hazards for a plant undergoing decommissioning. These examples are provided for guidance and information and are not NRC requirements.

Spent Fuel Pool Area

The fire hazards in the spent fuel pool area and those in adjacent areas should be quantified if they present an exposure hazard or could propagate to the spent fuel pool area. The potential for these fire hazards to impact radioactive materials, including the spent fuel, should be evaluated.

The radiological hazards in the area should be quantified, including hazards of the spent fuel and any radioactive waste or contamination that may contribute to a radiological release if exposed to fire. Potential releases of radioactive materials should be quantified by a conservative analysis of the fire-related source term, the capabilities of mitigating systems, and emergency response actions. Exposures resulting from the fire-induced release of radioactive materials should not exceed the limits of 10 CFR Part 20.

Structures, systems, and components (SSCs) that are necessary to provide protection of the spent fuel and mitigate any radiological release should be evaluated and protected from the effects of fire, as appropriate. These systems may include building ventilation, spent fuel pool cooling and makeup, instrumentation and controls, and electrical power. Rated fire barriers should be maintained that provide separation between significant fire hazards and SSCs important to the safe operation of the spent fuel pool. Where adequate separation cannot be provided, the use or storage of combustible materials should be minimized and controlled.

If a fire in the spent fuel pool area could result in a loss of the normal spent fuel pool cooling and makeup systems or a rapid loss of pool inventory, the capability to maintain spent fuel integrity and minimize the potential for radiological release should be evaluated and alternative cooling and makeup capabilities should be provided. The response time for reestablishing cooling and makeup capability for the spent fuel pool should be quantified according to the need to ensure that fuel integrity is maintained and radiological exposure limits for emergency response personnel, including fire-fighters, are not exceeded.

Procedures should be developed that describe equipment configurations and necessary operator actions in response to a fire in the spent fuel pool area. For example, ventilation systems and any other building openings such as access doors should be configured to confine radioactive materials and minimize the potential for their release to the environment. Spent fuel cooling and makeup system components may have to be de-energized or operated from outside the fire area if electrical and control systems are subject to potential fire damage.

Administrative controls for housekeeping, transient combustibles, and hot work in the spent fuel area should be established by procedures. The work control procedures should ensure that decommissioning activities associated with spent fuel pool operations and maintenance, including any fuel movement or handling operations such as cask loading and shipment, are subject to appropriate fire protection reviews.

Smoke detection and fire suppression capability for the spent fuel pool area should be provided. Fire alarms and emergency lighting for personnel evacuation should be provided. As a minimum, manual suppression capability should be available from portable fire extinguishers and stand pipes or hose stations, or both. Manual fire suppression systems should provide adequate coverage according to the fire hazards, evacuation routes, and fire attack strategies. Water supplies should be sufficient to meet suppression system demands.

Fire pre-plans should be developed for the spent fuel pool area that identify the area layout, access and egress points, type and location of suppression systems, significant fire hazards, radioactive and toxic material hazards, and SSCs important to the prevention or mitigation of releases of radioactive material that should be protected from the effects of fires. Onsite fire brigades and offsite responders should be adequately trained and drilled on the pre-plans and general fire attack strategy for the spent fuel pool area.

Radioactive Waste Storage and Accumulation Areas, Including Temporary Structures

Specific plant areas or separate structures should be provided for the storage of radioactive wastes. Waste accumulation areas within the plant may be necessary to support certain decommissioning activities. Combustible waste should be moved daily from accumulation areas to designated storage areas. The waste storage and accumulation areas should provide adequate separation and protection of the waste from exposure fire hazards. Temporary structures provided for interim waste storage should comply with the appropriate fire codes and should be designed to prevent or minimize the potential for radioactive material releases in the event of a fire.

The fire hazards in the radioactive waste storage and accumulation areas and fire exposure hazards in adjacent areas that could propagate to the waste storage and accumulation areas should be quantified. The potential for fire hazards to impact radioactive materials should be evaluated. Special hazards such as contaminated electrical cables and plastics that, if ignited, can be difficult to suppress and can emit considerable quantities of acrid smoke and toxic gases and hamper fire fighting and evacuation efforts should be evaluated. Confinement measures should be provided as necessary to mitigate release of radioactive materials entrained in the smoke and gases.

Conservative estimates of the radioactive material content for stored wastes should be established, to the extent possible, based on standard survey and measurement requirements. These estimates, combined with any contamination in the area, should be used as the basis for estimating potential radioactive material releases in the event of a fire. Potential releases of radioactive materials should be quantified by conservative analyses of the fire-related source term, the capabilities of mitigating systems, and emergency response actions. Exposures resulting from the fire-induced release of radioactive materials must not exceed the limits in 10 CFR Part 20.

Radioactive waste storage areas within existing plant structures should provide adequate fire protection to minimize the potential for fire and the subsequent release of radioactive materials. SSCs necessary to protect radioactive waste and mitigate any radiological release should be evaluated and protected from the effects of fire, as appropriate. These SSCs include structures that provide separation and confinement, building ventilation, instrumentation and controls, and electrical power. Rated fire barriers should be maintained that separate significant fire hazards, the waste storage and accumulation areas, and SSCs important to the safe storage of the contaminated waste materials. Where adequate separation cannot be provided, the use and storage of combustible materials should be minimized and controlled.

Temporary structures used for radioactive waste storage areas should be constructed with noncombustible materials to the extent possible. Radioactive waste packaging should be fabricated of noncombustible or fire-retardant materials. Activities and equipment that are a potential ignition source should be prohibited or strictly controlled within waste storage areas.

Smoke detection and fire suppression capability should be provided for areas in which radioactive waste materials will be accumulated or stored. Fire alarms and emergency lighting for personnel evacuation should be provided. As a minimum, manual suppression capability, including portable fire extinguishers, should be available. Confinement measures should be provided to control potentially contaminated runoff from automatic or manual fire suppression, including inadvertently actuated automatic systems. For temporary structures, automatic or manual fire suppression or both should be provided according to the fire hazards and the need to maintain adequate confinement to prevent or minimize the potential release of radioactive materials. Automatic and manual fire suppression systems should provide adequate coverage according to the fire hazards, evacuation routes, and fire attack strategies. Water supplies should be sufficient to meet automatic (if applicable) and manual suppression system demands.

Administrative controls for housekeeping, transient combustibles, and hot work in radioactive waste storage and accumulation areas should be established by procedures. Noncombustible or fire-resistant materials should be used for packaging radioactive waste materials. The work control procedures should ensure that decommissioning activities associated with the removal and storage of radioactive waste, including packaging and shipment of radioactive materials, are subject to appropriate fire protection reviews.

Procedures that describe necessary actions in response to a fire in the radioactive waste storage and accumulation areas should be developed. For example, ventilation systems and any other building openings such as access doors should be configured to confine and minimize the potential for a release of radioactive materials to the environment. Consideration should be given to the waste storage area layout and the availability of stand pipes (i.e., to avoid hose lays through doors) to allow fire fighting activities and at the same time maintain adequate confinement.

Fire pre-plans should be developed for the radioactive waste storage and accumulation areas. The pre-plans should identify the area layout, access and egress points, type and location of suppression systems, radiological hazards, and SSCs important to the prevention or mitigation of releases of radioactive material that should be protected from the effects of fires. Onsite fire brigades and offsite responders should be adequately trained and drilled on the pre-plans and general fire attack strategy for the radioactive waste storage and accumulation areas.

REGULATORY ANALYSIS

A separate regulatory analysis was not prepared for this regulatory guide. The regulatory basis for this guide is the regulatory analysis prepared for the amendments to Parts 2, 50, and 51, "Decommissioning of Nuclear Power Reactors," issued on July 29, 1996 (61 FR 39278), which examines the costs and benefits of the rule as implemented by the guide. A copy of this regulatory analysis is available for inspection and may be copied for a fee at the NRC's Public Document Room at One White Flint North, 11555 Rockville Pike, Rockville, Maryland, telephone (301) 415-4737; fax (301) 415-3548.